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on

SELECTED BIRD SPECIES

INHABITING THE

CALIFORNIA DESERT

by

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for

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1695 Spruce Street
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ANNOTATED BIBLIOGRAPHIES ON SELECTED BIRD SPECIES INHABITING THE
CALIFORNIA DESERT:

1. Sharp-shinned Hawk (*Accipiter striatus*)
2. Cooper's Hawk (*Accipiter cooperii*)
3. Swainson's Hawk (*Buteo swainsoni*)
4. Golden Eagle (*Aquila chrysaetos*)
5. Prairie Falcon (*Falco mexicanus*)
6. Marsh Hawk (*Circus cyaneus*)
7. American Kestrel (*Falco sparverius*)
8. California Quail (*Lophortyx californicus*)
9. Gambel's Quail (*Lophortyx gambelii*)
10. Mountain Quail (*Oreortyx pictus*)
11. Chukar (*Alectoris chukar*)
12. Clapper Rail (*Rallus longirostris*)
13. Black Rail (*Laterallus jamaicensis*)
14. Yellow-billed Cuckoo (*Coccyzus americanus*)
15. Roadrunner (*Geococcyx californianus*)
16. Barn Owl (*Tyto alba*)
17. Screech Owl (*Otus asio*)
18. Elf Owl (*Micrathene whitneyi*)
19. Western Burrowing Owl (*Athene cunicularia*)
20. Short-eared Owl (*Asio flammeus*)
21. Lesser Nighthawk (*Chordeiles acutipennis*)
22. Black-chinned Hummingbird (*Archilochus alexandri*)
23. Costa's Hummingbird (*Calypte coastae*)
24. Anna's Hummingbird (*Calypte anna*)
25. Common Flicker (*Colaptes Auratus*)
26. Gila Woodpecker (*Melanerpes uropygialis*)
27. Cassin's Kingbird (*Tyrannus vociferans*)
28. Ash-throated Flycatcher (*Myiarchus cinerascens*)
29. Black Phoebe (*Sayornis nigricans*)
30. Willow Flycatcher (*Empidonax traillii*)
31. Vermilion Flycatcher (*Pyrocephalus rubinus*)
32. Horned Lark (*Eremophila alpestris*)
33. Cliff Swallow (*Petrochelidon pyrrhonota*)
34. Common Raven (*Corvus corax*)
35. Verdin (*Auriparus flaviceps*)
36. Bushtit (*Psaltiriparus minimus*)
37. White-breasted Nuthatch (*Sitta carolinensis*)
38. Bewick's Wren (*Thryomanes bewickii*)
39. Canyon Wren (*Catherpes mexicanus*)
40. Bendire's Thrasher (*Toxostoma bendirei*)
41. Le Conte's Thrasher (*Toxostoma lecontei*)
42. Crissal Thrasher (*Toxostoma dorsale*)
43. Hermit Thrush (*Catharus guttatus*)
44. Blue-gray Gnatcatcher (*Polioptera caerulea*)
45. Black-tailed Gnatcatcher (*Polioptila melanura*)
46. Phainopepla (*Phainopepla nitens*)
47. Loggerhead Shrike (*Lanius ludovicianus*)
48. Starling (*Sturnus vulgaris*)
49. Bell's Vireo (*Vireo bellii*)
50. Gray Vireo (*Vireo vicinior*)
51. Warbling Vireo (*Vireo gilvus*)
52. Orange-crowned Warbler (*Vermivora celata*)
53. Virginia's Warbler (*Vermivora virginiae*)
54. Lucy's Warbler (*Vermivora luciae*)
55. Black-throated Gray Warbler (*Dendroica nigrescens*)

56. Hooded Oriole (*Icterus cucullatus*)
57. Scott's Oriole (*Icterus parisorum*)
58. Brown-headed Cowbird (*Molothrus ater*)
59. Hepatic Tanager (*Piranga flava*)
60. Lazuli Bunting (*Passerina amoena*)
61. Brown Towhee (*Pipilo fuscus*)
62. Abert's Towhee (*Pipilo aberti*)
63. Rufous-crowned Sparrow (*Aimophila ruficeps*)
64. Brewer's Sparrow (*Spizella breweri*)
65. White-crowned Sparrow (*Zonotrichia leucophrys*)
66. Black-throated Sparrow (*Amphispiza bilineata*)
67. Sage Sparrow (*Amphispiza belli*)
68. Chipping Sparrow (*Spizella passerina*)

SHARP-SHINNED HAWK
Accipiter striatus

I TAXONOMY

A. Type description

Wilson (1812) noted this form was described from a specimen taken on banks of the Schuylkill River near Philadelphia, Pennsylvania.

B. Current systematic treatments

Peters (1931) recognizes four races of the sharp-shinned hawk including velox of Alaska, Mackenzie, central Quebec, and Newfoundland south to lower California and Mexico, Texas and Florida. Winters from British Columbia and northern United States to Costa Rica. Also fringilloides of Cuba; striatus of Hispaniola; and ventor of Puerto Rico.

AOU (1957) recognizes three races including A. s. velox from Canada and the United States including California as a breeder which winters south to Costa Rica; A. s. suttoni of Mexico; and A. s. perobscurus of British Columbia.

Synonomies - Nisus pacificus, Astur fuscus, Accipiter fuscus, Nisus fuscus, Accipiter velox, Accipiter velox rufilatus; western sharp-shinned hawk, northwestern sharp-shinned hawk (Grinnell and Miller, 1944). Mallette and Gould (1978) noted sharp-shin, bullet hawk, sharpie, little blue darter, sparrow hawk, bird hawk, chicken hawk, pigeon hawk.

C. Recent taxonomic revisions

AOU (1957) reported no recent taxonomic revisions.

II DESCRIPTION

A. External morphology of adults

Friedman (1950) reported sexes similar in both adult and immature plumages. The males are smaller than the females: adult male - wing 162-185 (171.1) mm, tail 134-152 (140.8) mm, and tarsus 46-54 (49.9) mm; adult female wing 180-210 (200.3) mm, tail 150-179.5 (165.6) mm, and tarsus 45-58.5 (54.9) mm from sample size of 51 males and 40 females. The adult has forehead, blackish; pinkish margins; upperparts, black to plumbeous; tail, grey; banded dark grey, white tipped; undertail coverts, white; underparts, whitish with red or cinnamon wash; bill, black; cere, yellow; iris, red; feet, yellow; tarsi, toes, yellow. Mallette and Gould (1978) noted the wingspread as 23-27 in; male 11 in long and female 12-14 in long. This is the smallest North American Accipiter. The adults are blue-grey above with reddish underparts; head, black; undertail coverts, white; black tail bars; tail, squared. Beebe (1974) gave the length as 255-305 mm and weight as 102 g for the male and 179 g for the female.

Accipiter striatus (con't.)

B. External morphology of subadult age classes

Mallette and Gould (1978) noted the immatures are brown above; white below; dark vertical streaks; brown tail bars; tail squared. Friedman (1950) reported the immatures with natal down, white to buff with feathers, upperparts, fuscous; darker on head and upper back; scapulars, tertials, upper tail coverts with white spots; under tail coverts, white; tail, brownish with black bars, white tipped; underparts, white with cinnamon to brown streaks and spots; bill, bluish to black; cere, whitish; iris, whitish to yellow to grey; legs, feet, yellow.

C. Distinguishing characteristics

Beebe (1974) noted similar to Cooper's hawk in plumage in both the adult and the immature - distinguishing characteristic is squared cut at the end in the sharp-shinned hawk and almost totally devoid of the white tail tip. Similar to the merlin, but with rounded, not pointed, wings; as in the merlin, has five-beat and glide flight which is unmistakable from falcons.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Peters (1931) reported breeds from Alaska, Mackenzie, Quebec, and Newfoundland south to lower California and Mexico; winters south to Costa Rica. AOU (1957) noted breeds from Alaska and Canada south to California, Arizona, Texas, Louisiana, and Alabama; winters from the United States-Canada border to Mexico and Central America.

B. California distribution of the species

Grinnell and Miller (1944) reported in summer - south from Oregon line through coast belt as far as Monterey County and along Sierra Nevada and on White and Inyo Mountains and mountains of southern California as far as Cuyumaca Mountains in San Diego County; in migration - reaches every locality where observers active: islands, oases in deserts, southeast to Colorado River and to Imperial Valley at the Mexican boundary.

C. California desert distribution

Bent (1937) noted in the Inyo Mountains of southern California.

D. Seasonal variations in distribution

Bent (1937) reported best known as a migrant, moving along with migrations of small birds. Grinnell and Miller (1944) noted a winter visitor to California in September to April; abundant; widely distributed below level of and south of winter snows. Remains as breeder in small numbers in northern half of state, farther south along mountain ranges.

Accipiter striatus (con't.)

IV HABITAT

A. Biotopic affinities

Bent (1937) reported frequents open country, edges of woods, clearings, hedge rows, bushy pastures, and shore lines where small migrating birds may be found. Grinnell and Miller (1944) noted breeding in the Transition life zone.

B. Altitudinal range

Mallette and Gould (1978) reported breed in high mountain coniferous forests of California over 6000 feet. Grinnell and Miller (1944) noted found at altitudes from sea level up to 7000 feet.

C. Home range size

Craighead and Craighead (1956) reported the home range size of two territories as 0.51 and 0.26 sq mi.

D. Territory requirements

Perch site - Bent (1937) noted sitting on some convenient fence post, rock or low tree.

Courtship and mating site - Bent (1937) reported courtship and mating took place flying about grove and perching on sticks and branches of nest tree.

Nest site - Beebe (1974) noted the nest tree 4-6 m from the edge and in thick foliage. The nest was 60 cm in diameter made with small sticks; shallow cup lined with bark, lichen and moss. The eggs are up to 7, usually 5; bluish-white with dark brown and measure 37.5 x 30.4 mm. The incubation is shared for 34-35 days and fledging is only another 23-25 days.

E. Seasonal changes in habitat requirements

Grinnell and Miller (1944) reported either deciduous or coniferous woodland, not dense forest, but at edges or where broken (in summer) is where can be found. All sorts of vegetational areas except open prairie and bare desert (in winter) is where can be found.

V FOOD

A. Food preferences

Mallette and Gould (1978) reported this species as the most persecuted hawk because it takes songbirds; over 96% of its diet is birds taken no larger than jays, usually finch and warbler size. Beebe (1974) noted

Accipiter striatus (con't.)

mostly birds, some insects are taken including juncos, tree sparrows, song sparrows, and white-throated sparrows. Bent (1937) reported this species takes game birds, poultry, mice, insects, pigeons, woodpeckers, rabbits, bats, frogs, grasshoppers, crickets, caterpillars, moths, butterflies, and beetles. Birds are the principal food including doves, swifts, flycatchers, larks, sandpipers, cowbirds, orioles, blackbirds, grackles, jays, meadowlarks, sparrows, towhees, vireos, warblers, mockingbirds, thrashers, catbirds, wrens, nuthatches, chickadees, creepers, kinglets, robins, thrushes, and bluebirds.

B. Foraging strategies

Bent (1937) noted often pursues quarry on the ground. It flies low, keeping out of sight behind fences until it can dash over and down and seize small birds. Beebe (1974) reported the sharp-shinned hawk hunts like a harrier; not static, cruising rapidly and somewhat at random; 1-2 m off the ground. It depends on surprise, quick reflexes, and rapid acceleration to capture its prey.

C. Energy requirements

Bent (1937) noted young require 3 or 4 birds daily.

VI REPRODUCTION

A. Age of first breeding

Brown and Amadon (1968) reported Falconiform birds exhibit second-year sexual maturation.

B. Territorial behavior

Craighead and Craighead (1956) noted sharp-shinned hawks generally reveal the position of its nest by very active territorial defense. Bent (1937) reported hostility toward human invader at its nest is well marked.

C. Courtship and mating behavior

Bent (1937) noted dashing and circling at or about each other over a nearby mowing. In 5 minutes they returned to the tree, alighted; male on a dead branch 5 feet below the female, both facing easy. The female called several times, crouched, and the male flew to her side. Three matings at short intervals occurred and the male sidled toward her until their wings touched. The male settles on his perch immovable, looking away and uttering a feeble whine. Three minutes later a mating took place; female crouched, with mating both went in for much wing-flapping for 40 seconds.

Accipiter striatus (con't.)

D. Nesting phenology

Craighead and Craighead (1956) noted territory selection in early May, egg laying in mid-June, hatching in early mid-July and fledging was in mid-July. The breeding season was an average of 83 days. Mallette and Gould (1978) reported return to breeding grounds in April; nest of small sticks lined with bark and greenery constructed in June-July. Beebe (1974) noted as most birds of prey, male brings all the food to the female from prior to egg production through ovulation through incubation. Both sexes share incubation and feeding of the young.

E. Length of incubation period

Mallette and Gould (1978) reported incubation period of 21-24 days. Reynolds (1975) noted 30-32 day incubation period.

F. Length of nestling period

Craighead and Craighead (1956) reported 28 days was period for young remaining in the nest. Reynolds (1975) noted young remained in the nest for 21-24 days after hatching. Mallette and Gould (1978) reported fledging at 30 days.

G. Growth rates

Bent (1937) noted egg pipped on July 2; hatched on July 3; increase in size by one-third by July 7; held heads up and showed resentment on July 10; wing quills bursting sheaths on July 16 and on July 26 (at 23 days) the young left the nest.

H. Post-breeding behavior

Reynolds (1975) reported young accipiters are dependent on the adults for food after fledging. They remain close to the nest and vocalizations increase. It is difficult to determine when parental care ends. Eight days is the longest they have been observed around the nest after fledging.

VII POPULATION PARAMETERS

A. Clutch size

Reynolds (1975) gave clutch size as 4.6 eggs per pair for 5 pair with a range of 3-5 eggs.

B. Nesting success

Reynolds (1975) noted 2.7 young per pair for 11 pairs.

C. Mortality rates per age class

Reynolds (1975) reported hatching success as 69.6%. Egg loss is more important than nestling loss with 81% fledged. Egg mortality may be due to pesticides.

Accipiter striatus (con't.)

D. Habitat density figures

Reynolds (1975) gave density as 2750 hectares per pair with a mean distance apart of 3.1 km.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Mallette and Gould (1978) reported this species has no enemies except man and perhaps larger species of accipiters.

B. Competition

Bent (1937), "I never have found the two species nesting together, but several times cooperii has replaced velox (striatus) in a tract where the latter nested."

IX STATUS

A. Past population trends

Grinnell and Miller (1944) noted abundant in winter; rare breeder in summer in the mountains and along the coast.

B. Present population status

Remsen (1977) reported a very scarce breeder in California. Probably never much more common than at the present time.

C. Environmental quality: adverse impacts

Snyder et al (1973) noted A. striatus is exhibiting signs of DDE stress which may mean potential for severe declines.

Accipiter striatus (con't.)

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COOPER'S HAWK
Accipiter cooperii

I TAXONOMY

A. Type description

Bonaparte (1828) noted this form was described from a specimen taken near Bordentown, New Jersey.

B. Current systematic treatments

Peters (1931) reported no racial separation for this species.

AOU (1957) recognizes only a single race of Cooper's hawk.

Synonomies - Astur cooperii, Accipiter mexicanus, Nisus cooperii, Accipiter cooperii mexicanus, Accipiter cooperii cooperii; blue-backed hawk, Mexican hawk, Mexican blue-backed hawk, western Cooper's hawk, and Mexican Cooper's hawk (Grinnell and Miller, 1944). Mallette and Gould (1978) noted as bullet hawk, bird hawk, swift hawk, chicken hawk, big blue darter, striker, black-capped hawk, quail hawk.

C. Recent taxonomic revisions

AOU (1957) reported no recent taxonomic revisions.

II DESCRIPTION

A. External morphology of adults

Friedman (1950) noted the sexes are alike in color in both the adult and juvenal plumages. The males are smaller than the females: adult male - wing 214-238 (231) mm, tail 181-211 (198.8) mm, and tarsus 61.5-73 (64.1) mm; adult female - wing 247-278 (259.9) mm, tail 215-242 (220.9) mm, and tarsus 66-75 (71.1) mm out of a sample size of 34 males and 27 females. The adult is described with forehead, blackish; crown, black; upperparts, dark plumbeous; nape, lighter; scapulars with circular white spots; feathers generally edged in white; tail, dark with black bands and white tip; underparts, white to reddish with red-brown streaks; white undertail coverts - male may have bluish cast on back; bill, blue-black; iris, orange-red; cere, greenish-yellow; tarsi, toes, lemon-yellow. Mallette and Gould (1978) reported the size of a magpie: 14-20 in long and wingspread of 27-36 in. The adults have tail, rounded; no eye streak; blue-grey above with rusty-barred underparts; top of head, black; undertail coverts, white. Beebe (1974) noted length as 380-460 mm; weight as 380 g for the male and 560 g for the female; crow-sized.

B. External morphology of subadult age classes

Friedman (1950) reported the juvenal with natal down, white - feathered immatures with forehead, black; feathers widely margined tawny to buff; upperparts, gray-brown to brown; tail paler than back and heavily barred

Accipiter cooperii (con't.)

with black with white tip; underparts, white with brown streaks club-to arrow-shaped; white undertail coverts; bill, black; iris, brown to yellow; cere, tarsi, toes, greenish to yellowish. Mallette and Gould (1978) noted the immatures as brown above; white below; with dark vertical streaks and brown bars on the tail.

C. Distinguishing characteristics

Beebe (1974) reported the Cooper's hawk is distinguished from A. striatus by distinctly-rounded tail with 4 mm white tip; A. striatus is squared and lacks a tip.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Peters (1931) noted breeds from southern British Columbia, southern Alberta, central Quebec and Nova Scotia south over the United States to northern Mexico. Winters from northern United States to Costa Rica. AOU (1957) reported breed from British Columbia, Alberta, Montana, North Dakota, Manitoba, Quebec and Maine south to Baja California, northern Mexico, Texas, Alabama, and Florida. Winters from the United States-Canada border to Florida, Mexico and Central America.

B. California distribution of the species

Grinnell and Miller (1944) gave the northernmost record as Siskiyou County and the southernmost record as Poway in San Diego County and Picacho in Imperial County. Individuals reached various desert oases and most islands. Practically the entire area of the state below the Canadian life zone is covered, but numbers few in northwest coast belt and on southeastern desert.

C. Seasonal variations in distribution

Grinnell and Miller (1944) noted a permanent resident. Autumnal drift down and south from localities of heavy winter snow; return in spring. Winter populations more widespread and southerly than spring. Some wintering birds are from north of California.

IV HABITAT

A. Biotopic affinities

Beebe (1974) reported a woodland species; seldom leaves the shelter of trees and prefers landscapes where woodlands occur in patches and groves. Grinnell and Miller (1944) noted breeding range chiefly within upper Sonoran and Transition life zones. Found in woodlands, chiefly open, interrupted, or marginal type.

Accipiter cooperii (con't.)

B. Altitudinal range

Grinnell and Miller (1944) noted altitudes of known nesting from near sea level up to 6500 feet. Mallette and Gould (1978) reported commonly nests in foothills and mountains up to 6500 feet.

C. Home range size

Craighead and Craighead (1956) noted 0.7-2.5 m diameter of territories and 0.12-2.05 (0.79) sq mi area of territory (home range).

D. Territory requirements

Perch site - Beebe (1974) reported the male maintains an abattoir not far from the nest, about 15 m away, and in sight of it. All prey is brought and plucked clean before delivered to the female. This plucking perch may be log on ground, large horizontal or tilted branch, or a lodged tree trunk, or an old nest. Bent (1937) noted sometimes use old nests as plucking perches. Brown and Amadon (1968) reported uses inconspicuous perches.

Courtship and mating site - Brown and Amadon (1968) noted courtship flights may be over open fields.

Nest site - Brown and Amadon (1968) reported a pair, maybe the same, nests in the same tract of woods, year after year and usually a new nest is built. Bent (1937) noted from scarcity of suitable timber, they are confined to shrubbery of creek bottoms. Mallette and Gould (1978) reported nests found 20-60 feet above the ground: twigs and sticks lined with fine material. Grinnell and Miller (1944) noted nesting sites are in riparian growths of deciduous trees as in canyon bottoms and river flood plains; live oaks often used.

V FOOD

A. Food preferences

Beebe (1974) reported this species feed on lizards, chipmunks, small squirrels; food consists almost entirely of birds - chickadees, kinglets, and occasionally pheasant or mallards. Mallette and Gould (1978) noted they take large number of small birds and mammals; often upland game birds and mammals.

B. Foraging strategies

Mallette and Gould (1978) noted the Cooper's hawk is adept at flying in pursuit of prey through dense cover. They skillfully use their tails in maneuvering between branches.

Accipiter cooperii (con't.)

C. Energy requirements

Craighead and Craighead (1956) reported 1 Cooper's hawk to 60.5-71.4 game birds. Brown and Amadon (1968) noted 66 prey items needed to raise a Cooper's hawk to the age of 6 weeks.

VI REPRODUCTION

A. Age of first breeding

Brown and Amadon (1968) reported Falconiform birds exhibit second-year sexual maturation.

B. Territorial behavior

Bent (1937) noted often return to the same patch of woods to nest for several years. Beebe (1974) reported strong attachment to traditional territories; 2-3 to 6 nests may be located in territory. Nest building begins in flight display period.

C. Courtship and mating behavior

Brown and Amadon (1968) noted either sex or pair together performs courtship flights. Wings are lifted high above the back and move through deep arc. Some perform frequently for a month or so. Mating continues through nest building and egg laying. Beebe (1974) reported flight displays on mornings of bright sunny days over patch of forest selected for nesting. Soaring, diving by male and slow-motion chasing with white undertail coverts (plumes) spread. Then both drop into the trees.

D. Nesting phenology

Craighead and Craighead (1956) noted in early June the eggs are laid; in early July hatching occurs; and late July is fledging. Breeding season is an average of 89 days. Beebe (1974) reported as most birds of prey, male brings all food to female from prior to egg production through ovulation and incubation. Both share incubation and feeding of the young.

E. Length of incubation period

Brown and Amadon (1968) gave as 35-36 days for incubation.

F. Length of nestling period

Craighead and Craighead (1956) noted a 25-day nestling period. Beebe (1974) reported four, rarely 5 or 6 young each season. Young leave the nest before they can fly properly, moving through the trees as much by scrambling and jumping as flying.

Accipiter cooperii (con't.)

G. Growth rates

Brown and Amadon (1968) noted young grow rapidly for the first 17 days, they slow down for 3 weeks until feathers are grown.

H. Post-breeding behavior

Reynolds (1975) reported the young are dependent on their parents after fledging. They remain close to the nest and begin vocalizing; as flying skills develop the attachment wanes. It is difficult to determine when the parental care ends (maybe 53 days for Cooper's hawks).

VII POPULATION PARAMETERS

A. Clutch size

Reynolds (1975) noted out of 13 nests the clutch size mean = 3.8. Brown and Amadon (1968) reported clutches of 4 or 5 eggs; rarely 6. Craighead and Craighead (1956) noted clutch size as 4.3 eggs with 5 as maximum.

B. Nesting success

Craighead and Craighead (1956) reported the fledging success as 2 per pair of adults per year. Reynolds (1975) noted out of 24 nests, the fledging success mean = 2.1.

C. Mortality rates per age class

Reynolds (1975) reported egg loss is important. The greatest loss during the nesting period. Predation and unexplained death of the young are the most important factors. Henny and Wight (1972) noted from 1925-1940 the mortality of the first year was 82.5% and of subsequent years was 44.0%. From 1941-1957 the first-year mortality was 72.0% and that for subsequent years was 36.8%. Craighead and Craighead (1956) reported juvenile mortality was 20% and 18% in 1942 and 1948, respectively.

D. Longevity

Henny and Wight (1972) noted longevity at least 8 years.

E. Habitat density figures

Reynolds (1975) reported one Cooper's hawk nest per 2200 hectares with a mean distance apart of 3.1 km. Craighead and Craighead (1956) noted 4.1 sq mi per nesting pair. Brown and Amadon (1968) reported the male defends 100 m diameter area. Mallette and Gould (1978) noted one pair for each 12 sq mi of suitable habitat.

Accipiter cooperii (con't.)

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Beebe (1974) noted no bird of prey was more villified in the literature and altitudinal range of the Cooper's hawk coincides so exactly with the areas of the continent most suitable for human occupancy; places to which this species is remarkably tolerant. Immatures, particularly females not yet skilled in stalking and surprise attack, are the recipients of predation.

B. Competition

Reynolds (1975) reported finding 5 Cooper's hawk nests 300-450 m from goshawk nests and 2 sharp-shinned hawk nests 300 m from Cooper's hawk nests. Bent (1937), "I never have found two species nesting together, but several times cooperii has replaced A. s. velox in a tract where the latter nested."

IX STATUS

A. Past population trends

Grinnell and Miller (1944) noted varyingly common to even abundant (for a hawk) in autumn in favorable territory. Bent (1937) reported one of the most common hawks in nearly all parts of the United States. Henny and Wight (1972) noted population declining at an annual rate of 13.5% from 1941-1945. The annual decline was more pronounced prior to 1941 when shooting pressure was greater. The reproductive rate had dropped 24.4% after 1948 and the population was estimated declining by 25% due to pesticides (annually).

B. Environmental quality: adverse impacts

Remsen (1977) noted the destruction of its habitat is the primary factor, but declining due to pesticide contamination is also a factor.

C. Potential for endangered status

Remsen (1977) reported in the second-priority category. It is definitely on the decline, but populations still sufficiently substantial so that danger is not immediate.

Accipiter cooperii (con't.)

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SWAINSON'S HAWK
Buteo swainsoni

I TAXONOMY

A. Type description

Bonaparte (1838) noted this form was described from a specimen taken near the Columbia River.

B. Current systematic treatments

Peters (1931) reported no racial separation for this species.

AOU (1957) recognizes only one race of the Swainson's hawk.

Synonomies - Buteo insignatus, Buteo harlani, Buteo obsoletus, Buteo swainsoni oxypterus, Buteo oxypterus; Rocky Mountain buzzard, Canada buzzard, brown hawk, harlan hawk, Swainson buzzard, sharp-winged hawk (Grinnell and Miller, 1944). Prairie hawk or buzzard, grasshopper buzzard, gopher hawk, hen hawk, brown or black hawk (Mallette and Gould, 1978).

C. Recent taxonomic revisions

AOU (1957) noted no recent revisions in taxonomy.

II DESCRIPTION

A. External morphology of adults

Friedman (1950) reported sexes alike in color in all three color phases in adult and immature plumages. Males are smaller than the females: adult male - wing 362-406 (383.6) mm, tail 185-214 (204.6) mm, and tarsus 63-72 (68.2) mm; adult female - wing 375-427 (404.6) mm, tail 193-234 (214.6) mm, and tarsus 61.5-76.4 (70.6) mm out of a sample size of 20 males and 38 females. In the adults there are three phases - pale phase: forehead, whitish; crown, nape, auriculars, scapulars, back, rump, wing coverts, dark grayish-brown; secondaries, fuscous; primaries, black; rectrices, gray subterminally obscured and broadly banded with black (10 bars); most of underparts, white; rufous phase: entirely similar to pale phase except entire abdomen, sides, flanks, thighs, undertail coverts washed with brown and slightly barred with russet; black phase: remiges and rectrices similar to pale phase; rest of body, except undertail coverts, black; covert, whitish; iris, brown; bill, black; cere, greenish-yellow; and feet, yellow. Beebe (1974) noted the length as 430-510 mm and the weight as 908 g for the male and 1069 g for the female. Mallette and Gould (1978) reported this western hawk is 19-22 in long and with a wingspread of 48-54 in. The upperparts, brown; throat, white; breast, reddish-brown; the rest of the underparts, white; wing lining, light contrast with dark secondaries and primaries, light gray; tail finely barred with a wider terminal band. Bowles and Decker (1934) noted it was not unusual to find a nesting pair in which one parent was dark and the other light.

Buteo swainsoni (con't.)

B. External morphology of subadult age classes

Friedman (1950) reported juvenal has white natal down; feathered immatures have three phases: pale phase - very different from the adults; forehead, white; crown, nape, broadly edged in white; tertials and medium wing coverts marked with white; remiges as adults; rectrices broadly barred and bars extend to outer webs of outer pair; cheeks and auriculars, buff as are the rest of the underparts, often to cinnamon; breast and abdomen, large pear-shaped spots; lower abdomen, thigh, undertail coverts, unspotted; iris, pale reddish-brown; other parts as in the adults; rufous phase - similar to juvenal pale phase, but with rufous washed underparts; underparts washed with cinnamon; black phase - darker than pale phase; dark parts, darker; barring, wider; underparts, heavily spotted.

C. Distinguishing characteristics

Slipp (1947) noted difficulty of separating certain plumages of the swainsoni from B. jamaicensis; even misidentified in many collections. Beebe (1974) reported wide range of plumage variations and the close resemblance of some of these to other species make Swainson's hawk one of the more difficult North American birds to identify. They are rather slim and delicate; pale phase has definite dark band across the upper breast. Cameron (1913) noted this species resembles a small golden eagle from a distance. Brown and Amadon (1968) reported as long-winged; lankier than the red-tail; basal half of the tail, white, distinguishes the immature and adult from the red-tail.

D. Special morphological features

Brown and Amadon (1968) noted this species as being weak-footed.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Peters (1931) reported this species breeds from southern British Columbia, western Alaska, northwestern Mackenzie and Manitoba south to southern California and southeastern Arizona. In migration through Central America and South America to Chile. AOU (1957), "Breeds from Alaska, Mackenzie, Saskatchewan, Manitoba, Minnesota to Baja California, north Mexico, Texas; winters in Argentina; migrates in large flocks."

B. California distribution of the species

Grinnell and Miller (1944) noted summer resident in Great Basin, Sacramento and San Joaquin Valleys; coastally from Marin County, Monterey County, Ventura County, Los Angeles County and San Diego County.

Buteo swainsoni (con't.)

C. California desert distribution

Grinnell and Miller (1944) reported scarce summer breeder in Colorado and Mojave deserts, but nest in Cima, San Bernardino County. Remsen (1978) noted few pairs in Cima, Dome area; disappeared the last few years.

D. Seasonal variations in distribution

Grinnell and Miller (1944) reported summer resident and transient; no authenticated record of winter occurrence. Passes north through south and central interior California in March-April and south in September-October.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) noted found in dry plains, open foothill, sparsest woodland or scattering small trees. Bowles and Decker (1934) reported fond of treeless region; might well be call "prairie hawk".

B. Altitudinal range

Grinnell and Miller (1944) noted found mainly in the upper Sonoran life zone. After nesting they move up-mountain, as high as 9800 feet.

C. Home range size

Craighead and Craighead (1956) reported territory covered as 2.4 square miles per pair.

D. Territory requirements

Perch site - Mallette and Gould (1978) noted frequently gliding, wings uptilted. Very tame; sit on fence posts or low perch; easily approached.

Nest site - Bent (1937) noted nests in commanding situations, all located so incubating bird could have good outlook. Typical Buteo nests: large sticks; lined with grasses, bark, fresh leaves. Twenty-one to 28 in in diameter. Mallette and Gould (1978) reported this species is the latest to nest in California. The nest is constructed 30-80 feet above the ground near top of tallest tree available. Nest lined with bark or green material. Beebe (1974) noted no flight display is recorded. Nests always in trees or large shrubs if available, if not, they build on coulees or on cliff ledges. They are large (1 m in diameter) and contain greenery. Bowles and Decker (1934) reported they prefer to repair a nest of previous year, or years, to building a new one. Cameron (1913) noted unused nests remain for 7 or 8 years.

Buteo swainsoni (con't.)

V FOOD

A. Food preferences

Bent (1937) reported food habit is beneficial; feeds almost entirely on injurious rodents and insects. Takes a minimum of birds and poultry. Food includes: rabbits, gophers, spermophiles, mice, lizards, frogs, locusts, grasshoppers, rattlesnakes, Dobson flies, crickets and meadow mice.

B. Foraging areas

Craighead and Craighead (1956) noted nesting on Blacktail Butte and hunting together on surrounded sageland benches (with other species). Bent (1937) reported on plateaux along river, barren hills, catching insects in air and in plowed fields behind tractors.

C. Foraging strategies

Beebe (1974) noted the Swainson's is a mouse-buzzard which utilizes such insects as locusts and crickets. It captures prey on the ground or hunts from utility poles and may often roost on the ground if no trees are available. Mallette and Gould (1978) noted it prefers open prairies and rangeland, coursing over open country in their slow, sluggish flight foraging. They eat insects, small rodents and ground squirrels.

D. Energy requirements

Bent (1937) reported each hawk captures 200 grasshoppers a day.

VI REPRODUCTION

A. Territorial behavior

Beebe (1974) noted not social during the breeding season, but where common tolerates other pairs breeding close by. This species shows no animosity to others of its kind. Craighead and Craighead (1956) reported to defend small nesting territories, but forages together with other species.

B. Courtship and mating behavior

Grossman and Hamlet (1964) stated the breeding behavior is similar to that of the red-tail. Display flights are spectacular: they circle in the air around each other, the male above the female; tails are widespread, wings held stiff with a diving display and loop-the-loop.

Buteo swainsoni (con't.)

C. Nesting phenology

Brown and Amadon (1968) noted laying season is in late April. Bowles and Decker (1934) reported this species is late - making its first appearance in April then leaving surprisingly early in fall. The nest building is done in the middle of April. Eggs are deposited at an unusually late date for a large hawk (May 15).

D. Length of incubation period

Cameron (1913) noted the incubation period as 25 days; young hatching at intervals. Brown and Amadon (1968) reported incubation period as 28 days.

E. Length of nestling period

Beebe (1974) noted fledging complete about 30 days after hatching. Brown and Amadon (1968) reported fledging period when young leave the nest at one month old. Mallette and Gould (1978) noted both parents feed the young and the young stay in the nest until 35 days old.

F. Post-breeding behavior

Beebe (1974) reported even during the breeding season the species shows no animosity to others of its kind. During migration huge flocks, probably most of the species entire population, passes over certain flight-routes.

VII POPULATION PARAMETERS

A. Clutch size

Beebe (1974) noted this species has a low annual reproductive rate. Two eggs are normal with four being the highest recorded. They are white; obscure brown markings. Eggs measure 56 x 44 mm. Both sexes incubate and the eggs hatch in 28 days. Fledging is complete about 30 days later. Cameron (1913) reported in half of the clutches with three eggs, one was infertile and remained intact after the young had flown. Craighead and Craighead (1956) noted the average clutch was 1.8 eggs and the maximum was 2.0. Bowles and Decker (1934) reported the usual number is 3, 2 is not uncommon, 4 is decidedly rare. The size is 2.22 x 1.67 to 2.33 x 1.82 in.

B. Nesting success

Craighead and Craighead (1956) noted the fledging success per pair of adults was 0.6 young per pair.

C. Seasonal abundance

Brown and Amadon (1968) reported in migration in the winter this species may have had the most impressive gathering (in Central America) since the demise of the passenger pigeon. There have been flocks of 300 immatures in Florida seen since 1950.

Buteo swainsoni (con't.)

D. Habitat density figures

Robertson (1930) reported 25 hawks in a 40 acre area.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Mallette and Gould (1978) noted golden eagles take Swainson's hawks, but man is its number one enemy. Many were shot by those with prejudice against all hawks because of tameness.

B. Competition

Craighead and Craighead (1956) reported a direct competition with more aggressive red-tailed hawk, thus being forced to use inferior nest sites.

IX STATUS

A. Past population trends

Grinnell and Miller (1944) noted formerly abundant, now (1943) greatly reduced in numbers and breeding range. Bent (1937) reported as having a wide distribution over the western North America region and large part of South America. One of the commonest Buteos on arid wastes and table lands. This species is especially abundant, out-numbering all other raptors combined.

B. Present population status

Remsen (1978) reported as once abundant, but reduction through present until now. This species is a scarce breeding bird. It has suffered the greatest proportional decrease of any raptor in the state.

C. Potential for endangered status

Remsen (1978) noted on the highest priority list - faces immediate extirpation if current trends continue.

Buteo swainsoni (con't.)

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GOLDEN EAGLE
Aquila chrysaetos

I TAXONOMY

A. Type description

Linnaeus (1758) noted this form was described from a specimen taken in the Hudson Bay, Canada region.

B. Current systematic treatments

Peters (1931) described eight races of the golden eagle, including canadensis of North America; the nominate race in Europe east to western Siberia; fulva in the British Isles; homeyeri in Spain and northern Africa; daphanea in Turkestan to central Asia; obscurior in the Russian Altai and Mongolia; kamtschatica in Kamschatka; and japonica in Japan, Korea, and probably northeastern China.

Brown and Amadon (1968) recognized five races, including A. c. chrysaetos, homeryi, daphanea, canadensis, and japonensis. The authors regard other purported races as being intergrades and state that variation in the species is mainly clinal in nature.

AOU (1957) recognized only a single race of the golden eagle, A. c. canadensis, as occurring in North America.

Synonomies - Aquila canadensis, Aquila chrysaetos; ring-tailed eagle, American golden eagle (Grinnell and Miller, 1944). Snow (1973), "Common vernacular names for the golden eagle include brown eagle, calumet eagle, ring-tailed eagle, black eagle, mountain eagle, royal eagle, war eagle, dark eagle, and black Mexican eagle."

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "Both adults and immatures have the rich dark brown body plumage. The golden neck feathers are seen only at close range. The broad white tail band and white wing patches of the immature are good field marks. Note its buteo flight with very long rounded wings. Legs are feathered to the toes." Peterson (1961), "Spread 6 1/3-7 2/3 feet. Majestic, flat-winged gliding and soaring with occasional wingbeats characterizes the eagle; its greater size, longer wings set it apart from other larger hawks. Adult: evenly dark below, or with a slight lightening at base of tail. When the bird wheels, a wash of gold on the hind neck may be noticed. Immature: from above and below in flight, shows a white flash in wing at base of primaries, and a white tail with broad dark terminal band. All manner of variation exists between this easy-to-identify 'ring-tailed' plumage and the less distinctive plumage of the adult." Under similar species: "(1) Immature bald eagle usually has some white in wing-linings (not at base of primaries) and often some on body. It may have tail

Aquila chrysaetos (con't.)

mottled with white at base (young golden has sharply banded tail). Bald eagle has bare tarsi (golden is feathered to toes), a taxonomic character sometimes useful. Head and massive bill of bald eagle project more; wings are not quite as wide, nor is tail as full. (2) Black rough-legged hawk is smaller, has more white under wing." Hill (1944) reported percentage of male to female measurements in specimens of the golden eagle were as follows: wing - 94.5; tail - 85.0; tarsus - 92.0; bill - 90.0. Beebe (1974) noted the adult female is colored like the male but measures considerably larger with one-third to double heavier in weight. "The adult plumage is acquired in about three years. Each successive moult tends to increasingly obscure and mottle the white areas so sharply defined in the first-year plumage... first-year golden eagles have larger measurements but nearly always weigh less than adults of the same sex." Jollie (1947) reported the adult plumage is obtained at the close of the third molt at an age of $3\frac{1}{2}$ years, although another molt may be necessary to rid the plumage entirely of immature feathers. Four recognizable age plumages occur before adult plumage is reached. A complete molt is accomplished in two seasons.

B. External morphology of subadult age classes

Summer (1929a) reported newly hatched young are covered with a thick dirty white covering of down. A few primary pin feathers begin to show through the skin at the age of two weeks, and these are about a quarter inch long at the age of three weeks. The wing quills are about two inches long at four weeks. At five weeks, the wing feathers are five inches long, the tail feathers nearly three inches long, and some contour feathers are breaking through the natal down. By eight weeks the primaries are 11 inches long and the rectrices seven inches long. The contour feathers have nearly all broken through by this time. Brown and Amadon (1968), "Downy young - pure white or very pale grey; second down thicker, white. Eye brown, cere and legs yellowish white. The adult plumage is acquired by a series of moults over about three to four years, involving gradual reduction of the white areas at the base of wing and tail feathers and by the body feathers gradually becoming paler." Spofford (1964), "Juvenile eagles: the base of the tail is broadly white, and the wings show a large central white spot from both above and below. The body plumage is very dark chocolate brown to blackish. The feathered feet are also white. The molting of the golden eagle is slow, protracted, and irregular. The white area in the wing largely disappears during the first molt in the eagle's second year. Two-year-old eagles show little or no white above the wing, but still show white underneath. It may take at least seven years to eliminate all or most of the white from the base of the tail. The white areas of immature eagles are lost after at least five years by feather replacement. The plumage is brown with irregular light and darker brown feathers giving a patchy appearance, and the whole cast is much lighter brown than in the juvenile. Old, worn feathers on the upper side of the wings may be almost white, particularly near the junction of wing and body."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Brown and Amadon (1968), "Holarctic, extending as far south as North Africa (Spanish Sahara), Arabia, and the Himalayas in the Old World, and Mexico in America. A partial migrant, the northern breeding birds migrating south in winter, while those of more temperate climates remain all the year round." Boeker and Ray (1971), "The breeding range of the golden eagle in North America extends from northern Alaska and northern Canada southward through the mountains to central Mexico and western Texas. Smaller numbers formerly nesting in the eastern part of the North American continent (from Quebec southward to the mountains of Tennessee and North Carolina) have declined steadily and currently exist only as scattered pairs. Today most golden eagle nesting habitat is contained in the uplands of northern Canada and in the western states." AOU (1957), "Breeds locally from northern Alaska, British Columbia, Mackenzie, northern Saskatchewan, northern Manitoba, and Quebec, also the Gaspé Peninsula, south to northern Baja California, Sonora, Sinaloa, Durango, Guanajuato, Nuevo Leon, western Texas, western Oklahoma, western Kansas, western Nebraska, western South Dakota, eastern Montana, New York, northern New Hampshire, and Maine; also occurs in summer and perhaps breeds from southern Franklin, and Labrador south to Anticosti Island and Nova Scotia; probably also in the wilder mountain areas of Virginia, West Virginia, western North Carolina, and eastern Tennessee; at least formerly in eastern counties of southern Ontario, New Hampshire, Vermont, western Massachusetts, and Pennsylvania."

B. California distribution of the species

Grinnell and Miller (1944), "Entire length of state, mainly west of Sierran divides, but north of Marin County, also mainly east of narrow humid coast belt."

C. California desert distribution

Grinnell and Miller (1944), "Scarce in lowlands of southeastern, desert section. Has been recorded from Death Valley, Inyo County... and from Laguna Dam, Colorado River, Imperial County..." Thelander (1974) noted within this area it is the isolated mountain ranges that provide the necessary habitat for nesting golden eagles. The rocky terrain provides adequate nesting substrate on cliffs overlooking the broad desert floor of the region. Twenty-five pairs of nesting golden eagles were located in the Mojave-Colorado desert region during this 1974 study. Summer (1929c) reported a golden eagle was seen on 27 December 1928 at Bennett's Well in Death Valley, California.

D. Seasonal variations in distribution

Spofford (1964) noted eagles in the southern part of the species' range (the U.S. southwest and Mexico) are largely resident, whereas those breeding in the northern part of the range are migratory and winter in a fluid

Aquila chrysaetos (con't.)

population in the southwestern states and Mexico. Boeker and Ray (1971), "A difference in the migration pattern of adult and immature golden eagles was suggested by age classification data obtained in New Mexico... It may be presumed that more immature eagles move through the area at both the beginning and end of the wintering period, but actually winter in regions not known to us."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Breeding life-zones, chiefly upper Sonoran and Transition, but also in desert mountains in lower Sonoran and up to or above timber line in Sierra Nevada." Habitat is typically rolling foothill or coast-range terrain, where open grassland is inhabited by ground-squirrels and jackrabbits in scatteringly grown oak trees, sycamores, or large digger pines. Cliff-walled canyons afford nesting headquarters in some regions." Beebe (1974), "Throughout its range the golden eagle shows a strong preference for open, tilted landscapes. Wherever the country lies flat and featureless, uncut by canyon or coulee with the horizon unrelieved by mesa-scarp or hill, it is rare or absent, particularly if such landscapes are timbered or given over to agriculture and human occupation. Its favorite haunts, therefore, are wild arid plateaux, deeply cut by streams and canyons, and rising to open or sparsely treed mountain slopes and rock crags." Spofford (1964), "Preferred habitat includes cliffs, mountains and escarpments for perching and security, and a rich grass and plant supply to maintain herbivorous animals suitable for food."

B. Altitudinal range

Dixon (1911), "I have noted eagles from within one-half mile of the ocean at only a few feet above sea level to 9000 feet elevation above sea level, and resident in all cases where found." Grinnell and Miller (1944), "Individuals reach high altitudes, for example, 11,500 feet over Mount San Gorgonio, San Bernardino Mountains." McGahan (1968) reported in Montana 81% of all nests found were between the elevations of 4000-6000 feet. The highest altitude of any nests was 7000 feet.

C. Home range size

Dixon (1937) reported in San Diego County, California the minimum home range size was found to be 19 square miles, the maximum 50 square miles, and the average for 27 pairs was about 36 square miles. Brown and Amadon (1968), "In forested country such as northeast North America the range hunted by a particular pair may be as much as 200 square miles, but only a small proportion of the total range (10-40% in patches) may be open enough to hunt. There is a general correlation between size of home range and prey density..." (See also POPULATION PARAMETERS - Density).

Aquila chrysaetos (con't.)

D. Territory requirements

Perch sites - Marion and Ryder (1975), "Golden eagles used a wide variety of perches, but strongly preferred haystacks and trees. Although nine golden eagles were seen perched on fenceposts, the high availability of these perch sites resulted in a low preference index value, suggesting that golden eagles avoid fenceposts as perch sites. Rabbits were abundant in and near the relatively rare haystacks during the winter months, which may explain the preference of the golden eagles for these sites." Carnie (1954), "The birds spent much time perching and preening on prominent rocky outcroppings or on bare trees affording good observation of the area about the nest. Perching did not appear to be a major means of watching for prey, as in some raptorial species. In one case, however, an adult female was observed to leave her perch on a rocky point two minutes after having settled there and fly across a wide canyon in a straight, unwavering flight to the top of the opposite ridge over a mile away where she killed and ate a striped skunk."

Nest sites - Mosher and White (1976) reported data from golden eagle nests in Alaska, Montana, Utah, and Texas suggest that differences in the directional orientation are related to the sensitivity of eagle chicks to thermal stress. McGahan (1968) noted sixty-two percent of 92 occupied and unoccupied nests in Montana were located on cliffs, and the next most common site was the Douglas fir. Data from this study suggested that nest-site preference is influenced by the direction of the sun's rays with few nests being located on cliffs with northern exposures. Carnie (1954), "The majority of the eagles studied (14 pairs) constructed their nests in tall trees. The remaining three pairs nested on cliffs ranging from 40 to 300 feet in height." Taylor (1890), "one eagle's nest I found was so accessible that a lady could have climbed it almost without difficulty." In central California the golden eagle usually chooses an open tree for its nest. Evans (1888), "Their nests seem to be equally distributed in sycamores, pines, and oaks." (This was in Santa Clara County, California). Boeker and Ray (1971) noted the habits of individual pairs of eagles varied widely in their use of alternate nest sites. "The number of alternate nests associated with a main nest site and the distance separating nests can probably be attributed to terrain features and the proximity of other nesting pairs. Cliff sites overlooking open grasslands, where both prey populations and ease of hunting are optimum, were more heavily used than those overlooking closed forests. In this study, 93 per cent of the 150 nests found were on cliffs; the remainder were in trees or on earthen mounds. In Idaho, Hickman (unpubl. rept., U.S. Bur. Sport Fish. Wildl., 1966) reported 96.5 per cent of 117 nests on cliff sites and 3.5 per cent in live ponderosa pine (Pinus ponderosa) trees." Dixon (1911), "Their nesting sites here (San Diego County, California) are usually in cliffs, but I have also noted them nesting in oak trees and sycamores. Their nest is invariably placed at an elevation exceeding that of the surrounding country." Dixon (1937), "A nesting location is generally on the margin of the hunting area where air currents are favorable to slow flying and landing at slow speeds. Eagles do not nest year after year in the same nest as generally reported." Eagles tend to nest where they can keep an eye on adjacent pairs. Chalker (1888) reported a nest in San Benito County was located in a redwood tree 94 feet off the ground.

Aquila chrysaetos (con't.)

E. Special habitat requirements

Thelander (1974) noted within California the basic nesting requirements of golden eagles are (1) a suitable food source, (2) an adequate nesting location, and (3) some degree of freedom from human intrusion.

V FOOD

A. Food preferences

Boeker and Ray (1971), "Prey remains found in 34 nests in 1965 showed that jackrabbits (Lepus sp.) and cottontail rabbits (Sylvilagus sp.) provided more than three-fourths of the eagle's total diet. Other mammals, in the order of their importance, included prairie dogs (Cynomys sp.), striped skunks (Mephitis mephitis), ground squirrels (Citellus sp.), marmots (Marmota sp.), mule deer (Odocoileus hemionus), and, in two nests, traces of domestic sheep and goats." Avian forms taken by eagles included great horned owls, magpies, ring-necked pheasants, mourning doves, mallards, chukars, and domestic pigeons. Remains of a prairie rattlesnake and a bullsnake were found in two nests. These authors believed that domestic livestock forms only a trace item in the diet of golden eagles in their study area. Riney (1951) noted an eagle was seen attacking a 5-6 month old mule deer in the central Sierra Nevada of California. The author mentions several other accounts of this sort for Wyoming, Montana, and elsewhere in California. Golden eagles also feed on dead deer. Ford and Alcorn (1964) reported three instances of golden eagle attacks on mature coyotes were witnessed in California and Nevada. Wood (1946) reported a cattle rancher came across an eagle that was in the process of killing a prematurely born calf in San Luis Obispo County, California. Miner (1954) noted two eagles were seen attacking a coyote northeast of Fort Collins, Colorado on 21 November 1953. The coyote escaped. Hock (1952) reported a golden eagle was observed swooping on a red fox, but it did not appear to be attempting to take it as prey, but rather was possibly merely playing with it. Nevertheless, other apparently valid accounts exist where eagles did actually prey upon foxes. Willard (1916) noted in Arizona this species was observed to feed on deer and calves, although there is some evidence that the latter may not have been actually killed by the birds. Dale (1936) reported several studies have shown that California golden eagles feed primarily on ground squirrels (Citellus beecheyi), rabbits and carrion. Goodwin (1977) noted several instances of golden eagle predation on pronghorn antelopes were observed in Wyoming in 1974 and 1975. Dixon (1937) noted in times of food stress eagles will hunt down, kill and eat red-tailed hawks and great horned owls. Young individuals are more often killed than adults. Ground and tree squirrels are the most important food items in San Diego County, California with three species of rabbits ranking next in importance. Third are water birds, including coots and large ducks. Other food items include skunks, gray foxes, house cats, young pigs, young deer, and young goats. The author had encountered no instance of eagles taking young calves, as purported by local ranchers. Henry (1939) noted a golden eagle was observed picking up and carrying off a wounded great horned owl in North Dakota. Kalmbach, Imler, and Arnold (1964) reported in a study area in the

Aquila chrysaetos (con't.)

Colorado-Wyoming region golden eagle predation on sheep was minimal or non-existent because of lambing procedures. In another study area in Texas west of the Pecos, there was some eagle predation on new-born lambs, but most lambs that eagles fed on were already dead. Carnie (1954), "Nearly all writers concur that golden eagles take a wide diversity of prey species, but in all localities the bulk of the diet consists of a few predominant mammalian species such as the ground squirrel, prairie dog, and/or jackrabbit. In some instances, such as in the present study, game species or livestock may form a significant portion of the diet." Nests of 17 pairs of eagles were examined for prey items in the San Benito-Contra Costa County, California region with the following results: ground squirrels (28.6%) and jackrabbits (26.4%) formed the majority of the prey items taken. Other mammal species included black-tailed deer, striped skunks, gray squirrels, woodrats, domestic cats, pocket gophers, weasels, meadow mice, opossums, raccoons, gray foxes, moles, and cottontail rabbits. Yellow-billed magpies were the most frequent bird taken, others included western meadowlark, great horned owl, California quail, common crow, turkey vulture, roadrunner, Steller's jay, mallard, scrub jay, American kestrel, common flicker, barn owl, Lewis's woodpecker, red-tailed hawk, great blue heron, in order of decreasing frequency (names conform to current AOU usage). In addition, numerous gopher snakes, a Pacific rattlesnake, a common king snake, and both Sacramento perches and Sacramento suckers were found in nests. This is apparently the first report of fish being taken by golden eagles. Murray and Murray (1934) noted eagles in Texas were observed feeding a cottontail, a prairie dog, and at least three American kestrels to their young. Another bird fed for about a week on a road-killed burro. Spofford (1964), "The variety of prey is great, ranging from insects, small mammals and reptiles through the large rodents, game birds and the young of larger mammals, to rare extremes of full grown deer, antelope and cranes. But the usual foods, far outranking all others in volume, are rabbits, marmots, ground squirrels, and sometimes mountain grouse and ptarmigans. Actual sightings of eagles killing a lamb are few, but there is much circumstantial evidence that eagles do kill lambs." Broun (1947) noted a migrating golden eagle that was being harassed by a red-shouldered hawk captured the latter bird in mid-air and apparently carried it off to eat. Summer (1929a) reported food brought to nestlings at a Los Angeles County nest included the following prey items: ground squirrels, a common crow, western meadowlark, cottontail rabbit, and a gopher snake. Ground squirrels comprised the majority of items fed to the young. Thelander (1974) noted (for California) prey items present at nests included black-tailed jackrabbits, small rodents, desert tortoises, black-tailed deer, barn owls, black-billed magpies, gray squirrels, ground squirrels, and one lamb. McGahan (1968) noted (in Montana), "Of the 980 specimens of prey identified, 87 percent were mammals. Of the mammals, 80 percent were lagomorphs. White-tailed jackrabbits were the major prey species, composing 42.7 percent of the mammals and 37.2 percent of all prey items. Desert and mountain cottontails were nearly as plentiful, representing 37.4 percent of the mammals and 32.6 percent of the total. Birds composed 12.4 percent of the total number of prey specimens, with black-billed magpies the most prevalent, representing 36

Aquila chrysaetos (con't.)

percent of the birds. Gray partridge and blue grouse were fairly common, together composing 37 percent of the birds. The only reptiles tallied were four snakes, representing only 0.4 percent of the total number of prey individuals... predation on domestic species in this study was negligible... the remains of one lamb, possibly taken as carrion, was found at the foot of a nest..." Gloyd (1925) noted prey items of Kansas golden eagles included cottontail rabbits, jackrabbits, prairie dogs, a young coyote, a woodchuck, a Franklin's ground squirrel, a short-eared owl, a fox squirrel, a red-tailed hawk, and a chicken. Mammalian prey, especially rabbits, formed the bulk of the diet.

B. Foraging strategies

Beebe (1974) reported among foraging strategies used by golden eagles are catching prey themselves, scavenging the kills of other agencies, or pirating prey from other predators, frequently also killing the predator itself in the process. They usually fly low and attack prey by surprise, appearing suddenly over hills or low rises, but they also may make direct attacks on larger prey from high soaring positions. Brown and Amadon (1968), "Most of the prey is taken on the ground, but occasionally large birds such as goose and crane or even diving ducks may be struck in the air. The commonest method of hunting is quartering the hill slopes slowly, often working along just behind a ridge and moving forward as if to look over from time to time; the bird is then able to drop suddenly on prey surprised in the open." Spofford (1964) noted in Texas eagles feed regularly on road-killed carcasses. Carnie (1954), "The basic hunting pattern consisted of soaring flight 100 to 300 feet above the ground, along the tops or upper faces of large open ridges in the vicinity of the nest, interspersed with low flights ($\pm$ 25 feet) coursing back and forth over patches of poison oak, small brushy draws, or rocky outcroppings. Eagles were observed making kills from both high soaring flights and low coursing flights. As the nesting season progressed and the young required less parental care, there was an increased tendency for the adults to hunt together. Singly or together, however, the hunting pattern remained essentially the same except that when together one bird frequently would maintain the soaring flight while the other descended and coursed over localized areas. It appears that hunting in pairs is a fairly common occurrence in the golden eagle, even to the point of combined efforts in making a kill." A pair of golden eagles was seen killing a great blue heron in Santa Clara County, California, and another pair was observed killing a fawn. Kelleher and O'Malia (1971) noted a golden eagle was observed capturing a mallard out of the air. (There are numerous records of eagles feeding on mallards, but no previous observation of them actually taking such prey). Gullion (1957) reported two instances of eagles attacking humans evidently were cases of mistaken identity by young birds, who may have thought they were attacking smaller mammals.

C. Feeding phenology

Beebe (1974), "A much wider range of species is hunted by golden eagles in autumn, winter, and spring, when not on the breeding territories."

Aquila chrysaetos (con't.)

D. Energy requirements

Finley (1906) reported a family (two young) of golden eagles was thought to consume an average of six ground squirrels per day during the nesting period, possibly more. Fevold and Craighead (1958), "The percentage of average body weight eaten per day by the golden eagle lay between 5.5 and 6.6." It is assumed that food consumption would increase slightly with exercise. Food consumption also apparently increased during the summer months when molting occurs. "The ratio of the weight of food consumed by the golden eagle, expressed in percent of its average body weight, varies inversely with respect to both the body weight of the individual bird and the environmental temperature. An adult female required an average daily ration during the fall and winter of 308 grams and two juvenile males required 262 and 266 grams respectively during the same seasons."

VI REPRODUCTION

A. Age of first breeding

Brown and Amadon (1968), "the young bird does not breed for about four years...". Spofford (1964), "an eagle does not breed until it is about five years old, and the sub-adult group is made up of several age classes: juveniles, immatures, and older 'sub-adults'."

B. Territorial behavior

Beebe (1974), "Of all northern raptors, golden eagles establish what are perhaps the most enduring reproductive territories... the more permanently occupied territories expand and contract in relation to the abundance of certain primary food sources... Except at high latitudes or in high alpine areas, the territories are occupied for much of the year. Golden eagles at all times show a higher tolerance to others of their own kind than they do to raptors of other kinds, and this attitude is maintained on the breeding territory." (Even so, it is rare to find eagle nests closer than 4 km to each other). Dixon (1937), "Boundaries of the area claimed by each pair of birds are definite and this area is handed down from generation to generation; the death of one bird of a pair does not affect the status of a given area. If both birds are destroyed at the same time the area is open territory but does not seem to remain so for any length of time."

C. Courtship and mating behavior

Bent (1937) noted the courtship behavior of the golden eagle consists mainly of spectacular flight maneuvers, spiral sailings in ever-rising circles, in which the birds frequently come close together and then drift apart; as they pass they almost touch... Bent believed that the birds are apparently mated for life, but that if one bird was killed, the other would immediately seek a new mate. Hanna (1930) noted courtship and mating was observed on 23 February 1924 in southern California, and it involved aerial acrobatics. "Such soaring is sometimes done with one bird going clockwise and the other anti-clockwise and at this season of the year followed by copulation, the female making a dive to a perch on rocks near

Aquila chrysaetos (con't.)

the nest, followed by the male at full speed. At this season the birds sometimes conduct flight antics over the nest such as swooping toward it from high elevations and making loop-the-loop flights."

D. Nesting phenology

Carnie (1954) noted in central California eggs were laid in late February or early March. (17 pairs were under observation). Boeker and Ray (1971), "Nesting and egg laying dates were generally dependent on the geographical location of the nests; nesting was earlier toward the south and at the lower elevations. In New Mexico, incubating eagles were found as early as mid-February, while in Colorado and Wyoming, most egg laying took place in March." Bent (1937), "If the first set of eggs is taken from an eagle's nest, the bird will often, but not always, lay a second set about a month later, sometimes in the same nest and sometimes in an alternate nest." Egg dates for nests in the southwestern part of the United States (California to Texas) are between 9 February to 18 May (272 records) with 136 records falling between 26 February to 24 March. Dixon (1937), "Eggs are deposited, in this area (San Diego County, California), as early as the first week in February and as late as the first week in March. If for any reason the first laying is destroyed, the birds will invariably deposit a second set, sometimes in the same nest but usually in another nest. The period between layings is 28 days." Beecham and Kochert (1975) reported along the Snake River, Idaho hatching dates ranged from 18 March through 21 April (median 11 April) in 1969; 17 March through 12 May (median 10 April) in 1970; and 23 March through 18 May (median 13 April) in 1971. The springs of 1970 and 1971 were wetter than that of 1969, probably accounting for the later hatching dates.

E. Length of incubation period

Spofford (1964), "Incubation... is six weeks." Carnie (1954) noted the incubation period was found to be 33 to 35 days. Brown and Amadon (1968) reported the nestlings "make their first flight, usually unaided, at 65-70 days, but exceptionally may stay in the nest for more than 80 days." Abbott (1924) noted an egg that was removed from an eagle's nest was placed under a succession of Rhode Island Red hens and hatched 41 days later. Beebe (1974), "Incubation requires 43 to 45 days and is shared by both sexes."

F. Length of nestling period

Carnie (1954), "The young remained in the nest 65 to 70 days." Sumner (1929a) noted that two eaglets fledged from a Los Angeles County, California nest between the age of 9 to 10 weeks. (The nest originally contained a third chick, but it disappeared early in the nesting attempt).

G. Growth rates

Sumner (1929a) reported at a Los Angeles County nest, the following weights were obtained for two developing nestlings (same order of young used

Aquila chrysaetos (con't.)

throughout): hatching - 105.0 g, 128.6 g; 1 week - 357.3 g, 232.3 g; 2 weeks - 1022.7 g, 584.7 g; 3 weeks - 1662.4 g, 1272.7 g; 4 weeks - 2668.8 g, 1880.9 g; 5 weeks - 2870.0 g, 2270.0 g; 6 weeks - 3581.7 g, 2606.7 g; 7 weeks - 3851.7 g, 2801.7 g; 8 weeks - 3401.7 g, 2441.7 g; 9 weeks - 4061.7 g, 2981.7 g. When these data are graphed, they present the classic sigmoid growth curve. The heavier bird was presumably a female, the other a male. Sumner (1929b) noted a young eagle was followed from the egg stage to fledging in a Los Angeles County nest in 1927 (see also Sumner 1929a). This individual, a female, weighed 4150.0 g at the age of ten weeks when it fledged. Growth was most rapid during the first three weeks after hatching, then tapered off until a decrease in weight occurred between 8-9 weeks and continued into the tenth week.

H. Post-breeding behavior

Beecham and Kochert (1975), "Apparently a large number of immatures range throughout the area, but do not remain in a specific area for any length of time. Fourteen of 16 banded eaglets recovered during the study (along the Snake River, Idaho) were found within 174 km of their natal nests." Beebe (1974), "The period of post-fledging dependence of young golden eagles is difficult to ascertain and apparently quite variable in different individuals." Young are clearly dependent in all cases for at least 30 days. After that, some young apparently leave their parents, while others spend a year or more with them. Spofford (1964), "after leaving the nest the eaglet is dependent upon its parent for another month or more. Migrant eagles from the north thus often pass in family groups composed of two adults and one juvenile." Boeker and Ray (1971) reported band recoveries suggested that young eagles in the Front Range area do not wander far from the nest site and may remain in the vicinity throughout the year.

VII POPULATION PARAMETERS

A. Clutch size

McGahan (1968) noted in Montana 13 nests produced 29 eggs in 1964 and in 1965 7 nests contained 13 eggs for an average of 2.1 eggs per nest for the two years. Three eggs held 3 eggs, one nest held only 1 egg, and the remaining nests contained 2 eggs each. Hanna (1930) reported in southern California nests contained only one egg in 35% of the cases, two eggs in 60% of the cases, and three eggs in 5%; all were believed to be complete sets. Dixon (1937), "About one set in ten will consist of three eggs per set, and about the same percentage of sets of one egg are laid." Beecham and Kochert (1975), "The average size of 89 clutches was 2.1 eggs. Proportions of 1-, 2-, and 3-egg clutches did not change significantly from 1969 to 1971." Ray (1928) noted a set of four golden eagle eggs was taken in early March 1928 in California, an unusually large number of eggs in a single clutch. DeGroot (1928) reported a "set" of five golden eagle eggs was found in California on 17 March 1928. One of the eggs was addled and was apparently not laid at the same time as the rest. In addition, another "set" of four eggs, possibly including an egg laid in the preceding season, was found in a San Diego County nest.

Aquila chrysaetos (con't.)

B. Nesting success

Boeker and Ray (1971), "Productivity remained relatively constant throughout the study. The six-year average for eagles hatched per nest was 1.52, and, excluding 1969 when there were insufficient data for determining fledging success, 1.39 were successfully fledged per nest. McGahan (1966 Master's thesis - not obtained by me) reported an average of 1.80 birds hatched and 1.56 fledged per nest from the 45 nests studied in Montana in 1963 and 1964. In Idaho and Oregon, a sample of 18 nests in 1966 showed an average per nest of 1.40 hatched and 1.30 successfully fledged (Hickman, pers. comm., 1967)." Spofford (1964), "Mature breeding pairs usually do not nest every year. Although there are usually two eggs, characteristically only one young is fledged, the larger eaglet frequently killing the younger. In Scotland, eagle pairs may raise one eaglet every other year. In Maine, one pair has raised an eaglet every three years, and in the Brooks Range of Alaska one carefully studied pair has produced no young in four years." Beecham and Kochert (1975), "Ninety-three of 146 nesting attempts (65%) were successful during this study (along the Snake River, Idaho) (61% in 1969, 70% in 1970, and 62% in 1971). An average of 1.1 young fledged per nesting attempt, while 1.6 young fledged per successful nest." Thelander (1974), "Young golden eagles were reported or observed at 49 (21%) of the 230 nesting territories visited during 1974. An accurate count of fledging age young produced was made at 44 locations. There were 61 young fledged for an average of 1.39 fledged young per territory where fledglings were counted." McGahan (1968) noted in a Montana study area in 1963 and 1964 a total of 45 successful nesting efforts hatched 81 young for an average of 1.8 young per nest. Of those hatched 70 (86.4 percent) fledged, an average of 1.56 fledglings per nest. Combining these data with those from unsuccessful nesting attempts yields an average of 1.59 young per nest hatched and 1.37 per nest fledged.

C. Mortality rates per age class

McGahan (1968) noted in a Montana study 22 golden eagles were found dead from 1962 to 1964. Fourteen were nestlings, but this does not necessarily indicate that nestling mortality is higher, rather that it is more apparent than mortality of free-ranging adults and immatures. Man caused the death of 10 eagles, and another 12 died from unknown causes (one possibly from attempting to eat a porcupine). Young were taken from nests in several instances. Brown and Amadon (1968), "As the young bird does not breed for about four years the average expectation of life of adults in the wild state, assuming 75% loss of young before maturity, would be ten years." Beecham and Kochert (1975) reported in a study along the Snake River in 1969, 1970, and 1971, 41 of 129 (32%) young died before fledging. Heat prostration accounted for 41% of the mortality. Fratricide resulted in the death of 3 eaglets. An average of 1.3 young hatched per nesting attempt, and 1.8 hatched per successful pair was found. Abandonment of nests and infertile, destroyed, and missing eggs decreased hatching success. Weather factors and accidental trampling of eggs by parents caused minor losses. Fledglings died of trichomoniasis, impact injuries, shooting, and other unknown causes. Electrocution was the major cause of mortality in 28 cases of immature and adult golden eagles with impact injuries

Aquila chrysaetos (con't.)

and shooting being the next most important mortality factors.

D. Longevity

Brown and Amadon (1968), "Golden eagles have been said to live in the wild state for more than twenty years on occasion. In captivity they have lived for up to 46 years, with an average of fifteen years for the twenty longest-lived. Suggestions that eagles may live for 100 years can be discounted." Spofford (1964), "Eagles are potentially long-lived. There are reports of birds kept in zoological parks for many decades, and it is probable that under optimum conditions eagles may live for 50 and even 75 years." Kennard (1975) reported a golden eagle of unrecorded sex and age was banded in southern California on 8 May 1927 and recovered (shot) in Guanajuato, Mexico on 10 October 1937.

E. Habitat density figures

McGahan (1968) reported in a Montana study area in 1963 the average density for 17 known pairs of golden eagles was one pair per 74.2 square miles. In 1964 the same area supported 19 known pairs for a density of one pair per 66.3 square miles. The maximum and minimum distances between nearest neighbors for 17 occupied nests in 1963 were 10.5 miles and 1.2 miles in 1963, and in 1964 only 1.0 mile separated two nests. Spofford (1964), "Each breeding pair occupies a territory of from 25 to 100 square miles in which are located several nests used in rotation. Under very favorable conditions, eagle territories are contiguous and the population is nearly maximum." For example, about 150 pairs occur in Scotland, where the available supply of food and nest sites is high, but in arid and other similar areas of low food supply, eagles are seldom seen. Carnie (1954) noted in the Contra Costa-San Benito County, California region the nests of four pairs of eagles formed a trapezoid, the largest side of which was not over two miles in length. Beecham and Kochert (1975) reported in a study area along the Snake River, Idaho in 1971 there were 73 km² per eyrie for the 56 breeding pairs recorded, or one pair per 5 km of river. This was an increase from 1969 when there was one pair per 8 km of river. Lockie (1964) noted thirteen pairs of golden eagles in Scotland nested at a density of one pair per 70 km².

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Thelander (1974), "Golden eagles compete with many other species of raptors for nesting sites and food." Prairie falcons, American kestrels, red-tailed hawks, and common ravens were observed nesting in close proximity to golden eagles, and each of these species was observed harassing eagles on several occasions. It is not known whether utilization of eagle nests by other species resulted in the construction of alternate nests by eagles. Tyler (1933) noted a golden eagle that was harassed by a prairie falcon near the latter's nest struck the falcon with its wing and nearly killed it. Riney (1951), "Koford once observed 28 condors

Aquila chrysaetos (con't.)

feed on a deer carcass; they cleaned it up in about one-half hour, after having been kept from the carcass for several hours by golden eagles." Beebe (1974) reported the harassment of eagles by smaller raptors when the nesting territories of the latter are invaded may often result in the death of the smaller birds, as indicated by the frequency with which the remains of other species are found in the vicinity of eagle nests. Dixon (1937), "As a rule, the eagles are tolerant of other predatory birds and simply ignore them." Almost all nesting territories in San Diego County contained one or more pairs of nesting red-tailed hawks and great horned owls. In one instance, however, a pair of eagles displaced a pair of peregrine falcons off a nesting cliff. Eagles occasionally steal sticks from the nests of other pairs, and this may result in an aerial battle that can involve as many as three pairs of birds.

IX STATUS

A. Past population trends

Pierce (1927), "This species is fairly common here in our southland (southern California) and seems to be holding its own unusually well for so large and conspicuous a bird." McGahan (1968), "The American eagles have declined over much of their former range." Spofford (1964), "it is thought that the total North American population of golden eagles is between 8000 and 10,000 birds... the number of breeding pairs may amount to some 4000." The annual crop of young produced in North America may be between 2000 to 4000 birds. Boeker and Ray (1971), "In October 1962 the Bald Eagle Act of 1940 was amended to include protection for the golden eagle (Aquila chrysaetos). Monthly flights over randomly located transects in a 10,000-square mile area in east-central New Mexico during the wintering periods of 1964-1969 showed a steadily increasing population of golden eagles. Similar flights conducted in western Texas study areas during the same period indicated smaller and more stable populations. A nesting study along the Front Range of the Rocky Mountains in New Mexico, Colorado, and Wyoming in 1964-1969 also indicated a relatively stable golden eagle population." Brokaw (1895), "The golden eagle is common in the Salinas Valley, being frequently seen singly and in pairs." Steinbeck (1884), "San Benito Valley, situated at the southern extremity of Santa Clara Valley, seems to be a favored spot for golden eagles. It is no uncommon occurrence to see eight or ten at one time." Dixon (1937), "The golden eagle (Aquila chrysaetos) is a common resident bird in San Diego County, California." Chalker (1887), "Golden eagles are in this section (San Benito County, California) growing fewer and fewer each year, owing to the numbers of them that are killed by the sheep herders, who shoot them on every occasion in payment for the numbers of lambs taken each year by these birds." Grinnell and Miller (1944), "Status - permanent resident. Within suitable territory, common. Reduced in numbers, or gone altogether in areas closely settled by man; elsewhere, apparently holding up close to normal." Bent (1937), "At the present time these eagles are probably more abundant in the wilder portions of southern California than anywhere else in this country, but even there they have decreased decidedly within the past few years." Murphy (1975), "A golden eagle population involving some 40 nesting pairs in west-central Utah has been under investi-

Aquila chrysaetos (con't.)

gation since 1967. Continuous breeding records have been kept for 16 pairs; these data indicate that high or optimum breeding success in the early years of the study was followed by a marked decline in overall productivity of young in more recent years. There is strong evidence to suggest that these trends are related to fluctuations, perhaps of a cyclic nature, in populations of the major prey species, the black-tailed jackrabbit."

B. Present population status

Thelander (1974), "It is estimated that 500 pairs of adult golden eagles are utilizing nesting territories in California at the present time." Beecham and Kochert (1975) reported the large proportion of immature birds during the nesting season along the Snake River, Idaho suggests that there is a stable population there. "High nesting densities and good productivity, as compared to data from other eagle populations that are considered to be stable, indicate that the golden eagles in southwestern Idaho are experiencing no reproductive difficulties at this time." Snow (1973), "In 1972, the Wyoming Game and Fish Commission conducted a winter aerial survey for golden and bald eagles. Their results indicated that there were over eleven thousand golden eagles wintering in the state of Wyoming, which was greater than the entire population estimate that Spofford made in 1964..." Heugly (1975), "Two studies conducted in the southwest indicate a stable population of golden eagles. The major source of data for the intermountain area came from aerial surveys which gave density estimates that suggested a healthy population of golden eagles. An estimate of over 40,000 golden eagles in the western United States was obtained..."

C. Population limiting factors

Hanna (1930), "This fine bird should receive our full protection; too many are being caught in traps, or shot as 'large chicken hawks'. An earthquake or a heavy snowfall caused a traditional nest to fall to the canyon below. This has been the fate of a number of other nests that I have had under observation..." Bent (1937), "Their decrease is mainly due to the indiscriminate use of poisoned baits and to shooting and trapping by cowboys, ranchers, and hunters, with the erroneous notion that they do more harm than good." Spofford (1964), "There is every reason to believe that something like 20,000 golden eagles were shot in the southwest in the last 20 years. A destruction of some 1500 or more eagles in one region in one year is far more than the relatively small eagle population in North America can stand without suffering a drastic decline. The size of the annual shoot-off is a substantial part of the annual crop of juvenile eagles." Beecham and Kochert (1975), "Territorial intolerance and availability of nest sites regulated the distribution of breeding pairs along the Snake River. Territorial intolerance appeared to be the less dominant force. We observed that nest sites were widely spaced in areas of poor cliffs, whereas in areas of adequate cliffs, pairs nested in close proximity. Three basic factors appear to regulate golden eagle densities: 1 - availability of preferred nesting sites, 2 - adequate prey populations within the hunting range, and 3 - minimum nesting territory size. Eagle densities were lowest in areas where suitable cliffs were present but most of the land was cultivated." Kochert (1975), "Mean

Aquila chrysaetos (con't.)

eggshell thickness was the same as pre-1947 values. DDE concentrations in eggs and tissues of eagles were much lower than in declining species producing thin eggshells. DDE levels in eggs and tissues of eagles were 4-8 times as concentrated as levels detected in tissues of the major prey." Boeker and Ray (1971), "Nesting density varied greatly throughout the study areas and appeared directly related to the availability of nest sites and associated vegetative types. Human disturbance accounted for at least 85% of all known nest losses in this study. Other mortality factors noted included wind destruction of a tree nest containing young, two instances of young eagles falling from the nest, one eaglet infected with trichomoniasis, and the disappearance of several eggs and young from unknown causes." Aiken (1928) reported a migrating "flock" of golden eagles became ground-bound after being covered by sleet and were captured by Indians and sent to Oklahoma where the resident Indians purportedly kept eagles in confinement, being periodically plucked for their flight feathers, which were used in war bonnets. Dale (1936) noted in Tehama County, California airplanes were being used to facilitate eagle-killing as early as 1936. It appeared that over 200 were killed during the winter of 1935-1936 and spring of 1936 in this area, although some of the birds may have been bald eagles or large hawks. Dixon (1937), "Where areas are planted to trees or cropped, or otherwise changed from their natural status, the feeding areas show an increase in acreage." Areas highly developed to orchards and permanent improvements force the birds to take in more territory.

D. Environmental quality: adverse impacts

Thelander (1974) reported it was believed that several areas of California had golden eagle nesting populations approaching carrying capacity. "But those areas where human activity has included the destruction of golden eagle foraging areas, prey populations or nesting sites, permanent exclusion of nesting golden eagles has occurred. This loss of nesting territories will continue as expansion of urban areas and the alteration of golden eagle nesting habitat continues. Pairs have been observed to abandon their nests apparently as a result of human disturbance." Beecham and Kochert (1975), "Eagle densities were lowest in areas where suitable cliffs were present but most of the land was cultivated... The extensive, monocultured irrigation projects... could result in a decrease in lagomorph densities with eagle density also decreasing." Remsen (1978) reported potential threats to this species in California include habitat destruction (reclamation of grasslands for agriculture), shooting, and human disturbance at nest sites. McGahan (1968), "The stability of golden eagle populations is threatened by several factors. Although a federal law was enacted in 1962 to provide protection for this species, limited seasons have been reopened in many of the western states for killing eagles that are purported to be taking livestock. The widespread use of pesticides has introduced another threat..."

E. Potential for endangered status

Remsen (1978) noted although California populations of this species seem stable, its natural densities are very low, its reproductive rate is very

Aquila chrysaetos (con't.)

low, it is at the apex of a food chain, and its large body size makes it a tempting target. Therefore, population trends in this species should be closely monitored. Beebe (1974), "Over most of its range in the west, the golden eagle is not rare and certainly not endangered. It has endured much persecution for a long time with amazing resilience and, with this era now largely past, it is more likely to retain maximum populations, wherever the combination of prey species and suitable landscape permit, than to decline in number."

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PRAIRIE FALCON
Falco mexicanus

I TAXONOMY

A. Type description

Schlegel (1843) noted this form was described from a specimen from Monterey, Mexico.

B. Current systematic treatments

Peters (1931) reported there is no racial separation for this species.

AOU (1957) recognizes only a single race of this species.

Synonomies - Falco polyagrus, Falco lanarius mexicanus, Falco lanarius polyagrus, Falco mexicanus polyagrus; American lanner falcon, prairie hawk, American lanner (Grinnell and Miller, 1944). Bullet hawk, American lanner, prairie hawk (Mallette and Gould, 1978).

C. Recent taxonomic revisions

AOU (1957) reported there are no recent taxonomic revisions.

II DESCRIPTION

A. External morphology of adults

Mallette and Gould (1978) noted adults are light brown above; white with brown streaking below; dark brown mustache below eye; distinct white line above eye; dark brown axillaries. Immatures have heavier breast streaking. They are crow-sized: 14-20 in long and 30-40 in wingspread. Males are one-third smaller than the females. Beebe (1974) gave the length as 380-460 mm and the weight as 525-575 g for the males and 840-980 g for the females. Friedman (1950) reported the sexes alike in the adult and immature plumages; adult and immature plumages also similar except soft parts. The adult is described as having forehead, white to buff; crown, nape, back, rump, scapulars, and upper wing coverts, umber to sepia brown; black shafts and tawny margins; incompletely barred rectrices plain pale drab; malar stripe of dark sepia; chin, throat, breast, abdomen, white washed with buff and with tear-shaped spots to streaks; axillars, plain brown (dark wing lining); primaries, light; spots long on lower abdomen, thighs, and flanks; iris, brown; cere, orbits, tarsi, toes, cadmium to yellow; bill, greenish to black; blue slate tip. The males are smaller than the females: adult male - wing 289-313 (299.4) mm, tail 159-179 (169.6) mm, and tarsus 50-57 (55.9) mm; adult female - wing 331-357 (342.8) mm, tail 185-201 (189.7) mm, and tarsus 57-64 (60.7) mm for a sample size of 17 males and 18 females.

Falco mexicanus (con't.)

B. External morphology of subadult age classes

Friedman (1950) noted natal down, pure white; feathered immatures like adults, but slightly darker upperparts, streaks and thighs. Bill, black; iris, brown; tarsi, toes, pale bluish; cere, orbits, bluish.

C. Distinguishing characteristics

Beebe (1974) reported the outline and manner of flight characterize it as a falcon with broad head, long tail, light head, dark axillars which all distinguish it from the peregrine falcon. The arid habitat is also a distinguishing feature of the prairie from the marine and mesic peregrine. Mallette and Gould (1978) noted as being dark brown in the axillaries which distinguishes it from other falcons. Snow (1974) reported confused with peregrine. Prairies lighter in color and has dark wing-pits which the peregrine doesn't. Prairies also have large-appearing head.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Mallette and Gould (1978) reported prairie falcons breed only in western North America. Found throughout California except coastal fog belt from below sea level to 14,000 feet. Winter population increased by migrants. AOU (1957) noted summers and breeds in British Columbia, Alberta, Saskatchewan, North Dakota south to Baja California, Arizona, New Mexico and Texas. Winters from north of breeding range south to Mexico. Peters (1931) reported breeds in southern British Columbia and southeastern Saskatchewan to lower California and southern Mexico.

B. California desert distribution

Grinnell and Miller (1944) noted range is extensive throughout the state except humid coastal belt metropolis. Lie in southeastern deserts and thence northwest along inner coast ranges. Garrett and Mitchell (1973) reported scattering of historic nests ($n \approx 50$) in Mojave and Colorado deserts.

C. Seasonal variations in distribution

Parker (1973) noted in winter in wheat lands, irrigated farm lands and other non-nesting lands.

IV HABITAT

A. Biotopic affinities

Denton (1975) reported found in open grasslands interrupted by broken terrain including escarpments for nesting. Agricultural land contiguous

Falco mexicanus (con't.)

ous with river bottoms, rolling foothills, ridges, canyons and buttes to precipitous montane topography are areas all covered by this species. Grinnell and Miller (1944) reported breeding in lower Sonoran life zone commonly and in the upper Sonoran life zone less commonly. Found in dry, open terrain which is level or hilly. Breeding headquarters include cliffs with nesting niches. The cruising radius is long and it carries foraging birds far afield, even to marshlands and ocean shores.

B. Altitudinal range

Garrett and Mitchell (1973) noted nesting pairs were observed from sea level to 10,000 feet. Grinnell and Miller (1944) reported it occurs altitudinally from below sea level to above 14,000 feet (Inyo County).

C. Home range size

Snow (1974) noted much time is spent perching. This species has definite hunting ranges, confined to the least possible radius necessary to secure required food supplies.

D. Territory requirements

Perch site - Falcons eat while perched, either on the spot where they have captured their prey or on a convenient vantage point. Both birds spend much of their time perched on or near the eyrie (Snow, 1974).

Courtship and mating site - Bent (1937) reported courtship consists of spectacular aerial flights which are a series of loop-the-loops near the nesting cliff. Then both birds perch on cliff and survey their domain.

Nest site - In Denton (1975), Leedy in 1972 reported that 72% of 49 nests faced south or east and Enderson in 1964 noted 61% faced south. Denton reported 61% faced southwest or west. There are no ground nests or nests on man-made structures known for prairie falcons. Most nests are in potholes or vertical cracks with lodged boulders providing a surface for nest scrape and horizontal ledges. Mallette and Gould (1978) noted this species is a bird of open spaces, cliffs, rocky outcroppings, or steep banks. The nest is a simple depression scraped in sand on rock or dirt ledge or in pothole; occasionally old stick nest. Beebe (1974) reported the height and direction of cliff faces is not important. These factors take second place to nature and character of ledge. Old cliff nests of other raptors are used along with overhang ledges, potholes or cracks. Far more nests are on low (15-50 m) than high (300 m) cliffs. Aeries are marked by the same inverted yellowish-white excrement on the cliff face and same basal trash heaps that are characteristic of all falcon aeries.

Falco mexicanus (con't.)

E. Special habitat requirements

Denton (1975) reported 32% bordered agricultural land and 76% had water sources within 0.25 miles throughout the breeding season. Many sites were located within 0.5 miles of a road (62%). Only 15% nested within 0.5 miles of habitation.

V FOOD

A. Food preferences

Denton (1975) reported eat meadowlarks, horned larks, red-winged black-birds, mourning doves, starlings, ground squirrels, and least chipmunks. Snow (1974) noted with mourning doves, burrowing owls, horned larks, jays, meadowlarks, blackbirds, shrikes, wrens, gophers, squirrels, buntings, magpies, sparrows, quail, lizards, beetles, grasshoppers, longspurs, pigeons, cottontail rabbits and young jackrabbits. Garrett and Mitchell (1973) noted in the Mojave desert the falcons were preying primarily on reptiles and mammals. In this study small passerines were the main prey species captured. Historically Beechy ground squirrels was the main prey species during the reproduction season. Horned larks are particularly important prey in the winter. Beebe (1974) reported horned larks, western meadowlarks and mourning doves are the 3 most important prey items. The most important mammal is the squirrels of the genus Citellus.

B. Foraging strategies

White (1962) reported prairies occasionally hunt like accipiters or marsh hawks rather than aerial falcon hunting. Beebe (1974) noted while it takes some of its prey in flight, such captures are usually the end of calculated high-speed approaches to prey initially seen on the ground.

C. Feeding phenology

Platt (1974) reported that early morning and late evening are the times when falcons are the most active. A brood of young forces mid-day hunting activity in the adults.

VI REPRODUCTION

A. Age of first breeding

Platt (1977) noted 7 females in juvenile plumage nested in 1976 and 1977 in a study of 28 eyries.

B. Territorial behavior

Platt (1974) reported prairie falcons exhibit intense territorial behavior throughout their nesting and hunting territories. Snow (1974)

Falco mexicanus (con't.)

noted birds scream and stoop at intruders. The male is aggressive, but the female is more persistent in the nest defense. Some falcons have struck human observers. Garrett and Mitchell (1973) reported the prairie falcon, like other cliff-nesting Falconiformes, tends to be faithful to a breeding territory. In 1970-1971 an extensive shifting of production between locations was seen with few territories supporting productive pairs both years. Platt (1974) noted 6 falcons seen while traveling between nests during an 8-week observation. Emphasizes highly secretive nature of the birds. Adults stand motionless until observer approaches a few hundred feet from the nest.

C. Courtship and mating behavior

Bent (1937) reported the males come hurtling out of the heavens, screaming like all possessed and cutting parabolas with acuteness in a marvel of the unexpected. The females shrieks in wild approval, or takes a turn herself. Parker (1973) noted without preliminaries the male sailed gracefully down and mounted female; coitus immediately followed. During the coital act, the wings of both birds are high, upraised and rapidly and excitedly fluttering. Tyler (1923), "I am inclined to believe that certain pairs occasionally pass a season without nesting, as I have, on two different occasions found both birds present but no actions indicating nesting."

D. Nesting phenology

Denton (1975) reported pair formation followed by courtship, nest-ledge selection and copulation. Walton (1977) noted the mean egg laying date from 71 records in 1972-1977 as April 11. The mean egg laying date from 209 records in 1900-1960 was April 4. Courtship is from 2-3 weeks in late March - early April. Mallette and Gould (1978) noted early in the year the birds form a pair. By early March they defend the nest site. Three to 5 creamy white eggs blotched with brown are laid by April. Incubation is 30 to 32 days and the young fledge in 4½ weeks. Beebe (1974) reported prairies quite regularly winter at the same latitude as they breed; seldom on their territory; return singly to cliffs and go through noisy flight displays and ledge selection then copulate frequently to termination of egg production. As with other falcons, the female prairie ceases to capture food for herself and is supplied by the male from the time of her arrival through ovulation and incubation and during close brooding of the downy young.

E. Length of incubation period

Enderson (1964) noted incubation takes place over a 29-31 day period and the eggs hatch over a 2-3 day interval. Walton (1977) reported incubation is 36-37 days (captive-bred eggs in an incubator).

F. Length of nestling period

Walton (1977) noted the fledging period as 33-40 days.

Falco mexicanus (con't.)

G. Post-breeding behavior

Walton (1977) noted in June and July, young disperse, adults leave the nesting territories while the females are more common in flat, open areas and the males in rolling or wooded areas.

VII POPULATION PARAMETERS

A. Clutch size

Walton (1977) reported the clutch size over 5 years had an average of 4.4 eggs from 65 total nestings with a range of 2-5; 34% = 5. Beebe (1974) noted clutch size averages slightly higher than peregrines; 5 eggs rather than 4. Eggs are pinkish-white, heavily peppered with brown; average 52.3 x 40.8 mm. Incubation slightly more than 30 days and the young reach flying at 40 days after hatching.

B. Nesting success

Denton (1975) reported out of 51 nests, 82% had successful fledging; 75% of failures were pre-hatching. Garrett and Mitchell (1973) noted statewide that 3.20 young was the average number of fledging per productive pair and 1.59 fledglings per active pair. Platt (1977) reported productivity required for stable population is 1.92 fledged per nesting attempt. Walton (1977) noted fledging success over 5 years had an average for 135 total nestings of 3.2 with a range of 0-5 with 19% = 5.

C. Mortality rates per age class

Denton (1975) noted nestling mortality was less pronounced than egg loss. Enderson (1969) reported the mortality rate for juveniles was 74% and for adults was 25%.

D. Longevity

Denton (1975) reported they live at least 13 years; some may live longer. Enderson (1969) noted falcons may live to be 20 years old.

E. Habitat density figures

In Snow (1974), Webster in 1944 reported area of Colorado with 23 pairs in 16 miles of cliff; Ogden in 1973 noted 101 pairs on 45-mile stretch of Snake River; and Olendorff in 1973 noted 1.4 pairs per 100 square meters of Pawnee grasslands. Oakleaf (1975) reported in 1973 there were 4.0 individuals per 100 miles of survey routes in winter in agricultural lands and in 1974 there were 12.4 individuals per 100 miles. Crude densities were 0.01-0.06 territories/sq mi or 16.62-66.86 mile/territory and the ecological densities were 0.08-3.50 pairs/sq mi or 0.29-13.00 sq mi/pair. Ogden (1973) noted in 1970 there were 56 territories in the 45-mile study area (0.87 mi/pair); in 1971 there was more searching for 74 territories with 0.67 mi/territory; and in 1972 of 101

territories surveyed, 0.59 mi/territory. Platt (1974) noted the distance from each eyrie to others varied from 4.9 miles, 2.6 miles and 8.7 miles. Denton (1975) reported minimum distance between territories (0.25 miles) which were unsuccessful and those between successful sites (0.5 miles). Geographical orientation was important and visibility between sites usually did not occur.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Denton (1975) noted egg predation invariably occurred at sites judged accessible to mammalian predators. Nestling predation similar. Walton (1977) reported this species lays replacement clutches if their eggs are removed or destroyed. Snow (1974) noted predation by bobcats and coyotes on nestlings. Mallette and Gould (1978) reported that man is its number one enemy.

B. Competition

Beebe (1974) noted when prairie has taken large prey, it will leave its prey and fly toward the other bird (red-tail, ferruginous, or golden eagle) with a furious aerial assault. Still they steal prey occasionally. When taking small prey it easily out-distances competitive species. Thelander (1977) reported this species is an active competitor with peregrines in California for food and nesting cliffs. Platt (1974) noted competition with great horned owls for nest sites and red-tailed hawks for food and nest sites. Common ravens and prairies inhabit the same territories; in Canada, prairies compete with Canada geese. Geese and ravens warn falcons of intruders and the falcon defends the territory - thus apparently a harmony between these species.

C. Parasitism

Ogden (1973) reported nearly all harbored ectoparasites including lice, mites, ticks and fleas and tapeworms. Platt (1974) noted abandonment of 3 eggs and death of 7 young (2 broods) due to the presence of the Mexican chicken bug (Haemotosiphon inodons).

IX STATUS

A. Past population trends

Beebe (1974) reported protected by states in mid-1960's and federal level in United States in 1972. Prior to 1965 - unprotected. Year-round exposure to shooting, trapping and aerie destruction with growth of many centers of human population was apparent. The environmental impact of humans on its range has thus been effectively tolerated by this falcon. Boyce and Garrett (1977) noted rare resident breeding bird. Grinnell and Miller (1944) reported permanent resident, common in metropolis of range. Numbers in general holding up well.

Falco mexicanus (con't.)

B. Present population status

Walton (1977) noted prairie falcon population in the coast range studied to develop management techniques because of its abundance and apparent stability. Productivity within the study area (coast ranges) since the report by Garrett (1973) has been similar to historic levels. Garrett and Mitchell (1973) reported during 1971 and 1972 production was below expectation (1.59 young rather than 2.56) and indicated declining populations. Mallette and Gould (1978) noted this species is maintaining a stable population. Remsen (1978) reported second priority category; definitely on decline but population still substantial. That danger is not immediate for expiration. Snow (1974) noted Enderson estimates 2000-2500 pairs in the United States where habitat is suitable and available prairies are maintaining a good level of productivity and populations remain stable.

C. Population limiting factors

Boyce and Garrett (1977) reported climbers and nature enthusiasts contribute to reproductive failure keeping females off eggs, habitat destruction by off-road vehicles, shooting, illegal collection of eggs or young all eliminate territories or breeders.

D. Environmental quality: adverse impacts

In Denton (1975), Leedy in 1972 and Fyfe et al. in 1969 have suggested that organochlorine pesticides may have interfered with reproduction in Montana and Canada, as evidenced by a reduction in eggshell thickness. Beebe (1974) reported the cities of Denver and Colorado Springs in Colorado have both overrun and obliterated several former aeries, but there are still active and productive aeries within only 5-10 km from the perimeter of both cities.

E. Potential for endangered status

Snow (1974) noted this species nests almost anywhere there is suitable site. Cold-hardy and very tolerant of arid conditions. As long as ban on organochlorine pesticides they should not become endangered.

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MARSH HAWK
Circus cyaneus

I TAXONOMY

A. Type description

Circus cyaneus hudsonius - AOU (1957) Linnaeus; Falco hudsonius Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766. Based on the ring-tailed hawk Pygargus canadensis Edwards, Nat. Hist. Birds, 107. (ad fretum Hudsonis = Hudson Bay).

Circus - AOU (1957) Lacepede, Tabl. Ois., 1799. Type, by subsequent designation, Falco aeruginosus Linnaeus (Lesson, 1828).

B. Current systematic treatment

Brown and Amadon (1968), "It (C. c. hudsonius) is possibly a distinct species, but is normally regarded as a race."

Synonomies - Grinnell and Miller (1944), Strigiceps uliginosus; Circus hudsonius; Circus uliginosus; Circus hudsonicus. American marsh hawk; marsh hawk; harrier; American harrier.

II DESCRIPTION

A. External morphology of adults

Udvardy (1977), "Seventeen and one half to twenty-four inches (45-61 cm). Slim, with long wings, tail, and legs. Male is light gray above, white underparts with reddish spotting; in flight, black wing tips and barred tail. Female is brown above with some brown streaks below. Both sexes have white rump." Peterson (1969), "Seventeen and one half to twenty-four inches... spread 3½ - 4½ feet. Note the white rump patch. A slim hawk. Males are pale gray; females, streaked brown;... the white rump is always conspicuous. Overhead, the wing-tips of the whitish male have a 'dipped in ink' pattern." Grossman and Hamlet (1964), "The harrier is a slender, long-legged hawk with an owl-like facial ruff, long cere, large nostrils covered with bristles, and a small compressed beak. The tarsi are mostly bare with a single row of transverse scales down the front and on the long toes; the claws are sharply curved. In flight, the wings appear long, narrow, and pointed, and the tail is also long. The most important field mark of many of these low-coursing hawks is a conspicuous white rump patch. In most species there is distinct sexual dimorphism; females tend to be brown and white or entirely brown, contrasting with the gray and white plumage of the males... Dark phases are common... Beak, black; cere, greenish-yellow; eyes (female), pale gray-brown to dark brown, or (male), yellow; legs and feet (female and young), orange, (male), pale yellow; claws, black. Size, 18-22 inches." Pearson (1936), "General description - Length, 19 inches; spread of wings, 45 to 52 inches. Males have the fore and upper parts light ashy, and abdomen white; females are dark umber-brown above, and brownish white below. Both sexes have the face encircled with an imperfect ruff, somewhat as in

Circus cyaneus (con't.)

the owls. Adult male - In perfect feather, head, neck, breast and upper parts, pale light ashy; rest of under parts, pure white with a few drop-shaped rusty spots; in most specimens there is a dusky wash on back, shoulders, and secondaries; five outer primaries, blackish; all primaries and secondaries with large white areas at base of inner webs; tail, bluish-ash banded with 5 or 6 obscure dusky bars. The terminal one darkest, and mottled with white at base of feathers; upper tail coverts, pure white. Adult female - upper parts, dark umber-brown; feathers of head and neck edged laterally with yellowish-rufous; lores, line over and line below eye, dull yellowish-white with a dusky stripe between them running back from the rear angle of the eye; lesser wing-coverts, indented with pale rufous; tail, deep umber crossed by 6 or 7 regular but obscure bands of blackish, the lateral feathers being lighter; sides of head, dull rufous faintly streaked with dark brown; the facial disk, pale cream color also streaked with dark brown; chin and throat; plain dull yellowish-white; beneath, variable shades of dull white to brownish-yellow, thickly streaked with broad longitudinal stripes of dark umber-brown more numerous laterally; upper tail coverts, white."

B. External morphology of subadult age classes

Grossman and Hamlet (1964), "Immature males and females (of those species which have a distinct second-year plumage) usually resemble the adult female; juvenals are darker below... Juveniles (sexes alike) - similar to adult female but completely light cinnamon to cinnamon-colored below, and streaked on chest and belly. Young also have a white rump... legs and feet (female and young), orange." Brown and Amadon (1968), "Immature - like the female but with more pronounced pale edgings to the feathers of upper parts, especially on crown and nape, and generally more rufous in color, especially on under parts." Eye, brown; cere, greenish; feet, yellow."

C. Distinguishing characteristics

Dawson (1923), "Recognition marks - crow size; white upper tail-coverts make the best field mark; long tail; marsh-haunting habits."

Interspecific - Peterson (1969), "Similar species: (1) rough-leg has white at base of tail, but is much more heavily built; (2) accipiters (which sometimes appear white-rumped from side) have much shorter wings." Robbins, Bruun, and Zim (1966), "white rump... wings, long and narrow, but not as pointed as a falcon's, are held above the horizontal."

Intraspecific - Brown and Amadon (1968), "C. c. hudsonius of North America differs from C. c. cyaneus in being a little browner above, having a few small rufous spots on the white underside. Outer tail feathers with five or six blackish bars. Eye yellow. About the same size, but with longer tarsi, wing of male 328-352 (340); female 335-405 (368); tarsus 73-80. Average weight of male 472 (30), female 570 (13) apparently considerably heavier than C. c. cyaneus. It is possibly a distinct species, but is normally regarded as a race."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Brown and Amadon (1968), "Range: breeding in North America, Europe, and Asia, as far east as R. Kolyma in eastern Siberia, as far south as Portugal, Pyrenees, Italy, the Carpathian and Caucasus Mountains, North Turkestan, North Tibet and Manchuria; in America south to northern lower California, Texas and Virginia. A migrant in winter reaching Korea, Japan, China, Indo-China, Burma, India, rarely Borneo, Baluchistan, Persia, the Mediterranean basin. North Africa south to Nubia; in America south to Central America and Cuba, rarely Colombia."

Circus cyaneus - AOU (1957), "South of the arctic tundra from northern Norway, Finland, northern Russia and eastern Siberia (except Kamchatka) south to Spain, Italy, and central Asia, in winter to the Mediterranean (casually to northern Africa and Arabia), Palestine, Iran, Baluchistan, northern India, Burma, and southern China; and from northern Alaska, Mackenzie, Manitoba, Ontario, central Quebec, and Labrador, south to Baja California, New Mexico, Kansas, and Virginia, in winter to southern Colombia; the Gulf coast, Florida, the Bahamas, Cuba, and Hispaniola; casually in the Antilles to Barbados."

Circus cyaneus hudsonius - AOU (1957), "Breeds from northern and western Alaska (St. Michael, Kobuk River), northwestern Mackenzie (Mackenzie River, lower Anderson River), northern Manitoba, northern Ontario, central Quebec, Labrador, and Newfoundland (probably) south to northern Baja California (El Rosario, Cape Colnetl, San Ramon), southern Arizona (Tucson, formerly), southern New Mexico (Pecos Valley south to Lake Arthur), northern Texas (probably), western Oklahoma, Kansas, Missouri, southern Illinois, southern Indiana, Ohio, West Virginia, and southeastern Virginia."

B. California distribution of the species

Dawson (1923), "Fairly common winter visitor of lower levels throughout the state. Breeds commonly east of the Sierras south at least to Owens Valley; and sparingly west of the Sierras at various valley points outside of the fog belts, and south to San Diego."

C. California desert distribution

Grinnell and Miller (1944), "Recovery at Blythe, Riverside County, of bird banded in Alberta." Wauer (1962) reported on list of Death Valley species.

D. Seasonal variations in distribution

AOU (1957), "Winters from southern British Columbia (Okanagan, lower Fraser Valley), Alberta (Belvedere, rarely), Saskatchewan (McLean, rarely), western South Dakota, Minnesota (occasionally), southern Wisconsin, lower peninsula of Michigan, southern Ontario, New York, and Massachusetts (casually in southern Vermont and New Hampshire) south through Mexico and Central America

Circus cyaneus (con't.)

to Colombia, and to Cuba, the Isle of Pines, and Hispaniola; casually to Puerto Rico, St. Croix, and the Bahamas. Accidental in Hawaii (Oahu), Barbados, and Bermuda." Grinnell and Miller (1944), "Winter visitant widely, September to April. Common, even abundant (for a hawk) locally when in migration. Also relatively small numbers occur through summer and breed, in suitable territory... Life zones in summer, lower Sonoran to Canadian." Wauer (1962) reported in Death Valley - "During the first two weeks of March... marsh hawks are common."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - characteristically, marshlands, both coastal salt, and fresh-water. But forages also over grasslands in general from patches of salt-grass in desert sinks, and dry prairie, to mountain cienagas." Dawson (1923), "... a bird of the meadow and marshes, it usually avoids the woods entirely, and is to be seen coursing over the grass and weed tops with an easy gliding flight."

B. Altitudinal range

Grinnell and Miller (1944), "... from below sea level, as in Death Valley, up to as high as 9800 feet, in Big Cottonwood Meadows, Inyo County."

C. Home range size

Craighead and Craighead (1969), "... hunting range... In consequence of numerous environmental factors, these ranges varied in both size and duration. The result was much less stabilization of ranges among the marsh hawks... There were 7 pairs which encompassed 5.3 square miles per pair. Of four nesting pairs - 9.3 square miles per pair in 1948. Of an observed area of .43 - .87 square miles, the maximum diameter was 1.2 - 1.4 square miles; observed area of 1.15 - .46 square miles, the diameter was 1.7 - 1.0 square miles; observed area of .38 - 1.85 square miles, the diameter was 1.1 - 2.4 square miles; observed area of 1.44 - .86 square miles, diameter was 1.9 - 1.5 square miles; and of an observed area .58 square miles, the maximum diameter was 1.6 square miles in Wyoming in 1948."

D. Territory requirements

Perch sites - Brown and Amadon (1968), "It roosts on the ground... and very often communally when not breeding, in groups up to fifty, though usually smaller, less than ten... it punctuates its hunting by perching on the ground, on stumps, or fence posts, and occasionally in trees." (Also, males may perch on the nest briefly).

Nest sites - Brown and Amadon (1968), "The nest is built on the ground, very often in marshy places (especially in America) and commonly in low

Circus cyaneus (con't.)

shrubby vegetation, tall weeds or reeds rather than very open sites." Dawson (1923), "A nesting site is selected... customarily in the tall grass adjoining a swamp, although lately alfalfa fields have come to be great favorites." Grossman and Hamlet (1964), "The marsh hawks... of North America... build smaller nests above the water, in swamps, but also commonly line hollows in the ground - in cornfields, moorlands, and meadows. Around a thick pad of dead rushes or grasses, the female (mostly) arranges dry stalks of plants, such as heather and small twigs." Pearson (1936), "Nest: on the ground in a tangle of weeds or grassy hummocks; neatly constructed, for a hawk, of fine dried marsh grass." Udvardy (1977), "... eggs in a grass nest on the ground in marshes."

E. Special habitat requirements

Grossman and Hamlet (1964), "... and the marsh hawk being examples of long-legged terrestrial birds that kill and spend a good deal of time walking on the ground. Since the (harriers) are, almost without exception, ground nesting hawks, the open spaces are their major ecological requirement."

V FOOD

A. Food preferences

Dawson (1923), "The food of the marsh hawk consists almost entirely of meadow mice, young rabbits, ground squirrels, garter snakes, frogs, lizards, grasshoppers and the like... So great is its fondness for mice that one may... succeed in calling the hawk very close by imitating the squeak of a mouse in distress... Its fondness for... ground squirrels is so undisguised..." Pearson (1936), "The food of the marsh hawk varies with the season and with local conditions. In some parts of the country it is principally birds, and in others it is exclusively small quadrupeds, and of these field mice are the favorites... Rabbits, tree squirrels, ground squirrels, lizards, snakes, and frogs are found on the menu of this bird." Craighead and Craighead (1969), "Meadow mice, small and medium-sized birds, and frogs."

B. Foraging areas

Craighead and Craighead (1969), "a pair of marsh hawks, observed from dawn to dusk, hunted almost entirely within a 40-acre field and made only an occasional swing away for a distance of less than one-half mile." Grinnell and Miller (1944), "But forages also over grasslands in general, from patches of salt-grass in desert sinks, and dry prairie, to mountain cienegas."

C. Foraging strategies

Craighead and Craighead (1969), "The male hunted on the wing, frequently landing to watch for mice. For a 35-minute period in the morning he

averaged one landing per minute; and in the afternoon he was observed to land 13 times in 12 minutes. Many flights were of longer duration; but not long in linear distance covered. This flight activity was duplicated by the female. Marsh hawk flights of a mile or more were made while they were flying from one daily hunting spot to another. Marsh hawks hunted by coursing for long periods without landing. They also hunted by alternately flying and landing, sometimes alighting an average of once per minute. In addition they hunted from ground perches, which they occupied for periods varying from one second to 75 minutes." Dawson (1923), "Since it flies at such a low elevation as neither to see nor be seen, over the limits of an entire field, it often moves in a huge zigzag course, quartering its territory like a hunting dog. Now and then the bird pauses and hovers to make a more careful examination of a suspect, or drops suddenly into the grass, seizing a mole or cricket and retiring to a convenient spot... In hunting for ground squirrels the bird flies higher and secures its prey by a headlong dash, pinning the victim to the ground and making sure of the kill before rising." Grossman and Hamlet (1964), "The harriers may be recognized by their flight - cruising only a few feet from the ground, with leisurely wing beats and swift glides. This systematic coursing or beating of the bush may flush a bird or startle a small mammal or reptile into revealing its presence. Then the harrier drops suddenly and seizes its prey." Pearson (1936), "Slowly and steadily with a gliding flight the harrier quarters back and forth across the fields with the care and precision of a well-trained pointer dog. Not a square yard is overlooked. Suddenly the forward flight is checked with almost a back somersault and as abruptly as though he had run into a wall; a short interval of hovering, then a descent that as often missed as captured the quarry below. When caught, the prey is devoured on the spot." Udvardy (1977), "Harriers... are specialized mousers in tall vegetation; their owl-like disk-shaped face mask directs the squeaks of field mice to their sensitive ears. They surprise small waterfowl or the young of other birds among the reeds."

D. Feeding phenology

Craighead and Craighead (1969), "concentrations of marsh hawks during winter indicate high densities of small rodents... meadow mice formed staple food... during the... winter. Field observations verified a diet high in meadow mice... These mammals continued to form the staple food of the marsh hawks during the periods of courtship and nest building before the spring vegetation furnished them protective cover. As cover increased the dwindling meadow mouse population became less vulnerable and frogs and small birds became major food items."

E. Energy requirements

Pearson (1936), "An average pair rearing young would destroy in the neighborhood of 1000 field mice during the nesting period." Brown and Amadon (1968), "Food requirements vary from 100 grams daily for 2 females (19% of body-weight) in cold weather to 43 grams (12% of body-weight) for a male in warm weather, the maximum daily intake by a female being 142

Circus cyaneus (con't)

grams in cold weather." Craighead and Craighead (1969) reported the food requirements for a male in the spring and summer as a maximum daily ration of 70 grams; the average weight of food eaten per day equal to 42 grams; the average weight of the raptor as 343 grams; the percent of the average body weight eaten per day was 12.1%; the average temperature during the feeding period was 69.6° F.; and the number of days fed as 17 days.

VI REPRODUCTION

A. Territorial behavior

Brown and Amadon (1968), "At most times it is likely to be aggressive towards other birds of prey, especially at the breeding site, and will drive off or attack birds very much larger and more formidable than itself (eagles, etc.). At the nest site some are very aggressive to man." Dawson (1923), "... marsh hawks are most zealous in defense of their nests. The male bird maintains a sharp lookout in spite of his venatorial duties, and the approach of a stranger is marked by uneasy cries... When the female is flushed, both birds will circle about with incessant protest, and will even dash at the head of the investigator... and a favorite enemy will be decried... a half mile from home." Grossman and Hamlet (1964), "... the marsh hawks of North America... change their behavior pattern from pair protection of territories in spring and summer to communal roosting in late fall and winter, radiating out each morning to their own individual food ranges and returning at night."

B. Courtship and mating behavior

Dawson (1923), "As the breeding season approaches, the male harrier... mounts aloft and performs some astonishing aerial evolutions for the delectation of his mate. He soars about at a great height, screaming like a falcon; or he suddenly lets go and comes tumbling out of space head over heels, only to pull up at a safe distance from the ground... He assists in nest-building, shares the duty of incubation, and is assiduous in providing for his brooding mate." Brown and Amadon (1968), "The male hunts and brings food to incubating female, who may also leave the nest and hunt - only the female incubates and the male visits the nest, especially when the female is hunting, but seems ill at ease. Bigamy and even polygamy occurs and has an adverse effect on breeding success. The female broods young, and occasionally the male attempts to. Males arrive at breeding grounds 5-10 days before females. They perform display flights. On arrival of the females, they perform these displays near hunting or perching (on ground) females. Later, pair performs mutual soaring. Coition occurs on the ground or on a perch, and prior to it, both sexes flap their wings and raise them. In the act, the female raises her tail and the male flaps his wings to retain position." Pearson (1936), "The courting maneuvers of the male above the female... sweeping in great semi-circles, gradually lessening in diameter, he stops suddenly on the top of a swoop, closes his wings, drops, turns head over tail, drops again, turns over and swings upward from the last somersault, just clear of the

Circus cyaneus (con't.)

ground, in another ecstatic performance. These wild movements are usually executed in a silence unbroken except for the sound of rushing wings."

C. Nesting phenology

Brown and Amadon (1968), "Earliest clutches at the southern fringe of the range are laid in late April; late April or the first half of May at about 50° - 60° north, and later, late May or early June in the arctic."

Craighead and Craighead (1969) noted the first selection of a nesting territory in 1942 was March 26 and in 1948 was March 29; the earliest laying date in 1942 was May 5 and in 1948 was April 26; the latest laying date in 1942 was May 20 and in 1948 was May 9; the average laying date in 1942 was May 13 and in 1948 was May 1; the earliest hatching date in 1942 was June 5 and in 1948 was May 31; and the latest hatching date in 1942 was June 26 and in 1948 was May 31. Also reported the average hatching date in 1942 as June 16 and in 1948 as May 31. In 1942 the earliest brood departure date was July 21; the latest brood departure date was July 27; the average brood departure date was July 24 and the breeding season span was 124 days. Dawson (1923), "Season: April 10 - May; one brood."

D. Length of incubation period

Brown and Amadon (1968), "varies from 29-39 days for the clutch, 29-30 days for the later eggs, which are incubated continuously (incubation begins the second, third, or fourth eggs and is by female only). In America it may be shorter, 23-24-31 days... and will continue up to 63 days with infertile eggs." Craighead and Craighead (1969) reported the span of the nesting period as 53 days and the average number of days in the nest as 31 days. Dawson (1923), "Incubation is accomplished in about 31 days, or if it has commenced with the laying of the first egg, as is often the case, then the last egg may not hatch for a week longer."

E. Length of nestling period

Craighead and Craighead (1969) noted the span of the nesting period as 53 days and the average number of days in the nest as 31 days.

F. Post-breeding behavior

Brown and Amadon (1968), "On leaving the nest the young remain in the vicinity for some time and are fed by the parents... Later they accompany their parents on hunting trips... It is not known when they become independent of their parents, but they probably remain loosely attached to them for some months, forming part of communal roosting groups on migration." Dawson (1923), "Not only are the marsh hawks wedded for life, but the male is very much devoted to his family. The young, after leaving the nest, hunt for several months with their parents." Pearson (1936), "In the spring, marsh hawks are seen always in pairs; but after the young are able to fly they generally hunt in family parties, and later in the season twenty to fifty individuals will flock together." Udvardy (1977), "After breeding, families gather together on ground roosts for the night."

VII POPULATION PARAMETERS

A. Clutch size

Brown and Amadon (1968), "Clutch sizes vary, four to six being normal, with five most frequent, and occasional clutches of up to eight or even twelve (all laid by one female)." Craighead and Craighead (1969) noted the average clutch was 4.6 and the maximum was 6. Pearson (1936), "Eggs: 2 to 9, but usually from 4 to 6."

B. Fledging success

Craighead and Craighead (1969) reported the nesting success from eggs laid as 16 fledglings in 1942 for 70% and in 1948 0 fledglings for 0%.

C. Mortality rates per age class

Brown and Amadon (1968), "Survivors dying each year up to the fifth year expressed as percentage of birds alive at beginning of the year: (Of 242 records in Europe and America) year #1 - 164 left for 67.7%; year #2 - 30 left for 38.5%; year #3 - 23 left for 47.9%; year #4 - 14 left for 56%; and year #5 - 3 left for 26.4%." Craighead and Craighead (1969) reported in 1942 the nestlings resulted in 18 hatched and 16 surviving... the average clutch was 4.6 for 2.3 young per pair of adults. In 1948 the average clutch was 4.3 with 100% survival of nestlings and 2.8 young produced per pair. Incomplete clutches and failure to lay eggs in 1942 was 19 for 45% and in 1948 was 21 for 39%; egg destruction and failure to hatch in 1942 was 5 for 22% and in 1948 was 33 for 100%; and the mortality in the nest after hatching in 1942 was 2 for 11% and in 1948 was 0 for 0%.

D. Longevity

Brown and Amadon (1968) reported out of 206 records in America, the number of birds found to be "x" number of years old: 143 = 1 year; 26 = 2 years; 19 = 3 years; 12 = 4 years; 2 = 5 years; 1 = 6 years; 1 = 7 years; 1 = 8 years; 1 = 10+ years... the greatest age was 18 years (1 record). "... from these data, one may conclude that, once mature, the hen harriers average life must be about seven years in the wild state, and they may live rarely up to sixteen years. Individual females are known to have bred for six or seven successive years."

E. Seasonal abundance

Grinnell and Miller (1944), "Common, even abundant (for a hawk) locally, when in migration. Also relatively small numbers occur through summer and breed, in a suitable territory."

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Craighead and Craighead (1969), "The marsh hawks could and did hunt the same fields as the buteos, but they tended to shift in response to hunting

Circus cyaneus (con't.)

pressure; that is, to move to a temporarily unhunted field, thus filling niches left by the buteos... Hunting grounds... vacated by the buteos for a field outside the strip, were filled by the more mobile marsh hawks. Where marsh hawks nested reasonably close together, range peripheries overlapped to some extent, forming mutual hunting grounds... the ranges of hawks of different genera overlapped. Nest sites were defended against hawks of different species, but ranges usually were not." Grossman and Hamlet (1964), "Ten species of harriers (Circus) are the diurnal counterparts of the short-eared owls (Asio), for they hunt the same marshes and dry open country the world over and may even share the same roosts on the ground."

IX STATUS

A. Past population trends

Dawson (1923), "Without question the past thirty years have shown a marked decrease in the abundance of this species in the west." Grinnell and Miller (1944), "... but such appropriate territory greatly reduced of late years, and summering population of marsh hawks diminished accordingly." Remsen (1977), "The decline already conspicuous by the 1940's... Wintering populations... There was a steady decrease from the early 1950's until about 1965 and then a slight increase through 1969 but still below 1953 levels. This species has declined greatly in California as a breeding bird, the decline already conspicuous by the 1940's... nesting localities are still scattered throughout the state, but numbers are much reduced, particularly in the southern coastal district... Numbers in the Santa Clara Valley have also diminished... wintering populations are much larger, but these have also declined. Reasons for the decline: destruction of marsh habitat is undoubtedly the major reason for the decline.

B. Potential for endangered status

Arbib (1976), "There is no evidence in the returns for 1976, that the harrier should be removed from the Blue List (indications of non-cyclical population declines or range contractions, either locally or widespread) ... In the middle Pacific, central southern, and western mountain regions, sentiment is strongly prolisting." Remsen (1977) reported the northern harrier (marsh hawk) is placed under second priority = populations are still on the decline, but populations are still sufficiently substantial that the danger is not immediate.

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AMERICAN KESTREL
Falco sparverius

I TAXONOMY

A. Type description

Linnaeus (1758) noted this form was described from a specimen from Carolina, America.

B. Current systematic treatments

Peters (1931) recognizes twenty-two races of the kestrel including sparverius of upper Yukon northwestern Mackenzie, southern Keewatin and Newfoundland south to northern California, Texas and northern Alabama and North Carolina. Winters from British Columbia, Colorado, Ohio, southern New England to Panama; phalaena of southern California, Arizona, New Mexico, west Texas south to lower California and northwestern Mexico; paulus of Alabama and Florida; peninsularis of lower California; tropicalis of Guatemala; sparveroides of Cuba; dominicensis of Hispaniola; loquaculus of Puerto Rico; caribearum of the Lesser Antilles and isabellinus, brevipennis, margaritensis, intermedius, ochraceus, perplexus, cauae, aequatorialis, distinctus, eidos, cearae, peruvianus, cinnamonus, and fernandensis all of South America.

AOU (1957) recognizes four North American races of the kestrel: F. s. sparverius of Canada, United States and north Mexico; F. s. paulus of Louisiana, Mississippi, Alabama, and Florida; F. s. peninsularis of lower California; and F. s. guadalupensis of Guadalupe Island, British Columbia.

Synonomies - Falco sparverius, Cerchneis sparverius, Tinnunculus sparverius, Tinnunculus sparveriodes, Falco sparverius deserticolus, Falco sparverius phalaena; little falcon, sparrow hawk, American sparrow hawk, desert sparrow hawk, Cuban sparrow hawk, western sparrow hawk, eastern sparrow hawk (Grinnell and Miller, 1944). Sparrow hawk, kestrel, killy hawk, windhover, grasshopper hawk, mouse hawk, rusty crowned falcon, short-winged hawk (Mallette and Gould, 1978).

C. Recent taxonomic revisions

Udvardy (1977) noted formerly known as "sparrow hawk", currently American kestrel.

II DESCRIPTION

A. External morphology of adults

Friedman (1950) reported sexes different in both immature and adult plumages; however adult and immature plumages similar for each sex. Adult male - forehead white; crown slate grey with central patch of brown; nape, scapulars, back, rump, tail coverts cinnamon; upper wing coverts slate; scapulars, upper back crossed by variable number of

Falco sparverius (con't.)

black bars. Tail hazel, broad subterminal black band; outermost rectrix white; black mustachial stripe; color variation enormous; underparts white to pinkish with black spots, sometimes immaculate. Adult female - head as in male, scapulars, back, rump, upper wing and tail coverts brown with black bars. Tail hazel crossed by a subterminal and ten narrower bands. Underparts with white to pale with tawny streaks on breast, sides, flanks; soft parts similar in male and female. Iris brown; bill, black; cere, orbits, tarsi, toes reddish-orange to yellow. Males smaller than females: adult male - wing 174-198 (183.1) mm; tail 116-142 (129.4) mm; tarsus 35-41 (38.2) mm. Adult female - wing 178-207 (195) mm; tail 119-142 (129.5) mm; and tarsus 34-42 (38) mm. Sample size = m - 64; f - 68. Beebe (1974) noted length as 250-305 mm and weight as 109 g for males and 114 g for females. Small, dove-sized falcon. Mallette and Gould (1978) reported smallest falcon was 8.5-12 in long and 20-24 in wing spread. Female larger than male. Adult male - blue wings, rusty back, blue crown with reddish center, black mustache, underparts white with black spots, tail rusty with band of black and white tip. Adult female - rust wing and back with black cross barring, underparts white with brown streaks, head like males, tail chestnut, narrow barring.

B. External morphology of subadult age classes

Mallette and Gould (1978) noted immatures - sexes dissimilar, but like those of adults. Friedman (1950) reported natal down white; juvenal males like adult males and juvenal females like adult females.

C. Distinguishing characteristics

Beebe (1974) noted poor light, in pursuit of prey, confused with merlin. Kestrel brightly colored, noisy and regularly hovers.

D. Special morphological features

Beebe (1974) reported kestrels differ from other falcons in the immediate color resemblance of the first year young to adults of same sex.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Peters (1931) reported breeds from Alaska, Canada, the United States to Mexico; winters to Panama.

B. California distribution of the species

Grinnell and Miller (1944) noted resident throughout most of California. At high altitudes and in northeastern plateau region, present in summer only.

Falco sparverius (con't.)

C. California desert distribution

Grinnell and Miller (1944) noted sparse in summer on southeastern deserts. Bond (1943) reported Colorado desert and Mojave desert region considered area hybridization between F. s. sparverius and F. s. peninsularis.

D. Seasonal variations in distribution

AOU (1957) noted summers in Alaska, Mackenzie, Manitoba, Ontario, Quebec, Nova Scotia to Baja California, northern Mexico, Texas and Georgia. Winters south of the United States and Canada border to Mexico and Central America. Grinnell and Miller (1944) reported breeding throughout state below timberline, below lower level of heavy snow in winter, also on Mohave and Colorado deserts in areas unoccupied at other seasons.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) noted breeds in life zones from lower Sonoran up to Hudsonian. Beebe (1974) reported it favors semi-open to completely open landscapes and has high tolerance to heat and extreme aridity. Requires trees in wilderness for nest holes. Nests in boxes and buildings in urban centers.

B. Altitudinal range

Grinnell and Miller (1944) noted altitudinally - 240 feet up to 13,000 feet (Siskiyou County).

C. Home range size

Average territory size is 129.6 hectares; daily range 1.5-2 miles. Range is a series of perches, some for hunting, others merely temporary stops (Craighead and Craighead, 1956). Balgooyen (1976) noted average area of 32 territories (home ranges) was 109.4 ha.

D. Territory requirements

Perch site - Typically open terrain such as plains, deserts, fields, meadows and unforested portions of mountains where perching places are present. Perching places may be dead-tipped trees, tree stubs, points of rocks, telephone or power poles, or fence posts (Grinnell and Miller, 1944).

Courtship and mating site - Bent (1937) reported coitus often takes place in braches of trees. Beebe (1974) reported flight displays by males, series of steep plunges and ascents above female perched in treetop.

Falco sparverius (con't.)

Nest site - Bent (1937), "makes no true stick nest nor does it use open ledges on cliffs; uses deep hollows, natural cavities, woodpecker holes in trees, woodpecker holes in cactus, holes in sandstone cliffs and clay banks. In southern California we found it nesting in cavities in sycamores, willows, and cottonwoods." Beebe (1974) reported nest in hole in stump, cutbank or bird box. Grinnell and Miller (1944) noted in holes in trees dug by woodpeckers or natural crevices in cliffs, earthbanks; also utilizes magpie nests.

E. Special habitat requirements

Balgooyen (1976) reported kestrels capture prey on or near the ground in short, open vegetation regardless of habitat type.

F. Seasonal changes in habitat requirements

Mills (1976) reported together in open habitat with groups of trees in summer. Winter males appear in denser vegetation and winter females in open vegetation.

V FOOD

A. Food preferences

Bent (1937) noted food includes insects, birds, mammals, reptiles, and amphibians. Where grasshoppers abound they are principle food. Birds are captured incidentally; during winter in northern latitudes this hawk's prey is birds and small mammals. Beebe (1974) reported this species is surprisingly versatile. Grasshoppers, kinglets, tree sparrows, redpolls are among their prey. They are capable of killing birds as large or larger than itself or it may be a post-sitting insectivore. Also earthworms, small reptiles, bats, mice and many birds.

B. Foraging areas

Mallette and Gould (1978) reported hunting from telephone pole, wire, post or while hovering.

C. Foraging strategies

Balgooyen (1976) noted kestrels adjust to prey availability and adapt the manner of search, the time spent hunting, and the area hunted, as pair formation and home range or territory is selected. Depending on her hunger, the female either eats item entirely or caches it in one of several predetermined sites. The primary advantage provided by caching prey is to assure constant input of energy to individual during inclement weather. A family of six kestrels exploits 1.6% by weight of prey in 109.4 hectares, the average-sized territory. Kestrels still-hunt from exposed perch by flying out a mean of 34 m and striking (97.2%). Kestrels hover when wind reaches speeds over 5 km/hr and then plummet

Falco sparverius (con't.)

directly onto prey (1.8%). Also hawking flights (1.0%) and foraging on ground (rare). Collopy (1973) reported 498 capture attempts were observed, 233 (46.8%) were successful. Of 233 199 (85.4%) were invertebrates and 34 (14.6%) were vertebrates.

D. Energy requirements

Balgooyen (1976) noted kestrels grow rapidly and require high input of energy. Eyas consume 2-4 g daily. By age 7-10 days they require as much as adult (25.5g/day). Adult male needs to supply 153 g of food per day for family of 4 (eyasses, his mate and himself). Because of high energy costs of flight, particularly when carrying prey, kestrels evolved efficient patterns of flight, reducing caloric demand, such as rising quickly into the wind and slipping with it, helicoid flight, and hovering. Small raptors require 25% of their body weight in food per day. Brown and Amadon (1968) reported their capacity to exist under conditions of heat and aridity related in part to their toleration of greatly elevated body temperatures and the fact that their carnivorous diet minimizes the importance of drinking.

VI REPRODUCTION

A. Age of first breeding

Bond (1943) noted kestrels may breed when less than one year old.

B. Territorial behavior

Balgooyen (1976) reported kestrels defend total area they occupy; the total home range. While males acquire and delineate the territorial boundaries, the females use areas outside territories and may be promiscuous.

C. Courtship and mating behavior

Bent (1937) noted commonly seen in pairs, often on windy treetops perched near together... male mounts high in air to fly rapidly in wide circles around where other is perched. Beebe (1974) reported flight displays by male, series of steep regular plunges and ascents above flying or perched female; very noisy at this time. Cade (1955) noted in southern California mating behavior begins in January. Copulations increase to as many as six in one half an hour and end with the last egg. Balgooyen (1976) reported aerial display, hunting together, various vocalizations, nest-site inspection, copulation, courtship feeding and annual philopatry are components of kestrel pair formation. Five copulations were observed in 10.5 minutes. Bent (1937) noted coitus, often takes place on branch of a tree and is a noisy, boisterous proceeding accompanied by a good deal of wing flapping by the male.

Falco sparverius (con't.)

D. Nesting phenology

Heintzelman and Nagy (1968) noted all eggs were deposited on alternate days (i.e. if egg laid on Monday then next egg was laid on Wednesday). Mallette and Gould (1978) reported eggs laid in mid-April to early May. Balgooyen (1976) noted copulation occurs two weeks before strong pairing, six to seven weeks before eggs. Copulation: mid-April to mid-June; egg laying: mid-May to late June; hatching: mid-June to late July; and fledging: mid-July to late August. Beebe (1974) reported as most birds of prey - male brings all food to female from prior-to-egg-production through ovulation and incubation. Both share incubation and feeding of young. Bent (1937) noted egg dates from 198 California records: March 2 to June 4 (99 records) and April 12 to May 3.

E. Length of incubation period

Bent (1937) reported incubation period was 29 and 30 days. Mallette and Gould (1978) noted incubation 28 to 31 days.

F. Length of nestling period

Balgooyen (1976) reported fledging 29-31 days after hatching. Mallette and Gould (1978) noted young fledge in $3\frac{1}{2}$ weeks.

G. Growth rates

Balgooyen (1976) reported young weigh 10-12 g at hatching; at 16-17 days young weigh same as adult, 110 g; by 21-25 days they weigh more. Weigh more than adults at fledging, then rapid weight loss occurs.

H. Post-breeding behavior

Balgooyen (1976) reported family flock persists into late September. Young leave area before adults and adults leave area separately supporting the contention that the pair bond dissolves at the end of the breeding season. Cade (1955) noted siblings form a social hunting group; several broods may band together after being driven off by their parents. In southern California most resident kestrels maintain permanent pair bond, occupying same area throughout the year. A few pairs leave territories after breeding in the fall; how far they move is not known.

VII POPULATION PARAMETERS

A. Clutch size

Bent (1937) noted kestrels ordinarily lay 4 or 5 eggs, occasionally 3, rarely 6 or 7. Beebe (1974) reported 3 to 7 eggs, white blotched with brown, 39 x 29 mm. Heintzelman and Nagy (1968) noted mean clutch size as 4.23 eggs and range was 3 to 4 eggs per clutch. Balgooyen (1976) reported during two years of study, mean clutch size was 4.0 eggs and $n = 42$ nests.

Falco sparverius (con't.)

B. Nesting success

Balgooyen (1976) reported only 3 of 150 (2.0%) eyasses failed to leave the nest and died. From 168 eggs, 42 clutches, 147 fledged (87.5%). Heintzelman and Nagy (1968) noted 78% of eggs hatched, sex ratio 1:1.

C. Mortality rates per age class

Roest (1957) reported the average annual mortality was 57% and the average life span was one year and three months. The oldest reported female was 5 years and 11 months.

D. Longevity

Bond (1943) noted 11 to 17% of young reach adulthood. Average life expectancy of kestrels reaching 1 year old is 8.3 to 12.5 more years.

E. Seasonal abundance

Mills (1976) reported winter habitat for males is denser vegetation. Winter habitat for females is open sparsely-vegetated habitats. Balgooyen (1976) noted the sex ratio of 1 male:1 female in the nest (spring). In summer and winter a skewed sex ratio: 65% males in Oregon; 38% males in southern California; and 29% males in San Benito County.

F. Habitat density figures

Nagy (1963) reported in a half square mile, usually 1 to 2 pairs and as many as 6 pairs in 1961. One pair per one-twelfth square mile. Mills (1976) gave densities in habitat as 16 birds/100 km in agricultural lands; 11 birds/100 km in deserts; and 9 birds/100 km in grasslands. Cade (1955) noted as many as 20 juvenals hunting over a single field of 200-300 acres.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Balgooyen (1976) shows evidence suggests squirrels invade and destroy kestrel nests. Roest (1957) reported kestrel remains in sharp-shinned hawk and Cooper's hawk stomachs. Man is the most serious enemy.

B. Competition

Kestrels are preoccupied with non-raptors, mainly cavity nesters, in early part of season; and with raptors, in latter part of season. They compete with flickers, sapsuckers, several other woodpeckers, starlings, screech owls, mountain bluebirds, chipmunks, and squirrels for nest sites (Balgooyen, 1976).

Falco sparverius (con't.)

C. Parasitism

Roest (1957) reported this species was parasitized by louse and black flies. Balgooyen (1976) noted Calliphorid flies in ears and nostrils, black flies in nests, young infested with ticks about the face and body. Milichiidae flies in every nest.

IX STATUS

A. Past population trends

Grinnell and Miller (1944) noted a considerable influx of birds from the north takes place in fall and winter; so lowland valleys in migration and winter to be rated as abundant. Generally common in summer but sparse then on southeastern deserts.

B. Present population status

Mallette and Gould (1978) reported survey results show it is the most common raptor in California. Robbins, Bruun and Zim (1966) noted the smallest and most common falcon in open and semi-open country.

C. Population limiting factors

Balgooyen (1976) reported factors limiting kestrel population include availability of hunting perches, food, nest sites and open-low vegetation in which to forage.

D. Environmental quality: adverse impacts

Brown and Amadon (1968) noted can exist in harshest desert, in suburban areas and even big cities, and virtually every other terrestrial habitat.

E. Potential for endangered status

No mention of endangerment - only abundance (ed.).

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CALIFORNIA QUAIL
Lophortyx californicus

I TAXONOMY

A. Type description of desert subspecies

Lophortyx californicus californicus, valley California quail: Tetrao californicus Shaw, Nat. Misc. 9, 1798, pl. 345 and text (California = Monterey) (Peters, 1934).

Synonomies- Callipepla californica vallicola Ridgeway, Lophortyx californica plumbea Grinnell, Lophortyx californica orecta Oberholser (Peters, 1934) and Ortyx californica, Perdix californica, Lophortyx californica vallicola (Grinnell and Miller, 1944); crested partridge, California partridge, California crested partridge, California valley quail, valley partridge, valley quail (Grinnell and Miller, 1944).

Lophortyx californicus canfieldae, Inyo California quail: Lophortyx californicus canfieldae van Rossem, 1939, Auk 56:68-69.

B. Current systematic treatment

Order Galliformes, family Phasianidae, subfamily Odontophorinae, genus Lophortyx Bonaparte, 1838, Geogr. and Comp. List, p. 42 (Peters, 1934).

The AOU checklist of North American birds (1957) recognizes eight subspecies of California quail: californicus, catalinensis, plumbea, achruster, canfieldae, orecta, decoloratus, brunnescens.

Grinnell and Miller (1944) reported on the mixing of subspecies due to planting and transplanting of quail stock to increase game. In this case californicus and plumbea were the subspecies involved and Grinnell and Miller (1944) concluded that "subspecific features of endemic populations are probably thereby being perverted."

C. Recent taxonomic revisions

The supplement to the AOU checklist of North American birds (1973 Auk 90: 411-419) indicates that there have been no revisions made in quail taxonomy since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

"Both sexes have... blackish crests that are enlarged... into a 'comma' or 'teardrop' shape... clear bluish gray to gray chests that become buffy toward the abdomen... The flanks are brownish gray with lighter shaft-streaks, and the upperparts are generally gray to brownish gray. Males have black throats... and are chocolate brown behind the plume, while the area in front of the eyes and above the bill is whitish"(Johnsgard, 1973).

Lophortyx californicus (con't.)

The females have dark brown rather than black crests and lack black throats (Johnsgard, 1973).

B. External morphology of subadult age classes

"Immatures have buff-tipped upper greater primary coverts which are carried for the first year... Juveniles resemble females but have forehead feathers with indistinct pale grayish terminal spots and have shorter and lighter crests" (Johnsgard, 1973; see also Sumner, 1935).

C. Distinguishing characteristics

Interspecific- "Males... may be distinguished from... the Gambel quail by the combination of a whitish rather than blackish forehead, no black abdomen patch, and dull brown rather than chestnut brown flank and crown coloration" (Johnsgard, 1973).

Intraspecific- The subspecies canfieldae is much paler and more slatey or bluish than californicus (van Rossem, 1939).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Lophortyx californicus californicus: "Subarid interior region of the western United States from Klamath Lake, Oregon, south into Lower California to about lat. 30° N" (Peters, 1934). Southern tip of Baja California to southern Vancouver Island with a coastal distribution "unbroken except for forested areas associated with the Coast and Olympic ranges" (Johnsgard, 1973).

Lophortyx californicus canfieldae: "Owens Valley north to Benton, Mono County, and eastward, scatteringly, in mountains of Inyo County to west side of Death Valley; specifically recorded from White, Inyo, Coso, Argus and Panamint Mountains" (Grinnell and Miller, 1944). Grinnell and Miller note that the boundary between canfieldae and californicus to the south has not been ascertained.

B. California distribution of the species

Lophortyx californicus californicus: "California below level of heavy winter snows, west of the deserts and main Sierra Nevada, and, north of Monterey Bay, interiorly from coastal fog belt" (Grinnell and Miller, 1944). Grinnell and Miller (1944) note that "the distributional picture is... confused by reason of the planting of quail stocks in new places and transplanting them from place to place within original range."

Lophortyx californicus canfieldae: Owens River Valley (Grinnell and Miller, 1944; Johnsgard, 1973).

C. California desert distribution

Lophortyx californicus californicus: "Formerly or sporadically to desert oases as far as Lone Willow and Leach Point Springs, northern San Bernardino

Lophortyx californicus (con't.)

County..., and down to Mohave River, at least back in the 1860's, to its sink, in middle San Bernardino County... Easternmost 'natural' edge of range..., southeastern flank of Santa Rosa Mountains, Riverside County, and vicinity of Jacumba, San Diego" (Grinnell and Miller, 1944).

Lophortyx californicus canfieldae: Owens River Valley (Grinnell and Miller, 1944; Johnsgard, 1973).

D. Seasonal variations in distribution

California quail are year-round residents (Grinnell and Miller, 1944).

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) report that the California quail characteristically inhabits the Upper Sonoran life zone and "extends marginally down into Lower Sonoran and up into Transition." Wauer (1964) concurred and characterized the vegetation of the upper canyons of the Lower Sonoran as an association of greenmolly (Kochia americana), rabbitbush (Chrysothamnus nauseosus) and Senecio douglasii.

B. Altitudinal range

Lophortyx californicus californicus "ranges from near sea level, as at Santa Barbara, up as high as 8500 feet on Mount Pinos, Ventura County" (Grinnell and Miller, 1944). Lophortyx californicus canfieldae "ranges... from 3500 feet up to 8400 feet" (Grinnell and Miller, 1944).

C. Home range

Summer (1935) reported that "the territory covered daily by a flock of quail is often less than 200 feet in diameter" although the "total year-round range of many of its individual members may be fairly extensive", covering more than two miles, due to the breaking up of the covey and dispersal of pairs during the breeding season. Emlen (1939) found that winter coveys of 21 to 46 birds ranged over an area of 17 to 45 acres. The range of breeding pairs in the summer was generally smaller, varying between 12 and 25 acres while in the egg laying phase and between 3 and 10 acres during incubation and early brood rearing.

D. Territory requirements

Perch site- Summer (1935) found that "the preferred type of roosting cover is furnished by a... variety of trees having characteristically dense foliage" and the height above the ground seemed "to be determined... by the location of the densest shelter in the tree concerned." The heights observed were 11 to 12 feet for live oaks, up to 35 feet for laurels, and most commonly 20 to 25 feet. Summer also commented that "in the arid parts of Southern California, ... the birds are obliged to use the low, open brush", perching only a few

Lophortyx californicus (con't.)

inches to 2 to 3 feet above the ground. This roosting situation led to increased horned owl predation (Sumner, 1935).

Nest site- Sumner (1935) found all nests "in slight depressions beneath but at the edge of clumps of overhanging brush."

Courtship and mating sites- Courtship and mating were reported to take place anywhere (Sumner, 1935).

E. Special habitat requirements

"Quail... require an interspersion of food and cover, and spend most of their lives along the edges between these two types of environment" (Sumner, 1935).

"The need for brushy habitat by the California quail is largely a reflection of its protective cover requirements, while most of its food sources come from herbaceous forbs, particularly legumes" (Johnsgard, 1973).

Lophortyx californicus californicus: these quail inhabit "broken brushland; low vegetative cover of 'interspersed' character, as where chaparral, to meet the safety-refuge requirement, adjoins weedy ground or grassland affording forage. Additional needed features... are presence of stiff-twigged, dense foliated trees for night roosting, and, in the dry season, fresh water within distance reachable in the daily cruising of the quail" (Grinnell and Miller, 1944).

Lophortyx californicus canfieldae: this quail subspecies is found in "riparian and spring-side brush, primarily composed of willows" (Grinnell and Miller, 1944).

F. Seasonal changes in habitat requirements

The California quail is a year-round resident and shows little seasonal change in location (Sumner, 1935; Emlen, 1939).

G. Physiological ecology

The California quail is very tolerant of high ambient temperatures, surviving increases in body temperature to levels of 44° C and exhibiting relatively small increments in body temperature for each degree centigrade increase in ambient temperature (Hudson and Brush, 1964). The quail also seems to be well adapted to arid areas by virtue of its water requirements. Brush (1965) commented that "the use of gular flutter and panting plus the low minimal water requirements, ability to utilize moderately saline waters, and high tolerance for dehydration extend the usefulness of the evaporative pathway for heat dissipation" and that the "unfeathered portions of the legs provide an important accessory pathway for heat dissipation" (see also McNabb, 1969 and Carey and Morton, 1971).

V FOOD

A. Preferences

Edminster (1954) reported that California quail consumed primarily legumes (25-35%), annual weeds (20-60%), grasses (10-25%), leaves and fruits of

Lophortyx californicus (con't.)

woody plants (3-5%). The exact species consumed varies with the exact location of the study. Sumner (1935) found the following species to be of primary significance on a yearly basis: bur clover (Medicago hispida, 14.5%), cultivated barley (Hordeum vulgare, 13.4%), red-stem filaree (Erodium cicutarium, 6.9%), feather acacia (Acacia decurrens, 5.3%), rye grass (Lolium multiflorum, 4.9%), brome grass (Bromus hordeaceus, 4.8%), Lupine (Lupinus sp., 6.9%), and buttercup (Ranunculus californicus, 4.1%). Sumner estimates that a total of 140 species of plant are known to be consumed to some degree. In addition to these species, Edminster mentioned the importance of deer-vetches (Lotus sp.), clover (Trifolium), vetches (Vicia) and turkey mullein (Eremocarpus). (See also Shields and Duncan, 1966 and Leopold et al, 1976).

Beal (1910) investigated 619 quail stomachs over the course of a year in California and discovered the following diet distribution. Only 3% of the food consumed was animal matter, and this food was found almost exclusively in the stomachs of broodlings. Ants, beetles, caterpillars and Hemiptera were represented. The quail consumed 97% of their yearly diet as vegetable matter. Seeds accounted for 62.5% of the total food and represented 73 different species including burthistle, lupine, bur clover, turkey mullein, pigweed, sumac, clover. Grass provided 25% of the yearly food, mostly in the period from January to April. Grain accounted for 6.4% of the total food consumed and included corn, wheat, oats, barley and rye. Fruit made up only 2.3% of the diet and included grape, prune, apple, blackberry, elderberry, and huckleberry.

"The food of the young quail differs from that of the adult by reason of its higher animal content" and because "the individual items are of smaller size" (Sumner, 1935). Young aged 6 to 7 days consumed 34.5% animal food and 50.0% rye seeds (Lolium multiflorum) which are smaller seeds than most of those consumed by the adults.

B. Foraging areas

Lophortyx californicus californicus utilizes weedy ground or grassland adjoining brushy protective areas (Grinnell and Miller, 1944). Sumner (1935) observed that "food must be present in adequate quantity within about fifty feet of cover" which is "well interspersed" with food plants and which includes "trees or dense bushes for roosting."

Lophortyx californicus canfieldae feeds in sage-brush land adjoining riparian and spring-side brush (Grinnell and Miller, 1944).

C. Foraging strategies

"Feeding is carried on with some vigor in the early morning and then intermittently until about 4 p.m. After this hour it increases and reaches a climax of last-minute gorging just before the birds fly up to roost" (Sumner, 1935).

D. Feeding phenology

Shields and Duncan (1966) found that in general, legume seeds contributed 60% by volume of the fall winter food intake, reaching 80% in some winter

Lophortyx californicus (con't.)

periods. The major species consumed were Lotus, Lupinus and Trifolium. The amount of leaves consumed increased from 6% of the food volume in November to 41% in January with leaves of forbs, clover and grasses all being utilized.

Leopold et al (1976) found contrasting results: seed consumption was greatest in summer (90% and 91%) and varied considerably between the 2 springs (83% and 43%) and winters (73% and 27%) studied. They concluded that low rainfall in the first winter accounted for the high incidence of seed useage in the first winter and spring periods. With greater rainfall leaves of forbs, grasses and clover contribute more to winter and spring diets.

In an early study, Summer (1935) documented food preferences throughout the year. He found that the most common species consumed tended to show peak useages in different months: January (Lupinus formosus, 17.5%; Ranunculus californicus, 31.4%), February (Hordeum vulgare, 53.6%), March (Acacia decurrens, 37.5%), April and May (unidentified species, 46.0%), June and July (Lolium multiflorum, 19.8%; Madia sativa, 12.7%), October (Bromus hordeaceus, 14.3%; Erodium cicutarium, 14.0%), November (Medicago hispida, 43.7%), December (Lupinus varicolor, 15.4%). In general, Summer found that the quail ate green leaf material primarily in the period from November through May and that seeds were most important in June through October.

E. Energy requirements

Summer (1935) reported that an average of 24g of food were consumed each day, representing 14.3% of body weight. Hourly energy expenditures in the thermoneutral zone for quail (27° - 37° C, Brush, 1965) range from 5.6 watts/kg (Brush, 1965) to 7.1 watts/kg (Snapp et al, 1977). Below 27° C, energy expenditure increases linearly at the rate of 0.381 watts/kg·° C (Brush, 1965), reaching approximately 13.0 watts/kg at an ambient temperature of 10° C (Brush, 1965; Snapp et al, 1977).

VI REPRODUCTION

A. Age of first breeding

Summer (1935) commented that one year old birds breed "just as freely as do the older birds." Anthony (1970) also implied that breeding occurred at the age of one year.

B. Territorial behavior

Genelley (1955) reported that "the available evidence suggests that California quail... do not actively defend a nest site" (see also Summer, 1935; Emlen, 1939; Johnsgard, 1973). Emlen (1939) and Genelley (1955) both observed "crowing territories" which are held by unmated males in the vicinity of the nest of a mated pair. Genelley (1955) found that these territories tended to be inhabited by older males (n = 12/20) and that yearling males were usually nomadic. He concluded that such territories functioned primarily in determining replacement mates; in the event of the death of a mated male, unmated males holding crowing territories tend to mate with the available female.

C. Courtship and mating behavior

Sumner (1935) described the gradual formation of the pair bond as a tendency on the part of each male "to attach himself to a particular female which he follows about, while constantly endeavoring to drive away any other male which comes near." He described the increasing intermale aggression that accompanied the break-up of the covey in the spring and the increasing frequency of assembly calling to attract females. These behaviors are also documented by Emlen (1939), Genelley (1955), and Johnsgard (1973) among others.

Sumner (1935) went on to observe that "when the fighting and courting is largely over, the two birds of a pair remain closely associated" and that copulation may occur anywhere.

D. Nesting phenology

In general, pair formation begins in March; egg laying occurs from mid-April through May (Alameda County, CA) or mid-July (southeastern Washington); broods may be found from mid-May to mid-September (southeastern Washington) or June through mid-July (Alameda County) (Alameda County data from Lewin, 1963; southeastern Washington data from Anthony, 1970). Family groups can be found soon after hatching and coveys form up in September, lasting until March (Sumner, 1935; Emlen, 1939; Lewin, 1963). Sumner (1935) mentioned the following egg dates for California: April 18 to June 27, mean for 21 nests = June 9. Sumner found that young broods could be observed from May 11 to July 19 (mean, July 2).

E. Length of incubation period

Incubation has been reported to require 22 days (n = 5 nests, Glading, 1938) or 23 days (Grinnell et al, 1918; Johnsgard, 1973).

F. Length of nestling period

Young are precocial (ed.).

G. Growth rates

Genelley (1955) reported that "young quail gain weight at approximately 2 grams per day until three months of age. All first year and adult quail attain (yearly) peak weight in midwinter." Sumner's (1935) data indicated an average weight gain of 1.6g per day for the first 78 days. Lewin (1963) recorded a peak weight of 160g, attained at 120 days, compared to an observed mean adult weight of 190g (n = 550, Sumner, 1935).

H. Post-breeding behavior

Sumner (1935) recorded the following observations on group formations. The first stage occurred after hatching of young "at which time they and their parents form a compact social unit... about the last week in July...

Lophortyx californicus (con't.)

neighboring family groups... merge", and full-sized coveys are visible by mid-September.

Emlen (1939) confirmed this basic pattern, adding that covey formation occurred in association with an increase in foraging range during the brood-rearing season. Emlen also observed aggression between winter coveys, implying that a "social barrier" exists between these non-breeding season groups.

In years with poor forb crops and low reproductive effort, pair bonds may dissolve early in the season and covey formation occurs as soon as May and early June (Francis, 1970).

VII POPULATION PARAMETERS

A. Clutch size

Clutch size has been reported as 10.97 eggs (n = 40 nests, Glading, 1938), 13.7 eggs (Lewin, 1963), and 14.2 eggs (Grinnell et al, 1918).

Johnsgard (1973) considered that the question of the frequency of second broods has not been resolved. Second broods have been inferred from observations of lone males with broods (McMillan, 1964; Anthony, 1970) and have been observed once in the wild (McLean, 1930) and twice in captivity (Francis, 1965). Summer (1935) found no evidence to support the existence of double brooding by a given pair.

B. Breeding success

Breeding success varies greatly, usually being high after years with substantial winter rainfall and abundant forb crops (McMillan, 1964; Francis, 1970; Leopold et al, 1976). Raitt and Genelley (1964) also correlated high production with a minimum of fog and rain during the breeding season in Alameda County, California. Francis (1970) developed a population model for California quail to explain young/adult ratios observed in San Luis Obispo County over a 14 year period. He found that quail productivity was primarily a function of 3 variables, in decreasing order of importance: 1) soil moisture in late April, 2) proportion of breeding females over 1 year old, and 3) seasonal rainfall from September to April.

Breeding success is usually inferred from fall juvenile:adult age ratios. The following values have been observed: 2.45 to 4.27 young per adult (4 years on Vancouver Island, Barclay and Bergerud, 1975), 0.57 to 2.22 young per adult (7 years in Berkeley, Raitt and Genelley, 1964), 0.06 to 4.0 young per adult (in San Luis Obispo, McMillan, 1964), 0.25 to 3.25 young per adult (2 years in San Luis Obispo County, Leopold et al, 1976), 0.1 to 4.4 young per adult (14 years in San Luis Obispo County, Francis, 1970).

C. Age-specific mortality

Barclay and Bergerud (1975) considered that "population trends... appeared to be largely a result of differential recruitment of chicks rather than

Lophortyx californicus (con't.)

compensatory mortality of adults." Therefore, the mortality should show an even percent loss in all age classes except newly reared young. Mortality of young was estimated to be approximately 57% by Sumner (1935), but almost 79% by Raitt and Genelley (1964) and only 12.1% by Anthony (1970, for Vancouver Island). Mortality for the first year has been reported as 73% (Sumner, 1935), 91.5% (Emlen, 1940), 73% (Raitt and Genelley, 1964). Mortality during the second year was essentially the same - 73% (estimate, Sumner, 1935), 75% (Raitt and Genelley, 1964) - but dropped slightly in the third year (67%, Raitt and Genelley, 1964) with few birds surviving a fourth year. Average annual mortality has been given as 54 - 79% (Emlen, 1940) and 71.4% (Raitt and Genelley, 1964).

Males and females appear to be subjected to different mortality rates during their first year. Juvenile sex ratios show unity (Anthony, 1970; Emlen, 1940) but breeding sex ratios are skewed in favor of males: 114 males:100 females (Sumner, 1935), 127 and 136 males:100 females (Emlen, 1940), 133 males:100 females (Lewin, 1963), and 120 males:100 females (Anthony, 1970, on Vancouver Island).

D. Longevity

California quail probably rarely live longer than 4 years (Sumner, 1935; Raitt and Genelley, 1964). Sumner (1935) estimated the average life span to be 8 months.

E. Seasonal abundance

Considerable mortality of juveniles occurs during the first winter. Emlen (1940) found that approximately 50% of the years offspring perished between fall and spring. Likewise Barclay and Bergerud (1975) found that winter mortality was higher than summer mortality on Vancouver Island: 62% and 55% vs 33% and 36% respectively for two years of study.

F. Habitat density figures

Densities of quail in winter have been reported as 1 bird per acre (Emlen, 1939; Raitt and Genelley, 1964), 0.26 to 0.59 birds per acre (Glading, 1941), and 1.1 birds per acre (Sumner, 1935). Sumner (1935) reported a summer density figure of 3.9 birds per acre.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Sumner (1935) reported that Cooper and sharp-shinned hawks are "the most destructive of all enemies of quail" although the damage to the population was not serious where there is plenty of food and cover. Lack of adequate roosting sites was also blamed for high losses to horned owls in arid portions of the range, notably western Riverside County (Sumner, 1935). Sumner also implicated gopher snakes, king snakes, milk snakes and rattlesnakes as potential predators. In the foothills of the Sierra Nevada,

Lophortyx californicus (con't.)

Beechey ground squirrels have been observed destroying a large number of nests; house cats, coyotes, skunks, bobcats and California jays were also occasional predators in this area (Glading, 1938).

B. Competition

no information located- The congeneric species Lophortyx gambelii is adapted to a more arid habitat and rarely occurs in the same area as L. californicus (ed.).

C. Parasitism

Little information located. California quail are not susceptible to at least some poultry respiratory diseases (infectious laryngotracheitis virus, Mycoplasma gallisepticum) and are only slightly affected by infectious brochitis virus (Allred et al, 1973). The blood parasite, Haemoproteus, has been observed in the quail (O'Roke, 1928).

IX STATUS

A. Population trends

Grinnell and Miller (1944) characterized the California quail as being "common to abundant in favorable territory where not 'shot out'" and marginally present in areas approaching altitudinal and desert limits. They concluded however that the "trend of aggregate population numbers in the past 35 years" has been "definitely downward".

B. Population limiting factors

Leopold et al (1976) reported on the suppression of reproduction by the presence of phytoestrogens in the foliage of annual plants. They found that high levels of formononetin and genistenin correlated with poor forb cover and low reproduction. They concluded that "the presence or absence of phytoestrogens... may be one of the mechanisms that coordinates quail reproduction with the prospective available food resource."

C. Environmental quality

Sumner (1935) concluded that "the chief causes for the decrease of California quail (are)... 1) over hunting, 2) destruction of food and cover by: a. clean farming (absence of cover); b. overgrazing (absence of food and cover); c. fire control (absence of food and cover), and 3) exclusive use by man of water sources."

D. Potential for endangered status

Emlen (1940) suggested that "in localities where high age ratios indicate low annual survival and high annual replacement, attention... should be directed to the winter environment. In the reverse situation summer factors should receive primary attention."

Lophortyx californicus (con't.)

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GAMBEL'S QUAIL
Lophortyx gambelii

I TAXONOMY

A. Type description

Lophortyx gambelii gambelii, southern Gambel quail; Lophortyx gambelii "Nutt." Gambel, Proc. Acad. Nat. Sci. Phila., 1843, p.260 ["some distance west (i.e., east) of California: = southern Nevada, fide AOU committee 1910"].

Synonomies- Callipepla venusta, Callipepla gambeli, Lophortyx gambelii, Callipepla gambeli deserticola, Lophortyx gambeli deserticola; southern Gambel quail, Gambel partridge, Gambel quail, desert partridge, desert quail (Grinnell and Miller, 1944).

B. Current systematic treatments

Order Galliformes, family Phasianidae, subfamily Odontophorinae, genus Lophortyx Bonaparte, 1838, Geogr. Comp. List, p. 42 (Peters, 1934).

The AOU checklist of North American birds (5th edition, 1957) recognizes seven subspecies of Gambel quail: gambelii, fulvipectus, pembertonii, sana, ignoscens, stephensi, friedmanni.

Johnsgard (1973) commented that "the Gambel and California quail are close species. The ecological differences between the two species prevent extensive sympatry, but where limited contact does occur hybridization has been found." Grinnell and Miller (1944) reported the presence of L. gambelii - L. californicus hybrids along the western edge of the L. gambelii range in California.

C. Recent taxonomic revisions

The supplement to the AOU checklist of North American birds (1973, Auk 90: 411-419) indicates that there have been no changes made in quail taxonomy since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External adult morphology

Johnsgard (1973) provided the following salient features of adult morphology: "teardrop" crests; unscaled underparts; rich reddish brown flanks; grayish brown to brown on upperparts; males - buffy underparts; black area on abdomen, black throat pattern, reddish crown color; females - dark brown crest.

B. External morphology of subadult age classes

Johnsgard (1973) described immatures as having buff-tipped greater upper primary coverts. The juveniles resemble females and juvenile California quail except that "nape feathers lack dusky borders and are uniformly gray".

Lophortyx gambelii (con't.)

C. Distinguishing characteristics

Interspecific- The Gambel quail lacks the scaly patterns typical of the underparts of California quail, and there is more rufescent brown flank coloration than in California quail (Johnsgard, 1973).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

The Gambel quail is found "from southern Nevada, southern Utah, and western Colorado south to northeastern Baja California, central Sonora, northwestern Chihuahua, and western Texas" (Johnsgard, 1973). The gambelii subspecies is "resident from southern Utah and southern Nevada south to the Colorado and Mojave deserts, northeastern Baja California, and introduced in north central Idaho" (Johnsgard, 1973; see also Peters, 1934).

Gullion (1960) considered that "the distribution is apparently more nearly continuous toward the center of this species' range than it is in the peripheral areas such as California, Nevada, New Mexico, Utah and Colorado" (i.e., continuous distribution is found in Arizona and Sonora).

B. California and California desert distribution

Grinnell and Miller (1944) provided the following detailed description of the California distribution: "in general, Colorado and Mojave Deserts. North... from Mexican border in Imperial Valley to... Needles, San Bernardino County; west... from Colorado River to Coyote Wells, Imperial County, and Borego Valley, northeastern San Diego County; northwest through Salton Sea region as far as Whitewater, Cabezón, and even Banning, Riverside County; on Mojave Desert, west to Mojave River, ... and north as far as the valley of Armagosa 'River', Inyo County."

Gambel's quail occurs in Death Valley (Wauer, 1962).

C. Seasonal variations in distribution

The Gambel quail are year-round residents (Grinnell and Miller, 1944).

IV HABITAT

A. Biotopic affinity

Grinnell and Miller (1944) described the biotopic affinity as exclusively Lower Sonoran. Gullion (1960) described two types of habitats frequented by the quail. The valley habitats were characterized as thorn shrub, saltbush, and desert riparian types with vegetation such as Pluchea sericea, Prosopis spp., Tamarix pentandra, Phragmites communis, Baccharis glutinosa and Atriplex spp. The hill habitats were described as bur-sage, blackbrush, desert grassland, desert shrub, and browse shrub types. Gullion (1960) observed Gambel quail in desert shrub habitats in the Providence Mountains and characterized the vegetation as a variable combination of microphyllous shrubs such as

Lophortyx gambelii (con't.)

Acacia, Lycium, Salvia, Larrea, Erigonum and also noted the presence of Opuntia and/or Yucca.

B. Altitudinal range

Gullion (1960) considered that "the local plant environment and climate rather than altitude governs the permanent occupancy of a given habitat." He found maximum altitudes of normal occurrence that varied from 4000 feet in Utah to 5400 feet in California. Within California, altitudes of occurrence range from -200 feet near Mecca, Riverside County, to +5400 feet near Granite Well, Providence Mountains, San Bernardino County (Grinnell and Miller, 1944).

C. Home range size

In Nevada, Gullion (1962) found that winter coveys averaging 12.5 quail covered ranges averaging 35.7 acres (range, 19-95 acres; 0.33 birds per acre). In Arizona, Hensley (1954) found that breeding ranges varied from 1.7 to 4.5 acres (mean, 3.4 acres) on one site to 3.2 to 3.8 acres (mean, 3.1 acres) on another site. Therefore, the average breeding home range size is 3.25 acres per pair or 0.62 birds per acre.

D. Territory requirements

Nest site- The primary requirement is a source of shade from the midday sun which is provided by desert shrubs or trees. Interspersed foraging sites and escape cover is important for brood rearing (Bent, 1932).

Neff (1941) reported an unusual nesting site for Gambel quail: 7 to 20 feet high in trees such as tamarisk and orchard trees.

Perch site- No information located. Probably similar to California quail (ed.).

E. Special habitat requirements

Raitt and Ohmart (1966) characterized the New Mexican habitat as being one of "restricted riparian 'bosques' dominated by tall mesquite (Prosopis juliflora), turnillo (P. pubescens), and introduced tamarisk (Tamarix pentandra), with shrubs in openings and at edges including mesquite, chamiso (Atriplex canescens), arrowweed (Pluchea sericea), wolfberry (Lycium sp.), Rhus trilobata, and jimmyweed (Haplopappus heterophyllus)" (see also Grinnell and Miller, 1944; Gullion, 1960). Gullion (1960) and Raitt and Ohmart (1966) both noted that Gambel quail occupy stringers of favorable habitat that accompany irrigation ditches.

The question of reliance on standing water is not entirely resolved. Grinnell and Miller (1944) stated that quail occupy areas within reach of water for daily use. Gullion (1960) observed that where streams were present "a combination of high humidity and fleshy plants provides the moisture needed for the survival of the species" and that in these areas quail need never drink. However, in extremely hot weather (38° C or more) when succulent vegetation has withered, particularly in desert upland habitats, access to water must be available (Gullion, 1960). In

Lophortyx gambelii (con't.)

addition, Smyth and Coulombe (1971) reported seeing Gambel quail drinking regularly at desert springs in Riverside County, California.

F. Seasonal changes in habitat

Gambel quail are year-round residents (ed.).

G. Physiological ecology

McNabb (1969) and Carey and Morton (1971) found that Gambel quail will tolerate saline drinking water up to 2.25% NaCl and 62.5% sea water respectively. This level is greater than that tolerated by L. californicus and was accompanied by stable plasma osmotic pressures, the excretion of concentrated urine and the stable maintenance of body weight. L. californicus was less efficient in all these processes and in addition showed a behavioral difference in response to heat stress: L. californicus increased activity in the presence of high ambient temperatures, whereas L. gambelii tended to decrease activity (Carey and Morton, 1971). The physiological differences between these two species may explain in part their separate distributions, although it does not explain why Gambel quail does not occur in less arid regions.

Gambel quail are well-suited for desert life in their ability to tolerate high ambient temperatures. Henderson (1971) reported that Gambel quail could withstand environmental temperatures as high as 40° C without ill effect, dissipating all of their metabolic heat. The quail can tolerate brief exposure to 45° C, and do not begin to use gular flutter noticeably until ambient temperature reaches 43° C.

V FOOD

A. Preferences

In the desert scrub the following plants provide important seed crops and determine the abundance or scarcity of Gambel quail in Nevada: Lotus, Lupinus sp., Erodium cicutarium, Astragalus nuttallianus (Gullion, 1960).

Similar plants are important in Arizona deserts: Lotus, Lupinus sp., Mimosa sp., Prosopis sp., and Erodium (Hungerford, 1962). Here the quail utilize leaves, flowers, and seeds. Annual percentages are as follows: forb seeds (43.5%), shrub seeds (14.2%), grass seeds (3.0%), succulent shrubs (17.6%), succulent forbs (10.7%), unknown green plants (5.4%), animal food (4.8%) (Hungerford, 1962).

B. Foraging areas

Foraging areas are similar to those of California quail in being interspersed with shrubs needed for protective cover (Johnsgard, 1973).

C. Foraging strategies

no information located- Probably similar to California quail (ed.).

Lophortyx gambelii (con't.)

D. Feeding phenology

Hungerford (1962) analyzed food consumption throughout the year in Arizona. He found that the ratio of dry:succulent foods utilized assumed the following pattern: spring (50:50), summer (58:42), fall (69:31), winter (67:33). The percent useages of each food type from spring through winter were: forbs (56%, 46.2%, 69.8%, 44.7%), shrubs and trees (37.1%, 30.0%, 18.2%, 42.1%), unidentified leaves and buds (5.5%, 5.4%, 6.4%, 4.1%), grasses (0.4%, 2.0%, 1.9%, 7.6%), and animals (mostly insects, 0.9%, 15.5%, 1.7%, 1.1%) (Hungerford, 1962).

E. Energy requirements

no information located- Probably similar to California quail (ed.).

VI REPRODUCTION

In general, social behaviors are similar to those observed in Lophortyx californicus (Raitt and Ohmart, 1966).

A. Age of first breeding

no information located- If L. gambelii is like L. californicus, birds will breed in their first year (ed.).

B. Territorial behavior

There is no defended territory, although male-male aggression increases during pairing and leads to the dissolution of the winter covey (Raitt and Ohmart, 1966). Unmated males call throughout the breeding season, and mated males, although quiet, are very intolerant of other males. As the young approach adult size, aggression decreases, and new coveys form (Raitt and Ohmart, 1966).

C. Courtship and mating behavior

"The process of pair formation is a subtle one, which apparently occurs over a prolonged period of contact" (Johnsgard, 1973), resulting in a strongly monogamous pair bond.

D. Nesting phenology

The duration of the hatching season varied from 81 to 128 days during a two-year period (Raitt and Ohmart, 1966). The nesting season of L. gambelii differs from that of L. californicus in being almost one month longer for L. gambelii. This extended breeding season is due to the occurrence of summer rains in the area of New Mexico studied by Raitt and Ohmart (1966).

E. Length of incubation period

The incubation period is reported as being 21 to 23 days in length (Johnsgard, 1973).

Lophortyx gambelii (con't.)

F. Length of nestling period

Young are precocious (ed.).

G. Growth rate

Growth is similar to that of other quail species with full size being reached by about 120 days (Raitt and Ohmart, 1966).

H. Post-breeding behavior

As the young increase in size, foraging area increases and coveys begin to form for the winter (Raitt and Ohmart, 1966).

VII POPULATION PARAMETERS

A. Clutch size

Gorsuch (1934) reported that the typical clutch size of 44 nests was 12-14 eggs. There is probably only time to raise one complete brood unless the male takes over the first brood leaving the female free to start a second one (Johnsgard, 1973). No direct evidence indicates that this occurs.

B. Nesting success

Gullion (1960) recorded fall young:adult ratios for 7 years in Nevada. He found that annual production varied from 0 young per 100 adults to 632 young per 100 adults. The wide variability is loosely correlated with the amount of winter rainfall which varied from 0.66 inches to 7.09 inches (Gullion, 1960).

C. Mortality rates per age class

No information located, but these rates are probably similar to those of L. californicus (about 70% for all age classes of adults) (ed.).

D. Longevity

No information located, but longevity is probably similar to that of L. californicus (average, 8 months, rarely longer than 4 years) (ed.).

E. Seasonal abundance

No information located, but these figures would depend greatly on chick recruitment each year, which is related to winter rainfall (see Nesting success, above) (ed.).

F. Habitat density figures

Emlen (1974) reported a density of 0.3 birds per 100 acres near Tucson, Arizona, but Johnsgard (1973) found levels as high as 20 male quail per 100 acres in the Arizona breeding season which presumably indicates the presence of 1 pair per 5 acres or 0.4 birds per acre. Hensley (1954)

Lophortyx gambelii (con't.)

found a figure between Johnsgard and Emlen: 6 breeding pairs per 100 acres. This indicates a wide variation in density values just within Arizona: 0.003 birds to 0.4 birds per acre. Hensley (1954) found a value of 0.06 birds per acre for a Colorado desert area during the breeding season, and Gullion (1960) found a winter density of 0.34 birds per acre in Nevada.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

no information located- Probably similar to California quail L. californicus (eg., Cooper and sharp-shinned hawks, snakes, horned owls) (ed.).

B. Competition

no information located- Does not usually overlap with L. californicus (ed.).

C. Parasitism

Quail malaria (Haemoproteus lophortyx) is present in populations to varying degrees (Gullion, 1957), and Hungerford (1955) found an infestation rate of 94% in his three study areas. The latter study could find no correlation between degree of infection and survival, and the conclusion of both studies is that this disease is usually not a serious source of mortality, although it is a potentially decimating factor.

Gullion (1957) also found the following parasites in Gambel quail: cestodes (Rhabdometra sp.), nematodes (Subulura sp., Aulonocephalus lindquisti), biting lice (Mallophaga), louse flies (Hippoboscidae), and ticks (Argus persicus, Ixodes sp.). None of these parasites are deemed serious, except possibly the Hippoboscid louse fly Stilbometopa impressa which is the vector for Haemoproteus.

IX STATUS

A. Population trends

Grinnell and Miller (1944) observed that the extension of available water, as through irrigation, has enlarged the area inhabited by L. gambelii, especially in the Imperial Valley.

The Seventy-seventh Audubon Christmas bird count (1977, Amer. Birds 31: 391-918) recorded Gambel quail on 6 of 22 desert or near desert areas censused. The areas (and numbers of quail present) were as follows: Death Valley (12), Joshua Tree National Monument (129), Salton Sea N (106), Salton Sea S (54), Parker, Arizona-Colorado River (320), Yuma, Arizona (209).

B. Population limiting factors

Grinnell and Miller (1944) considered that "the aggregate area of... cover in a given locality seems to govern the size of the quail population" (p. 125).

Lophortyx gambelii (con't.)

C. Environmental quality.

"The encroachment of mans activities has resulted in fragmentation of the habitat" (Raitt and Ohmart, 1966), whihc frequently leads to a decrease in local populations.

D. Potential for endangered status

no information located

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Lophortyx gambelii (con't.)

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MOUNTAIN QUAIL

Oreortyx pictus

I. TAXONOMY

A. Description

Oreortyx pictus eremophila, southern California Mountain quail: Oreortyx pictus eremophila van Rossem, 1937, Condor 39:20-24, Lang Spring, Mountain Spring Canon, Argus Mountain, Inyo County, California, elev. 6000 feet.

Synonomies - Callipepla picta, Oreortyx picta, Oreortyx picta plumifera, Oreortyx picta confinis, Oreortyx picta picta; plumed quail, plumed partridge, mountain partridge, mountain quail, San Pedro quail (Grinnell and Miller 1944).

B. Current systematic treatments

Order Galliformes, family Phasianidae, subfamily Odontophorinae, genus Oreortyx Baird, 1858, Rep. Expl. and Surv. RR. Pac. 9:638, 642 (Peters 1934).

There are 5 subspecies recognized in the A.O.U. "Check-list of North American Birds": pictus, palmeri, confinis, eremophila, russelli.

C. Recent taxonomic revisions

The supplement to the 5th edition of the AOU Check-list (1973, Auk 90:411-419) indicated that there have been no changes in mountain quail systematics since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adult

The mountain quail are unique among quail in the possession of 2 slender feathers in the "teardrop" crest. "The throat is chestnut edged with black, and this is separated from the slate gray chest, neck, and head by a white line...The birds are plain olive gray on the back, wings, and tail. The flanks are a rich, dark brown, with conspicuous vertically oriented black and white bars" (Johnsgard 1973).

B. External morphology of subadult age classes

"Immatures have buff-tipped greater upper primary coverts" (Johnsgard 1973).

"Juveniles have dull fuscous crest feathers... and have whitish chins surrounded by dark gray throats" (Johnsgard 1973).

Oreortyx pictus (Cont'd)

C. Distinguishing characteristics

Interspecific - "The slender plumes and boldly patterned flanks will serve to identify mountain quail without difficulty" (Johnsgard 1973). The California quail has a shorter crest and dull brown flanks, narrowly streaked with white, instead of the bold, rich dark brown and white of the mountain quail (Johnsgard 1973).

Intraspecific - van Rossem (1937) considered eremophila to be the palest of the races of mountain quail, except for the dark tones of the posterior and lateral underparts. This subspecies is paler above than confinis and pictus, and darker below than palmeri and pictus (van Rossem 1937).

D. Special morphological features

No information located.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Oreortyx pictus eremophila occurs "from about 37°30' in the Sierra Nevada of California and adjacent portions of extreme western Nevada, south through the mountains of southern California to the lower California boundary (van Rossem 1937; see also Peters 1934, Johnsgard 1973).

B. California distribution of the species

The eremophila subspecies is found in the "mountains of southern California in general. Northwest from Mexican boundary in San Diego County to southern San Luis Obispo County; east through Tehachapi County to southern Sierra Nevada and thence north along west flank of Sierra to Fresno County and on east flank to vicinity of Mono Lake...; east, interruptedly, in Inyo region to Inyo, Coso, Argus, Panamint and Grapevine Mountains" (Grinnell and Miller 1944).

Grinnell and Miller (1944) cautioned that although they followed the "latest review by van Rossem (.../1937)", they did so "with misgivings." They felt that "the amount of variation... prevents any trenchant definition of subspecific range, as between... picta and eremophila."

C. California desert distribution

Oreortyx pictus eremophila is found in sage, pinon, and juniper vegetation where water is locally available (Grinnell and Miller 1944) and especially in the desert mountains of Inyo County (Inyo, Coso, Argus, Panamint, Grapevine Mountains; Grinnell and Miller 1944; see also Wauer 1964).

D. Seasonal variation in distribution

Only vertical migration occurs in this species (see IV F below).

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) characterized the principal biotopic affinity as the Transition and Canadian Life Zones (the latter in the summer only) with some extension into the Upper and Lower Sonoran Zones locally" as on the eastern base of San Jacinto Mountains in Riverside County, and in mountains of Inyo County." Wauer (1964) described the Panamint Mountains habitat of occurrence as a pinon-juniper woodland, listing the following plant species as characteristic vegetation: Pinus monophylla, Juniperus, Chamaebatiaria millifolium, Vitis girdiana, Cowania stansburiana, Salvia, Artemesia, Brickellia, and Tetradymia. Wauer also mentioned that mountain quail are sometimes found in the timber pine association, where the dominant plant species are Pinus, Betula, Cercocarpus, Acer, Ceanothus, Chamaebatiaria, Tanacetum.

B. Altitudinal range

"Altitudes of known breeding occurrence extend from 1500 feet in San Rafael Hills, west of Pasadena, up to an extreme of 10,000 feet on west side of Olancho Peak, Tulare County" (Grinnell and Miller 1944). In the Panamint Mountains, mountain quail are found at altitudes from 5500 to 800 feet (Wauer 1964). In winter, the birds move downslope to escape extreme cold, and the lowest elevations are recorded in midwinter (Grinnell and Miller 1944, Wauer 1964).

C. Home range size

Johnsgard (1973) reported that mountain quail movements are generally limited. In the winter, daily movements rarely cover more than 1000 yards; in the summer daily movements are usually restricted to less than one-half mile unless the birds are disturbed. During brood rearing, the covey ranges over an area of 2-3 acres, with general movement always oriented to water sources (Johnsgard 1973).

D. Territory requirements

Roost site - Johnsgard (1973) reported that roosting and loafing areas are under scrub oaks, with small trees being preferred to large ones for roosting. In some areas, the mountain quail are associated with Juniperus thornbush (Lycium), blackbrush (Coleogyne), and desert apricot (Prunus), where woody cover shades one-quarter to one-half of the ground to provide roosting, loafing, and nesting areas (Johnsgard 1973).

Courtship and mating site - No specific information located. Presumably these activities occur in the brushy scrub growth described for roosting sites.

Nest site - Bent (1932) reported that the nest sites were "well concealed... under fallen pine branches amid weeds or shrubs at the base of large trees, beside large rocks... or in masses of shrubby vegetation." Johnsgard (1973) indicated that nesting areas did not differ from the roosting habitat (1973).

E. Special habitat requirements

Mountain quail require "brushy canyon walls and hillsides, mixed growths of deciduous or coniferous trees and scattered patches of bushes... always within daily reach of water," since "undisturbed access (on foot) to perennial springs is an essential factor for existence on desert mountain ranges" (Grinnell and Miller 1944). The brushy cover is necessary as a refuge from predation; the open areas between stands of cover are used for foraging.

Similarly, Johnsgard (1973) concluded that "hillsides of at least a twenty-degree slope are used by birds to escape by running uphill, and such slopes are used by birds to escape by running uphill, and such slopes serve purposes similar to that provided by plant cover." Johnsgard also commented on the importance of access to water, remarking that "the birds are apparently restricted to remaining no more than a mile from water." Chicks in particular need water and are rarely found more than one-half mile from water (Johnsgard 1973).

F. Seasonal changes in habitat requirements

Mountain quail undertake a vertical migration downslope in the fall (late August or early spring), returning to higher elevations in the spring (late February) for the breeding season (Johnsgard 1973) except at lower elevations where quail are year-round residents (Grinnell and Miller 1944). This vertical migration may cover a distance of up to 20 miles or more (Johnsgard 1973).

"The unique vertical migration... is... no doubt a reflection of the fact that it breeds at higher elevations and in a cooler climate than do any of the other North American quail species" (Johnsgard 1973).

G. Physiological ecology

Mountain quail require daily access to water, but are somewhat tolerant of arid conditions. "Mountain quail probably need to visit water sources only once a day and can hold up to 12 cc of water in their crops" (Johnsgard 1973; see also Miller and Stebbins 1964).

V FOOD

A. Food preferences

Judd (1905) reported that the annual diet of mountain quail was composed of 18% grain, 47% seeds (legume, weed, and grass), 8% fruit, 24% miscellaneous vegetable matter, and 3% animal matter. Yocum and Harris (1952) reported that late fall birds consumed plants of 85 different species, including Rhus (22.7% of total volume), Trifolium (8.1%), Stellaria (7.2%), Nicia (5.8%), Celtis (5.5%). Ormiston (1966, in Johnsgard 1973) found that the principal plant foods were chickweed (Holosteium), Microsteris, Collinsia, fringe cup Lithophragma, and seeds of grasses, pines, Hawthorn (Crataegus) sweet clover (Melilotus), thistles (Cirsium), ragweed (Ambrosia) and teasel (Dipsacus). Autumn food intake in Joshua Tree National Monument includes a high proportion of scrub oak acorns (Miller and Stebbins 1964).

Ormiston (1966) found very little difference in diet between adults and young. The young consumed only 7.5% animal matter and relied primarily on chickweed and miner's lettuce (Claytonia).

B. Foraging areas

Mountain quail forage under and around and between stands of vegetation in their habitats (Johnsgard 1973). On Joshua Tree National Monument, they forage in oak thickets and on the bare gravel of washes between groups of desert willows (Miller and Stebbins 1964).

C. Foraging strategies

Ormiston (1966 in Johnsgard 1973) reported that coveys foraged and drank near streams in early morning (8-10 AM) and then moved into cover for the hottest part of the day. A second bout of feeding occurred in the late afternoon and lasted until just before dark.

D. Feeding phenology

Acorns and pine seeds are heavily consumed in the fall and winter (Johnsgard 1973) as are the seeds of grasses, weeds, and shrubs (e.g., hawthorn, clover, thistle, ragweed, teasel; Ormiston 1966). Greens make up more of the diet as spring approaches and reaches a maximum of 40% of food uptake (25% of yearly food uptake; Johnsgard 1973). Ormiston (1966) found that chickweed and Microsteris were most important in the spring followed by Collinsia. In the summer, bulblets of fringe cup (Lithophragma) can make up 50% of the mountain quail diet (Ormiston 1966).

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

Territories per se are not defended, but male-male aggression increases as pair formation occurs in the spring, resulting in a dispersal of the winter covey such that each breeding pair occupies 5 to 50 acres (Johnsgard 1973). "In very dry years, the winter coveys... may stay together through the summer without any pairing or attempts to nest" (Leopold 1959).

C. Courtship and mating behavior

The onset of mating is signaled by the beginning of location calling by unmated males. This call is usually delivered from a prominent stump, rock, or exposed branch, and has been described as "quee-ark," "queerk," "Kyork," and "plu-ark" (Johnsgard 1973). The call serves primarily to attract females (Johnsgard 1973). Pair formation has not been adequately described; however, Johnsgard (1973) speculated that the initial contact between male and female would be aggressive on the part of the male, due to the similarity in coloring. Therefore, courtship would consist of a gradual establishment of mutual tolerance.

Once paired, the male participates actively in the nesting effort. He will defend the nest, may incubate, and actively defends the brood (Johnsgard 1973).

D. Nesting phenology

The winter coveys begin to break up by late winter and mating begins in March or early April. Nesting in the Sierras occurs from mid June to mid July, and winter coveys are formed and beginning to move downslope by August and September. The above information is from Johnsgard (1973) and applies mainly to the Sierra Nevada populations. Populations in southeastern California may begin breeding earlier. Egg laying in Joshua Tree National Monument occurs in April with hatching beginning by mid May (Millers and Stebbins 1964).

E. Length of incubation period

Eggs are incubated for 24 to 25 days (Johnsgard 1973).

F. Length of nesting period

Mountain quail young are precocial.

Oreortyx pictus

G. Growth rate

No information located.

H. Post-breeding behavior

Coveys begin to form in August and September. "The covey forms the basis for the social group for nearly the entire year. Except where drought conditions cause groupings, most covey are probably basically family groups" (Johnsgard 1973). Average covey size reported by Miller and Stebbins (1964) was 9.1 birds (range, 3-20 birds; n = 21 coveys).

VII POPULATION PARAMETERS

A. Clutch size

Grinnell et al (1918 in Johnsgard 1973) reported that the average clutch size was 8.7 eggs (n = 29 nests) with 9 or 10 eggs being the typical clutch size.

B. Nesting success

No information located.

C. Mortality rates

No information located.

D. Longevity

No information located.

E. Seasonal abundance

Mountain quail migrate vertically downslope in the fall and upslope in the spring (Grinnell and Miller 1944, Johnsgard 1973). Therefore, seasonal fluctuations in population size and/or species presence will occur at higher elevations.

F. Habitat density figures

"Where... covey size is... high (eleven birds), the late summer and fall density of birds may reach one bird per five acres" (Johnsgard 1973). Edminster (1954 in Johnsgard 1973) cited studies indicating an early spring density of 1 bird per 3 acres; near water, he recorded densities of up to 1 bird per 2 acres.

VIII INTERSPECIFIC INTERACTIONS

Little information located; presumably similar to other quail species.

Oreortyx pictus (Cont'd)

A. Predation

"Predation on this species... probably centers at the springs and is reflected in the caution... in birds as they go to water" (Miller and Stebbins 1964). Miller and Stebbins implicated coyote, rattlesnake, cooper hawk, and bobcat as potential predators.

IX STATUS

A. Past population trends

Mountain quail have been introduced into Washington, British Columbia, Idaho, Nevada and Colorado (Johnsgard 1973).

B. Present population status

Mountain quail were observed in 5 of 21 desert or near desert areas censused in the 1976 Audubon Christmas Bird Count: Claremont (4 birds), Idylwild (120), Redlands (14), Sespe Wildlife Area (2), Springville (8).

C. Population limiting factors

Little information located.

"Although it is possible that at times, especially in winter, mountain quail forego daily water, or can survive well without it, we have seen no sign of nesting success except close by springs" (Miller and Stebbins 1964).

D. Environmental quality: adverse impacts

No information located.

E. Potential for endangered status

Grinnell and Miller (1944) reported that "numbers seem to have held up well, save around remote desert-side springs where, in some arid ranges, completely shot out."

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CHUKAR
Alectoris chukar

I TAXONOMY

A. Type description

Alectoris chukar, Chukar partridge: Alectoris chukar chukar (J.E. Gray) as Perdiv chukar J.E. Gray 1830, in Gray and Hardwicke, Ill. Ind. Zool. 1, pt. 2, pl. 54 - India, Sringar, kumaon (from Peters 1934).

Synonomies - Perdiv chukar, Alectoris graeca, Alectoris graeca chukar.

B. Current systematic treatments

Order Galliformes, family Phasianidae, subfamily Phasianinae, genus Alectoris kaup, 1829, Skizz. Entw. - Gesch. Eur. Thierw., p. 180,193 (Peters 1934).

The North American introduced species is now considered to be Alectoris chukar and not A. graeca (Watson 1964; see below).

C. Recent taxonomic revisions

Watson (1964) compared the morphology of Alectoris graeca and A. chukar and determined that the wild species in the United States was A. chukar, not A. graeca as has been frequently assumed. Johnsgard (1973) concurred adding that "the racial origin of the birds introduced into North America is varied and includes not only Indian stock (probably A.c. chukar...) but also some Turkish stock (Cypriotes or Kurdistani).". The Thirty-second supplement to the AOU Check-list (1973) formalized the identification of Alectoris chukar as the North American species.

II DESCRIPTION

A. External morphology of adults

Johnsgard (1973) includes the following pertinent observations in his description of the chukar partridge: sexes, identical; white or buffy white cheeks; black collar passing through eyes; "crown and underparts are grayish brown to olive, grading to gray on the chest; underparts and planks buffy; black and chestnut vertical barring on blanks; bill, feet, legs are reddish. The most noticeable sexual difference is the shorter feather tip to wrist joint distance of the female (female 31.8 mm vs. male 39.3 mm; Johnsgard 1973).

B. External morphology of subadult age classes

Juveniles (until 16 weeks) have mottled secondaries (Johnsgard 1973). Immatures possess upper primary coverts of less than 29mm in length (Johnsgard 1973).

C. Dinstinguishing characteristics

No information located.

Alectoris chukar (Cont'd)

D. Special morphological features

No information located.

III DISTRIBUTION

A. Overall distribution of the species

Original range - Chukar partridges were introduced into the United States from India (Peters 1934, Grinnell and Miller 1944, Watson 1962, Johnsgard 1973) and possibly Turkey (Johnsgard 1973).

Present North American range - Chukar partridges are presently found from "southern interior British Columbia southward through eastern parts of Washington, Oregon, and California to the northern part of Baja California, and east on the Great Basin uplands through Nevada, Idaho, Utah, western Colorado, and Montana, with small populations of uncertain status in Arizona, New Mexico, western South Dakota, and southern Alberta" (Johnsgard 1973).

B. California distribution of the species

Grinnell and Miller (1944) stated that chukar partridges were planted mostly in "and southern parts of the state." They have since been seen in the Mohave Desert, Riverside County, Los Angeles County, Tuolumne County, Siskiyou County, San Joaquin Valley, Kings Canyon, Kern County (Grinnell and Miller 1944).

C. California desert distribution

Chukar partridges occur in the Mohave Desert (Grinnell and Miller 1944).

D. Seasonal variation in distribution

Chukar partridges are year-round residents (Grinnell and Miller 1944).

IV HABITAT

A. Biotopic affinities

Wauer (1964) describes the biotopic affinity of the chukar partridge in the Panamint Mountains as the upper canyons of the Lower Sonoran Life Zone, characterized by kochia, Chrysothamnus, and Senecio. He also found chukar partridges around springs and up onto the open sage flats, and in the pinon-juniper woodland and limber pine association. Harpster et al (1958) found a similar habitat distribution and mentioned additional dry plateau plant species characteristic of chukar partridge habitats (Yucca, Artemesia, Bromus, Stipa).

B. Altitudinal range

Chukar partridges are found below sea level in Death Valley and range up to 12,000 feet in the White Mountains (Harper et al 1958).

Alectoris chukar (Cont'd)

C. Home range size

Chukar partridges are extremely mobile and often move over one mile per day. They will travel 2 to 3 miles to reach water holes (Johnsgard 1973).

D. Territory requirements

Roost site - Chukar partridges roost on talus slopes, sometimes under shrubs or low trees (Johnsgard 1973).

Courtship and mating sites - No information located, presumably the same as nesting and roosting sites.

Nest site - Chukar partridges nest on "clopes of rolling hills" with rock outcroppings (Harper et al 1958). They are frequently found in sagebrush or a sagebrush-grassland mix on mountains several hundred feet above creek bottoms (Galbreath and Moreland 1953 in Johnsgard 1973).

E. Special habitat requirements

The distribution of the chukar partridge is related to the availability of water, especially in summer (Galbreath and Moreland 1953 in Johnsgard 1973). "The birds drink daily in hot, dry weather (and) lack of water is a principal factor limiting the spread of chukars in the desert mountains" (Leopold 1959). Therefore, in California, "the birds' distribution generally follows the 5 to 20 inch annual rainfall isohyets" (Johnsgard 1973).

"The most essential type of cover required by chukars for shelter from the weather and for escape from natural enemies is rocks" (Leopold 1959). Chukars run upslope when escaping potential predators, and they prefer rocky slopes of more than 200 foot elevation (Galbreath and Moreland 1953 in Johnsgard 1973). Roosting cover is also preferred when it occurs on at least a 7% grade. The optimum habitat is composed of 1/4 to 1/2 talus slope, rocky outcropping, cliffs and bluffs, and 1/2 sagebrush and cheatgrass near a small amount of brushy creek bottom with bunch grass (Agropyron) and bluegrass (Poa; Galbreath and Moreland 1953 in Johnsgard 1973).

F. Seasonal changes in habitat requirements

"Seasonal movements... often involve altitudinal migrations to lower valley areas during the wintertime, followed by a return to higher elevations in apring (Johnsgard 1973).

V FOOD

A. Food preferences

Harper et al (1958) documented the plant food preferences of chukars throughout the year in the Mono-Inyo area. On a yearly basis Solsa kali (seeds) and various species of Graminae are most heavily consumed (16.7% and 16.5% of the total volume respectively). Chukars also eat Rosa ultiamontana

Alectoris chukar (Cont'd)

(fruits, 6.4%), Medicago sativa (Leaves, 5.8%), Trifolium (leaves, 5.3%), Mendora spinescens (5.3%). In other areas, chukars depend on Erodium cicutarium (seeds, 41.1%), Amsinckia tessellata (seeds, 24.6%), and Bromus tectorium (seeds and leaves, 5.2%; Harper et al 1958).

Johnsgard (1973) reported that young chukars eat more insect material than adults who usually consume less than 15% by volume.

B. Foraging areas

Little information located; presumably foraging occurs under, around, and between clumps of brush throughout habitat. Harper et al (1958) stated that chukars utilize open knolls and flats without giving more specific details.

C. Foraging strategies

"Foraging behavior is usually high during mid-morning and may extend through the afternoon, with the birds moving widely" (Johnsgard 1973). "During hot days, they may feed early... and late... spending the hottest period in shady canyons near a supply of water" (Johnsgard 1973).

D. Feeding phenology

The following food items provide the largest percentage intake in each season: fall (Graminae, 19.4%), winter (Salsola kali, 53.3%), spring (Graminae, 39.1%), summer (Menodora spinescens, 27.4%), Harper et al 1958). Of the other preferred foods Rosa ultramontana is consumed in greatest quantity during the fall (17.9%), Medicago sativa in the winter (21.6%), Trifolium in the summer (10.4%), and unidentified forbs in the spring (15.3%; Harper et al 1958).

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

Defensive actions by the male are "restricted to repelling other males coming into the vicinity of the females"; defense is not site specific (Mackie and Buechner 1963).

C. Courtship and mating behavior

Initial male-female encounters resulted in highly aggressive behavior by the male ("waltzing", attack, rape) and submissive avoidance behavior by the

female (Stokes 1963). "The function of 'waltzing' was to establish the male's dominance over the female and as a means of sex identification. Tidbitting appeased the female and induced her to crouch for copulation" (Stokes 1963).

During active courtship, the males frequently utter a rally call ("Chuk-ar") as a means of location advertisement and attraction of females (Stokes 1961). The latter function may not be of critical importance, since the rally call continues after pairing is completed. The rally call also has a third function, that of being a contact call after the covey has been scattered as by a predator (Stokes 1961). On this context, the call is given by males and females year round.

"The nest ceremony functions to strengthen the pair bond in a species where the male plays an important parental role" (Stokes 1963). This ceremony occurs during the courtship period only. It does not require the presence of an actual nest and is not even seen once laying begins (Stokes 1961).

D. Nesting phenology

In Washington, chukars pair from the first week in February to April 1 with the older birds pairing in February and the yearlings in March; the bond may dissolve during or after incubation (Mackie and Buechner 1963). Hatching begins May 1, peaks in mid-June and ends in late August. The birds begin to regroup into flocks in mid-June if they are unmated, and in late August if broods are being raised (Mackie and Buechner 1963).

In the Inyo-Mono area, the breeding season gets underway earlier than in Washington. Nesting spans the period from the last week in April to the first week in August (Harper et al 1958). The peak of hatching occurs from May 15 to May 29 under normal circumstances. Cold, dry spring weather can produce a delay in hatching such that the peak occurs in the second week of June (Harper et al 1958).

E. Length of incubation period

Galbreath and Moreland (1953 in Mackie and Buechner 1963) reported that incubation took 24 days.

F. Length of nestling period

Chukar partridge young are precocial.

G. Growth rates

No information located.

H. Post-breeding behavior

"From the appearance of broods in late summer until the beginning of pair formation in spring, the social unit of the chukar partridge is the covey. Covey sizes range widely, often from five to forth or more birds, perhaps averaging about twenty" (Johnsgard 1973).

VII POPULATION PARAMETERS

A. Clutch size

Mackie and Buechner (1963) reported a mean clutch size of 15.5 eggs (range, 10-21 eggs; n = 4 nests). Goodwin (1953) cites several accounts which indicate that female Alectoris sp. may lay 2 clutches with the male incubating or rearing one while the female incubates and rears the other (observed in A. rufa, A. barbara, A. gracea).

B. Nesting success

Harper et al (1958) observed a mean brood size of 9 young (age 1 to 3 weeks, range 6-11 young/brood). The young to adult ratio fell from this value of 4.5 to fall values of 2.1 to 3.5 young per adult in the Inyo-Mono area. Fall ratios in the Temblor area in the same two years were 0.8 and 1.7 young per adult (Harper et al 1958).

In Nevada, fall young to adult ratios varied from 0.42:1 to 8.76:1 over an 18-year period (Johnsgard 1973). The low ratios were associated with drought years.

Haper et al (1958) noticed the same correlation between precipitation and breeding success. They noted that the high productivity associated with normal or above normal late winter-early spring rainfall was probably a function of the improved vegetative growth available for food and nesting cover. Leopold (1959) observed that "in very dry years, when food of all kinds is scarce, the chukars may not breed" at all.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

E. Seasonal abundance

Populations may vary in any one locality of vertical migrations occur down-slope in the winter and upslope in the spring (Johnsgard 1973).

F. Habitat density figures

Johnsgard (1973) commented that the scarcity of density data was due to the tendency of chukars to clump at water areas and to their high degree of mobility. He reported that density might reach levels of one bird per 10 acres in favorable habitats.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Harper et al (1958) reported that predation by Cooper's hawk, coyotes, ravens, and other ground predators probably did not constitute a serious loss to the population, although nest predation by ravens accounted for "high losses." Prairie falcons prey on chukars in Idaho; chukar remains were found in 4% of the eyries sampled by Ogden and Hornocker (1977).

B. Competition

Harper et al (1958) concluded that "competition for food was not prevalent, since the chukar utilizes the more open knolls and flats, which are not frequented by other game."

C. Parasitism

Harper et al (1958) stated that "of the hundreds of chukars handled... only four showed apparent symptoms of serious disease." They could not make a positive diagnosis and did not make any other attempts to determine diseases of parasites. Chukar have been reported to be susceptible to Erysipelothrix rhusiopathiae (Pettit et al 1976) and Venezuelan equine encephalomyelitis (Proctor and Gavutis 1975).

IX STATUS

A. Population trends

Chukar partridges have been introduced in 42 states and 6 provinces, and 10 states and 1 province have had sufficient success to declare legal hunting seasons (Nevada, Washington, Hawaii, Idaho, California, Wyoming, Oregon, Utah, Colorado, Montana, British Columbia; Johnsgard 1973). The chukar was observed in only 3 of the California areas censused in the 1976 Audubon Christmas count. The areas (and number of chukars seen) were: Claremont (2), Benecia (4), Honey Lake (1).

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CLAPPER RAIL
Rallus longirostris

I TAXONOMY

A. Type description

Rallus yumanensis - Dickey (1923). Type specimen was taken by Mrs. May Canfield on 15 May 1921 at Bard, Imperial County, California, altitude 140 feet. Original number 229. Adult male. No. J 1039 in the collection of Donald R. Dickey. (Specimen now presumably at UCLA-Dickey Collection). Regarded by Dickey as entirely new species.

B. Current systematic treatments

AOU (1957) recognizes the king rail and clapper rail as separate species. Only a single race of the former, elegans, occurs within the AOU checklist boundaries, while 10 races of R. longirostris are recognized (including yumanensis). Mayr and Short (1970) regarded R. longirostris as conspecific with R. elegans. Dickerman (1971) believed that the king rail and clapper rail should be combined into a single species, R. longirostris Boddaert. "The species differences based on the morphologically distinctive and largely ecologically separated populations of the north-eastern United States break down as one examines specimens from throughout the range of the entire complex." Hellmayr and Conover (1942) recognized R. longirostris and R. elegans as separate species and, like Peters (1934) included yumanensis and other western clapper rails under elegans. In all, 15 races of R. longirostris are recognized; 9 races of R. elegans. Peters (1934) regarded R. longirostris and R. elegans as separate species, but placed the western races of the clapper rail (per current treatments) under R. elegans. Thus, he recognized 11 races of the clapper rail (distributed in the eastern U.S., West Indies, and South America) and 9 races of the king rail (in the eastern U.S., West Indies, western U.S., and Mexico). Meanley (1969) gave evidence supporting the notion that king and clapper rails are the same species including their structural and behavioral similarities, the fact that the plumage of several clapper rail races closely resembles that of the king rail, and the fact that interbreeding (with the production of viable eggs) has been documented where their ranges overlap. Clapper rails are almost universally birds of salt marshes, while king rails occur normally in fresh water and brackish marshes.

Synonomies - Rallus yumanensis; Rallus obsoletus yumanensis; Rallus elegans yumanensis (Grinnell and Miller, 1944). Ridgway and Friedmann (1941) gave Rallus yumanensis; Rallus obsoletus yumanensis; Rallus elegans yumanensis; Rallus longirostris yumanensis. Grinnell and Miller (1944) noted king rail; red-breasted rail; marsh hen; California king rail; southwestern clapper rail.

C. Recent taxonomic revisions

Van Rossem (1929) regards the forms obsoletus, levipes, beldingi, and yumanensis as being races of the same species, Rallus obsoletus; the first time that they had been considered to be so closely related. Banks and Tomlinson (1974) defined the ranges and relationships of the races yumanen-

Rallus longirostris (con't.)

sis, nayaritensis, and rhizophorae. All three are regarded as good races with yumanensis breeding along the Colorado River in Arizona and California south to the Colorado River Delta in Sonora; rhizophorae being resident farther south in Sonora and Sinaloa, and nayaritensis being resident in southern Sinaloa and Nayarit. Oberholser (1937) placed yumanensis under Rallus longirostris as a subspecies. Also recognized two subspecies of R. elegans and 25 subspecies of R. longirostris.

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "The large gray-brown, tawny-breasted 'marsh hen' of California's coastal marshes. Note the henlike appearance, strong legs, long, slightly decurved bill, heavily barred flanks, and white patch under short tail. Sometimes swims." Under similar species: "The Virginia rail is the only other thin-billed rail found in California. It is half the size, rusty brown with gray cheeks, blacker flank-barring." Ohmart and Smith (1973) noted males average 106.7 mm in tarsus plus middle toe measurements, while females are smaller, averaging 97.3 mm. In weight, males average 224 g, while females average 215 g in the Salton Sea area. Colorado River birds average 266.8 and 226.2 g, respectively. Oberholser (1937) reported juveniles are similar to adults in autumn except for dusky edgings or mottlings on the side of the breast, body, and abdomen.

B. External morphology of subadult age classes

Wetherbee and Meanley (1965) noted downy young of clapper rails almost invariably have patches of white neossoptiles under the wing, while these are lacked by king rails.

C. Distinguishing characteristics

Intraspecific - Van Rossem (1929) commented on the similarities in color and size of the two known specimens of yumanensis to examples of the races levipes and beldingi, citing this as good evidence of the close relationships of these forms. The race yumanensis is most similar to levipes, differing chiefly in its smaller size and paler coloration. Dickey (1923) said differs from R. l. levipes by duller and more olivaceous outer superior wing-coverts and alula, by paler coloration of underparts and more slender tarsus and bill. Differs from R. l. obsoletus in having a smaller foot, shorter and much more slender tarsus and bill, and in brighter and more pinkish fore-neck and breast. Differs from R. l. saturatus in brighter and more pinkish underparts, in generally narrower white barring on sides and flanks, and more whitish abdomen; also in straighter, more slender, and much shorter bill, and in more slender tarsus. Banks and Tomlinson (1974) noted the race yumanensis is pal and brown; rhizophorae is pale and grayer; and nayaritensis is darker and gray. Additionally, characters of the head and neck coloration exist that permit specimens of the three races to be distinguished. Compared to levipes, yumanensis is paler on the breast and throat. Yumanensis has a more pointed wing than the other forms. Measurements do not provide a reliable criterion for separation of the races.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) reported range of species as a whole: "Along the coasts from the San Francisco Bay region, California, south around Baja California to Nayarit, Equador, and northwestern Peru; and from Connecticut south to Mexico, Central America, northern South America, and through the West Indies to southern Sao Paulo, Brasil; also in the lower Colorado River Valley and the Valley of Mexico. Fossil, in the Pleistocene of Florida." Range of the subspecies yumanensis: "Resident in fresh or brackish marshes of the Colorado River in California and Arizona from Laguna Dam to Yuma and at the southeastern end of Salton Sea." Phillips, Marshall, and Monson (1964) noted it is closely restricted to the Colorado River in Arizona. No nests had then been found in Arizona, but Monson had observed an adult with young along the Colorado River on 17 July 1948. Monson reported 19 sightings along the river between May to 16 September, all between Yuma and Parker, north to the Bill Williams Delta. Tomlinson and Todd (1973) noted during 1969-1970 158 Yuma clapper rails were located in cattail-tule marshes along the Colorado river between Needles, California to the International Boundary, and additional individuals were also found in the Colorado River Delta in Mexico, in the Salton Sea area, near Phoenix, and near Tacna, Arizona. The birds were located by use of taped calls. None responded during the winter months and were presumed to be absent. Friedmann, Griscom, and Moore (1950) reported this form was placed on the hypothetical list. They said Grinnell (in Baja California book) noted that Chester Lamb found evidence of the existence of a large rail, presumably this form, in the delta of the Colorado River, but specimens are yet to be taken there. AOU (1910) listed only a single specimen for the California desert region (one taken in Arizona) and placed it under Rallus levipes. This was prior to Dickey's description of yumanensis. AOU (1931) reported range as "lower Colorado River Valley from Laguna Dam south at least to Yuma." Treated as a subspecies of Rallus obsoletus, following van Rossem's 1929 recommendations. Wilbur and Tomlinson (1976), "Yuma clapper rails are found in marshes along the Colorado River from near Needles, San Bernardino County, California, south to the Mexican border. They also occur at the Salton Sea, Imperial County, California, and near Phoenix, Maricopa County, and Tacna, Yuma County, Arizona. The Colorado River population extends into the Colorado River Delta of Baja California and Sonora, Mexico. Distribution within this area varies from year to year with changes in local water conditions." (See Tomlinson and Todd, 1973).

B. Desert distribution

In Bent (1926) Huey wrote, "It is my opinion that the center of abundance of this rail is in the delta of the Colorado River, but that, during the flood time, which usually occurs in May and June of each year, the lower reaches of the river are made uninhabitable for the nesting of this bird and they annually come up the river seeking suitable localities in which to nest." He further believed that periods of excessively high water caused the birds to disperse into the tule marshes of the Imperial Valley.

Rallus longirostris (con't.)

Moffitt (1932) found clapper rails on a tule marsh near Mullet Island at the edge of the Salton Sea about 6 miles west of Niland, Imperial County. Apparently the first record of the species for the Salton Sea area. Date: 10 June 1931. Grinnell and Miller (1944), "Valley of lower Colorado River in Imperial County from Laguna Dam to Yuma... and marshes at southeastern end of Salton Sea, same county..." Tomlinson and Todd (1973) reported (based on 1969-1970 surveys) the areas of highest concentrations of Yuma clapper rails in the United States were: upper Topock Marsh, lower Topock Marsh, Topock Gorge from Devil's Elbow to 0.5 miles below Castle Rock (all in Havasu NWR), Davis Lake, Three-Fingers Lake, and Cibola Lake (all in Cibola NWR); Fence Lake and the extensive marsh areas immediately north of Imperial Dam; the marshes at the north end of Mittry Lake, south of Imperial Dam. "Yuma clapper rails at the Salton Sea in 1969 appeared to be confined to the extreme southern end, where cattail-tule marshes were not limited by a high salt content of the water." Snider (), "Clapper rails may be spreading in the lower Colorado River Valley. One was seen on 19 June in Topock Marsh, one nearby on 22 June at Beal's Lake, and 2 in Topock Gorge on 2 July (JMW = Joseph Welch?). Yet another was at Imperial Dam, California on 25 June as reported by Guy McCaskie." Monson (1949), "This species was first met with on 6 June 1948, when an adult was seen at a seepage pond just above the California side of Headgate Rock Dam. Later, at the same place, on 9 July 1948... I saw an adult and three small young. On 17 July 1948, I saw the young and two adults. There are no other records for this rail above Laguna Dam, some 100 air miles southward."

Swarth (1914) reported a specimen taken by Herbert Brown on 25 August 1902 at Yuma, Arizona may represent the earliest record of the Yuma clapper rail.

C. Seasonal variations in distribution

Banks and Tomlinson (1974) noted late winter specimens of yumanensis have been taken in freshwater and saltwater habitats in the Mexican states of Sinaloa and Puebla, well within the breeding ranges of other races of the clapper rail, i.e., principally rhizophorae. Thus, there is no question that yumanensis is migratory. Phillips, Marshall, and Monson (1964) noted summer resident - no authentic winter records. The absence of winter records (from October through April) makes the authors wonder if the population is migratory, although the species is so secretive that it would be hard to find in winter even if present. Grinnell and Miller (1944), "Evidently resident, but only summer occurrences (May and June) so far have been recorded. Known range very restricted and aggregate numbers probably small." In Wilbur and Tomlinson (1976) Tomlinson and Todd, 1973 note "except for stragglers, the Yuma rail is gone from the United States from October until late April" and Bank and Tomlinson, 1974 note "those that migrate probably winter in inland and coastal marshes in Mexico." The Yuma clapper rail differs from other western clapper rail populations in that it is migratory. Tomlinson and Todd (1973), "most Yuma clapper rails migrate from their summer habitat along the Colorado River in September and do not return to the breeding areas until late April." Smith

Rallus longirostris (con't.)

(1974) noted at Topock Marsh on the Colorado River, rails arrive in early April and remain until late September. Most birds have left by 1 October, but a few over-winter in the area. Ohmart and Smith (1973), "Some individuals winter along the Colorado River" according to Smith-unpublished.

IV HABITAT

A. Biotopic affinities

Wilbur and Tomlinson (1976), "Along the Colorado River and at the Salton Sea, Yuma rails reside in shallow, fresh-water marshes containing dense stands of cattail (Typha latifolia) and bulrush (Scirpus acutus). In the Colorado River Delta, Tomlinson and Todd (1973) reported that the rails inhabit brackish water areas dominated by salt cedar (Tamarix sp.) and iodinebush (Allenrolifia occidentalis). Unlike most clapper rails, this race seems to have adapted to fresh, brackish, and saltwater situations." Abbott (1940) found nests in a marsh that consisted of thousands of acres of cattails and other growths running around the eastern end of the sea. Nests were found in dense cattail and tamarisk associations. Grinnell and Miller (1944), "Fresh-water or brackish stream-sides and marshlands. Associated with heavy riparian and swamp vegetation." Tomlinson and Todd (1973), "Preferred habitat of yumanensis was found to consist of shallow-water marshes containing dense stands of cattail (Typha latifolia) and big bulrush or tule (Scirpus acutus). The birds were found in both brackish and freshwater situations. However, shallow-water areas and areas where mud flats were readily available for feeding grounds apparently were selected over areas where deep and steep banks were prevalent. Stands of cattails and tules that were dissected by narrow channels of water 5-20 feet wide appeared to contain the densest clapper populations. Habitat in the Colorado River Delta is fresh or brackish sloughs characterized by an overstory of saltcedar (Tamarix sp.) and an understory of iodine-bush (Allenrofia occidentalis). This is an estuarine habitat." Dickey (1923), "it is interesting to note that we have here a true clapper rail inhabiting for the first recorded instance a purely fresh-water environment." Ohmart and Smith (1973), "semiflooded habitats are important regardless of vegetation on site" according to Todd - unpublished. "Prefer light cattail or tule stands with downed vegetation; must be adjacent to dry land" according to Smith - unpublished.

B. Home range size

Smith (1974) reported mean territory size in Topock Marsh for 10 pairs was 1.44 hectares (3.55 acres). Paired rails appeared to restrict themselves to smaller territories than did unpaired birds.

C. Territory requirements

Nest site - Ohmart and Smith (1973), "It breeds primarily in freshwater marshes." Abbott (1940), "Of the five nests found, three were of black sticks with a few dead leaves on them and the other two were made of fine stems with dry blossoms on them. Two of the nests were on small mud hammocks, while the other three were in crotches of small shrubs just

Rallus longirostris (con't.)

above the water in dense cattail and tamarisk associations. The water varied in depth from a few inches to knee deep."

D. Special habitat requirements

Smith (1974) noted along the lower Colorado River, the species requires mature stands of cattails or bulrushes in shallow water near high ground. In Ohmart and Smith (1973), according to Todd - unpublished, "Seems to require wet mudflat or sandbar sites with vegetation exceeding two feet in height. Optimum conditions created by open ponds or channels as opposed to unbroken vegetation stands." Ohmart and Smith (1973), "it appears to take about 10 to 15 years for suitable Yuma clapper rail habitat to develop (probably directly related to sediment load and dam height) following impoundment. There is no question that the construction of dams along the lower river (Colorado) and subsequent river management have created suitable Yuma clapper rail habitat to the north of the original range, which was the Colorado River Delta." Gould (1975) noted the following characteristics were found in areas where rails were densest: 1. Water occurring in small channels, or as small bodies of open water. 2. Extensive areas of water where depth was less than 0.3 m and with little or no daily fluctuation in water level. 3. High ground found in strips, or as small isolated islands. 4. Emergent vegetation being cattail and bulrush with little or no carrizo cane.

E. Seasonal changes in habitat requirements

Adams (1900) reported because the author and friends encountered rails of only one sex in given portions of salt marshes, he suggested that the sexes may resort to different feeding grounds in the fall and winter, at least.

V FOOD

A. Food preferences

In Smith (1974), Ohmart and Tomlinson - unpublished, "In August, 1973, sixteen Yuma clapper rail stomachs were examined. Preliminary food habit studies indicate that crayfish form an important part of the diet." Wilbur and Tomlinson (1976), "Preliminary results of a study made by the junior author of 18 Yuma rails collected in 1971 indicate that crayfish of two or more genera constitute a major food item. Other food items were small fish, isopods, snout beetles (Curculionidae) and water beetles (Hydrophilidae), a small clam (Corbicula sp.), dragonfly and damselfly nymphs, other insects, and small seeds." Ohmart and Smith (1973), "crayfish are an extremely important food item."

VI REPRODUCTION

A. Territorial behavior

Ohmart and Smith (1973) noted according to Tomlinson - personal communication, "appears to defend territory."

Rallus longirostris (con't.)

B. Courtship and mating behavior

Wilbur and Tomlinson (1976), "As soon as rails return to the breeding areas, courtship activities begin. Males give a territorial 'kek' call before and during the initial stages of nesting. They also emit other calls for various purposes during and after the breeding season... The 'clatter', or 'primary advertising' call is usually given in unison by a male and his mate. At times, a whole marsh comes alive with these calls from several pairs."

C. Nesting phenology

Abbott (1940) reported a nest was found on 5 May 1940 with one egg, another with two eggs, and two empty nests. On the 12th, the first nest was empty, the second contained six eggs, one of the empty nests was still empty, and the other contained seven eggs. On this date an additional nest containing seven eggs was also found. On 16 May still another nest with six slightly incubated eggs was found. Presumably, these sets are at the San Bernardino County Museum of Natural History. Bent (1926) noted an egg was taken from the oviduct of a bird collected on 27 May 1921 (one of the type series). (This specimen is now at the Western Foundation).

D. Length of incubation period

Ohmart and Smith (1973), "Incubation: unknown - probably 21 to 23 days as reported in other races." Johnston (1956) reported in two clutches of eggs of Rallus longirostris in Contra Costa County, California the incubation period was found to be 23 days.

VII POPULATION PARAMETERS

A. Clutch size

Abbott (1940) noted the average clutch size of four complete clutches was 6.5 eggs.

B. Fledging success

Wilbur and Tomlinson (1976), "Hatching dates and nesting success are unknown."

C. Habitat density figures

Smith (1973) reported in dense cattail habitat there were 3.6 rails per 100 acres; in light cattail habitat there were 7.8 rails per 100 acres; in dense bulrush habitat there were 6.8 rails per 100 acres; and in light bulrush habitat there were 7.1 rails per 100 acres. Thus, light cattails held the highest densities of rails and heavy cattails the lowest.

Rallus longirostris (con't.)

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Abbott (1940) reported a destroyed nest was found with coyote and raccoon tracks plentiful in the vicinity.

IX STATUS

A. Past population trends

Welch (1966), "Clapper rails may be spreading in the lower Colorado River Valley." In Ohmart and Smith (1973) this species was not noted by a field party headed by Joseph Grinnell that spent three months within its range along the lower Colorado River in spring, 1910. The marsh habitat along the river was poorly developed then, and it is quite possible that Yuma clapper rails were absent. Suitable habitat did not develop in the vicinity of Laguna Dam until its construction in 1909. Other river-slowng dams also created suitable rail habitat in later years. Also in Ohmart and Smith (1973), G. Monson noted this species was not observed in the vicinity of Parker Dam until 12 May 1954. He believes that the species was very localized prior to 1965, and that it has since become more common. Welch also noted this species was not observed in the vicinity of the Topock Marsh near Needles until 1966. Oberholser (1937), "It undoubtedly is one of the rarest rails of this group (the Rallus elegans-longirostris complex), and on account of its limited distribution and the circumstances under which it must exist, it is possibly already extinct." Wilbur and Tomlinson (1976), "It is uncertain whether Yuma clapper rail numbers have declined. They have not been subject to heavy hunting or collecting pressures in the past. Although some of their native habitat has been destroyed by reclamation projects, a good deal more has been created in the Imperial Valley following the refilling of the Salton Sea in 1906."

B. Present population status

Ohmart and Smith (1974) noted a multi-agency census in May 1973 revealed 745 calling birds north of the Mexican boundary along the lower Colorado River, plus another 145 birds in the Colorado River Delta area. Wilbur and Tomlinson (1976), "It may be that the Yuma clapper rails have a greater geographical distribution now than at any other time in recent history." An extensive survey by Tomlinson in 1973 resulted in the location by sight or sound of 910 clapper rails, indicating that the total population must exceed 1000 birds. Totals: 161 in Lake Havasu National Wildlife Refuge; 44 in Cibola NWR; 132 in Imperial NWR; 56 in Mittry Lake Arizona Wildlife Management Area; 31 in marshes just south of the Salton Sea; 145 in Colorado River Delta; and 341 along other sections of the Colorado River and its tributaries. U.S. Bureau of Sport Fisheries and Wildlife (1973) listed this form as endangered. U.S. Bureau of Sport Fisheries and Wildlife (1966) considers Rallus longirostris yumanensis to be endangered. Gould (1975) gave an abstract as: "Censuses of the Yuma clapper rail were conducted along the Colorado River and in the

Rallus longirostris (con't.)

Imperial Valley by individuals of a multi-agency team. Nine hundred and five and 919 Yuma clapper rails were located during the May counts in 1973 and 1974 respectively." Smith (1974) has tape recordings of clapper rail calls which elicited responses from 134 Yuma clapper rails in May-June 1974. Ohmart and Smith (1973) noted the Yuma clapper rail is extending its range northward and may well appear in southern Nevada in the near future.

C. Population limiting factors

Ohmart and Smith (1973), "it appears that two factors are primarily responsible for the present population level of Yuma clapper rails: 1) available habitat, and 2) available food."

D. Environmental quality: adverse impacts

Wilbur and Tomlinson (1976), "Reclamation projects, mosquito control activities, and other occurrences may affect the welfare of this bird. Recent construction activities in northern Mexico have eliminated several swamps which were excellent clapper rail habitat." Ferrier (1976), "The extent of Yuma clapper rail habitat is greater today than at any time in history. However, the rate and extent of development seems to have reached its peak, and the process has slowed considerably. Optimum habitat conditions for the Yuma clapper rail are rapidly deteriorating in many areas as the natural processes of eutropication and plant succession convert the marsh community to a terrestrial community." Tomlinson and Todd (1973) reported dam construction has increased the number of marshes and thus the yumanensis population. However, reclamation projects are eliminating habitat along the Colorado and Gila Rivers, e.g., eliminating both the Three-Fingers and Davis Lakes, which were both prime habitat for this form. Reclamation probably poses the greatest threat to the continued survival of this form.

E. Potential for endangered status

Wilbur and Tomlinson (1976), "The Yuma clapper rail does not appear to be immediately threatened with extinction, but population levels should be monitored carefully."

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Rallus longirostris (con't.)

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Rallus longirostris (con't.)

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BLACK RAIL
Laterallus jamaicensis

I TAXONOMY

A. Type description

Pozana jamaicensis var. coturniculus - Ridgway (1874) Baird. Differing from var. jamaicensis of southeastern United States, West Indies and South America, in smaller size, and more uniform colors. Back without white specks. Habitat: Farallon Islands, California.

Grinnell (1932) gives details on the type specimen: Sex?, apparently in first fall plumage. Skin in poor condition, taken down from mount; no original data, but said to have been collected on the Farallons on 13 October 1859. Now USNM 12862.

B. Current systematic treatments

Peters (1934) recognizes five races of the black rail, including "stoddardi" in eastern and midwestern United States. The nominate race is considered to occur only on Jamaica. First to place the species in the genus Laterallus.

Hellmayr and Conover (1942) recognized five races of Laterallus jamaicensis, as follows: L. j. pygmaeus, eastern and midwestern U.S.; L. j. coturniculus, Pacific coast of U.S.; L. j. jamaicensis, island of Jamaica; L. j. murivagans, coast of Peru; and L. j. salinasi, central Chile.

Ripley (1977) recognizes four races, lumping stoddardi into the nominate race. Remainder of treatment is like that of Hellmayr and Conover.

AOU (1931) considered this form to be a race of the black rail, Creciscus jamaicensis coturniculus. Recognized "stoddardi" as a valid race for eastern populations, restricting jamaicensis to the island of Jamaica. AOU (1910) treated this form as a separate species, Creciscus coturniculus. AOU (1895) considered this form to be a separate species, Porzana coturniculus. AOU (1886) treated this form as a race of the black rail under the name "Porzana jamaicensis coturniculus".

Peters (1932) noted of several generic names applied to species in this genus, Laterallus is the oldest (1856).

Bryant (1888), "Regarding the claim of the unique specimen of this bird as a valid variety, there does not appear to be sufficient grounds for its retention as a separate form... it is an abnormal specimen of Porzana jamaicensis."

Oberholser (1918) followed Brewster (1907) in lumping this form under Laterallus (then Creciscus) jamaicensis, as the subspecies coturniculus.

Ridgway (1890) concluded, because of the virtual lack of spotting on the back of the type specimen (normal for an immature), that it must be more

Laterallus jamaicensis (con't.)

closely related to the Galapagos form, Laterallus spilonota, which is also virtually unspotted dorsally, than to jamaicensis. Thus, he recommended full species rank for coturniculus.

Synonomies - The following names have been used for this form: Porzana jamaicensis var. coturniculus "Baird"; Porzana coturniculus; Cresciscus coturniculus; Cresciscus jamaicensis coturniculus; Laterallus jamaicensis coturniculus. A more complete synonymy is found in Ridgway (Ridgway and Friedmann, 1941). Grinnell and Miller (1944) - Porzana jamaicensis; Porzana jamaicensis coturniculus; Porzana coturniculus; Cresciscus jamaicensis; Cresciscus coturniculus; Cresciscus jamaicensis coturniculus. Black rail; Pacific black rail; little black rail; Farallon rail; California black rail; and Farallon black crane.

C. Recent taxonomic revisions

Brewster (1907) presents evidence that the type specimen of the so-called Farallon rail is an immature specimen of the black rail population that inhabits the California mainland, that it is not unique, and that its closest affinities are not with the Galapagos black rail population, as hypothesized by Ridgway.

II DESCRIPTION

A. External morphology

Coues (1890) gave a description of the species as: "Upper parts blackish, finely speckled and barred with white, the hind neck and fore back dark chestnut. Head and under parts dark slate color, paler or whitening on the throat, the lower belly, flanks, and under wing and tail-coverts barred with white. Quills and tail-feathers with white spots." Peterson (1961), "A tiny blackish rail with a small black bill; about the size of a young sparrow. Back speckled with white. Nape deep chestnut." Under similar species: "Caution: All downy young rails are glossy black (but when small lack the barring on flanks)." Ridgway and Friedmann (1941) noted sexes alike. Juveniles similar to adult but more blackish, less brownish, and with fewer white spots on the back. Natal down dark black with an oily greenish sheen above. Robbins, Bruun, and Zim (1966), "The tiny size, the black coloration, and the white spots on the back identify it. The black bill of the adult is diagnostic. The chicks of all rails are black." Walker (1941) provides photograph of eggs and recently hatched young of the California black rail. Nest was in a Salicornia marsh near San Diego.

B. Distinguishing characteristics

Intraspecific - Ripley (1977), "Similar to nominate race but smaller, with a much more slender bill, the color of the underparts deeper - dark mouse gray to blackish mouse gray with a slate cast; nape, hind neck, and anterior intrascapulars more rufescent-russet, this color forming a somewhat broader patch than in L. j. jamaicensis. Color of bare parts: iris brown (red in nominate race); bill black; tarsi and toes dark grayish brown."

Laterallus jamaicensis (con't.)

Brewster (1907) noted the race coturniculus differs from the nominate race of the eastern United States by being smaller with a more slender bill, having the plumbeous of the underparts deeper, the chestnut brown of the upper parts brighter and more extended, forming a broad patch on the nape and tinging more or less strongly and generally much of the top of the head where there is often no pure unmixed plumbeous or slaty save on the forehead. Hellmayr and Conover (1942), "Differs from typical jamaicensis... in being smaller (wing 63-68 against 69-72) and in having a slenderer bill; also the tarsus and middle toe are shorter (19-21 against 22-24). The white markings of the upper parts are more plentiful and average larger."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Bowles (1906), "Very rare migrant. Saw two on November 10, 1900." (In the vicinity of Tacoma). This record regarded as questionable by later writers. Friedmann, Griscom, and Moore (1950), "Breeds in marshes along coast of California south to northwestern Baja California." They cite Baja records for San Quintin and San Ramon. Phillips, Marshall, and Monson (1964) regarded this species as hypothetical in the state with reports (sight records) coming from Tucson and near Casa Grande, Arizona. Gabrielson and Jewett (1940) reported the only records for Oregon of this form are those of Bendire who found it at Lake Malheur in 1875. Peters (1934) noted (of coturniculus), "Known to breed in the vicinity of San Diego Bay, California; the breeding range probably extends along the Pacific coast of North America from central California to northwestern lower California. Winter range not certainly known, but apparently from San Francisco Bay to San Diego Bay." Woodbury, Cottam, and Sugden (1949) reported a purported Utah sighting of this species by Ridgway in 1877 was probably erroneous. Jewett, Taylor, Shaw, and Aldrich (1953) placed this species on the hypothetical list for the state of Washington since they apparently felt that Bowles was mistaken in reporting the species from the South Tacoma marsh. Robbins (1949) provides map showing the distribution of North American races of the black rail, including indication of abundance and seasonal status. Grinnell (1928), "Resident locally in the northwestern coastal district." Specific localities are San Simon River, south of San Quintin; in a tule swamp near San Ramon (probably breeding); Sangre de Cristo; and San Telmo.

AOU (1957) gave the range of species as a whole), "Central California to northwestern Baja California; Colorado, Nebraska, Iowa, Illinois, Indiana, Ohio, Pennsylvania, New York, Connecticut, and Massachusetts south to Cuba, Jamaica, and Puerto Rico; coast of Peru (Lima); and central Chile (Aconcagua to Colchagua). Migrant in northern United States east of the Rocky Mountains." Range of the subspecies coturniculus: "Breeds, locally, in California, near San Diego and Chino (one record), probably to northwestern Baja California (San Ramon, San Quintin). Winters north in California to Tomales Bay and the San Francisco Bay area. Accidental on the Farallons, and casually inland to Stockton, Riverside, and Salton Sea, California.

Laterallus jamaicensis (con't.)

B. California distribution of the species

Grinnell and Miller (1944), "Permanent resident, but much more widely distributed in winter than in summer. Fairly common in but a few places, and not regularly so there; otherwise occurrences are scattered." Occurs mainly in salt marshes bordering the larger bays. Actual nesting has been recorded only from the vicinity of San Diego, as well as one record from Chino, Riverside County. Bryant (1888) regarded the Farallon Islands as an unsuitable place for this species, and he pointed out that no one else had found them there since the collection of the type specimen. Willett (1912), "Rather rare resident, locally, mostly on salt water marshes." Kibbe (1929) reported the finding of a dead young of the year in a Salicornia marsh in Marin County in August suggests that this species was nesting in the vicinity. Orr (1947) believed that the occurrence of a juvenile on 9 August 1945 at San Francisco and other similar records might indicate that the species breeds in the San Francisco Bay area. Baldridge and Chandik (1969) reported a dead black rail found in Butte County, California in March, 1962, the northernmost record for the species. Grinnell and Wythe (1927) regarded this form as a "fairly common fall and winter visitant" and gave numerous records for the species for this region. Repking and Ohmart (1977) noted in 1973-1974 this species was recorded along the lower Colorado River in California at West Pond, Imperial Reservoir, Squaw Lake, Senator Wash, Small Island, Ferguson Lake, and at other unnamed areas; on the Arizona side it was recorded at Mittry Lake, Gila Main Gravity Canal seepage, Imperial Reservoir, Large Island, and at Imperial National Wildlife Refuge. Wilbur (1974), "California black rails have definitely nested in San Diego, San Bernardino, Los Angeles, and Ventura Counties, in both saltwater and freshwater marshes. The presence of adult birds in the breeding season or juvenal birds in early fall suggests that nesting has also occurred at San Francisco Bay, along the Colorado River near Yuma, Arizona, and in northern Baja California." Small (1974) noted the range in California: "coastwise from Marin County to San Diego County; some non-breeding inland occurrences, but most consistently seen and heard from April to June in lower Colorado River Valley at West Pond, Imperial County." Wheelock (1920), "The black rail nests in the marshes at Alviso, California, and, I have no doubt, elsewhere throughout the state." Manolis (1977) reported black rails were heard calling in tidal marshes bordering San Pablo Bay, the Suisun marshes and the delta of the Sacramento-San Joaquin River system, Morro Bay, and Olema Marsh between March to July, 1977.

C. California desert distribution

Miller (1893) reported a specimen of this form was taken at Riverside on 13 August 1892. In Snider (1970), "At least 8 calling black rails were noted between Imperial and Laguna Dams, California, June 13-14 and July 18 (Guy McCaskie)." In Snider (1969), "At least 4-6 black rails were found in a minimum of two locations along the Colorado River in California near Imperial Dam, June 15 - August 2 (Guy McCaskie, Alan Craig, Jay M. Sheppard, Jon L. Atwood, Robert P. Norton, et al.)." Hanna (1935) noted a set of four eggs and a male bird was taken by Charles Bradford near

Laterallus jamaicensis (con't.)

Chino, Riverside County, on 4 May 1931. Laughlin (1947) reported the first record for this species east of the desert divides in California is of a bird captured alive near Calipatria, Imperial County, California on 5 January 1947 (It was captured by a retriever). Wall (1919) mentions a record of this species from Riverside by L. Miller in August, 1893 and also recorded a black rail from San Bernardino on 3 August 1919 (hit a power line).

D. Seasonal variations in distribution

Wilbur (1974), "... the number of records of California black rails found some distance from marshes in late summer and fall suggests this race also wanders considerably... However, Huey (1916) recorded California black rails in San Diego County every month of the year, and Tomlinson (1970, 1971) reports them along the Colorado River at various seasons, also. It may be that California black rail movements are sporadic rather than representing a true north-south migration. The idea that California black rails nest in the south and migrate north in winter... originated at the time when only San Diego County was known as a breeding area. While nesting has not been confirmed at the northern end of their range, it has become obvious that California black rails are much more widely distributed at all seasons than was formerly believed." Ripley (1977), "Permanent resident, but much more widely distributed in winter than in summer. Fairly common but only locally and then not regularly." Huey (1916), speaking of San Diego, "I, myself, am of the opinion that there is no migration at all in this region. At any rate I have seen or taken birds in every month of the year, so it is certain that these San Diego marshes are at least included in both their breeding and winter ranges." Huey knew that specimens had been taken in both spring and fall from three different marshes near San Diego. Repking and Ohmart (1977), "Our data show habitat occupancy year round which suggests a resident population."

IV HABITAT

A. Biotopic affinities

Wilbur (1974) found regularly in both saltwater and freshwater marshes. Vegetation inhabited varies from almost pure pickleweed (Salicornia sp.) along the coast to sedges (Carex sp.), saltgrass (Distichlis sp.), and bulrush (Scirpus sp.) in inland areas. This species may be quite adaptable to other vegetation types if the food supply is adequate. Grinnell and Miller (1944), "Chiefly, tidal salt marshes, where associated with heavy growth of pickleweed (Salicornia). But also occurs in brackish and fresh-water marshes, all at low elevations." Grinnell and Wythe (1927), "The black rail's favorite haunt is the growth of pickleweed on the salt marshes around the Bay shore." Repking and Ohmart (1977), "We found black rails in close association with three-square bulrush (Scirpus olneyii)..." Manolis (1977) reported 95% of black rails found in coastal central California were in marshes dominated by Salicornia virginica or Scirpus sp. "Breeding black rails seem confined to high marsh habitat at the upper limit of tidal flooding." Huey (1928) noted at Sangre de Cristo at the foot of the Sierra Juarez he found black rails in a "springy area

Laterallus jamaicensis (con't.)

of about four acres" with a heavy stand of sedge grass and tules. Huey (1926) reported at San Ramon he caught a male of this species near the water's edge in a fresh water tule swamp. Laughlin (1947) noted a bird was captured alive in a dense growth of green barley and wild oats at the edge of a fresh water pond near the Salton Sea.

B. Territory requirements

Nest sites - Sechrist (1915), "I have found them nesting in all the different sloughs around San Diego. They nest higher and dryer than the clapper rail, nesting way back where the ground is practically dry, except on flood tides. They nest very early on account of the high tides in May and June which would drown them out. Their homes are situated all the way from twenty-five feet right down to the edge of a small stream and most always setting on the ground." Willett (1912), "So far as I know, the only place in southern California where eggs of the black rail have been taken, is in the salt marshes bordering San Diego Bay." Stephens (1909), "The nest seems to be usually situated in very thick marsh vegetation (Salicornia, etc.) near the highest limits of the high tide." Nests are said to always be covered, but usually from an inch to several inches above the ground. Nests are very well hidden. Ingersoll (1909), "there is no bird whose nest is more difficult to find than an occupied nest of the species under consideration. Twenty-five special collecting trips to this colony by the undersigned, has resulted in only one bird and three sets of eggs; on each occasion two to six hours are spent in a most painstaking search for specimens. A favorite nesting site is one formed by an old top-heavy weed falling over a growth of previous years in such a way as to leave a shelf-like space between the layers of stems and foliage. Away from the glaring sun on such a platform, is concealed a flimsy nest of fine dry weed stems." Hanna (1935) reported a nest found at Chino, Riverside County was "on the damp ground and well concealed in a small clump of sedge growing in the middle of a small fresh-water marsh." Huey (1916) noted the tendency of this species to rebuild its nest in response to rains and high tides. One nest was as high as ten inches off the ground. All were located in the Salicornia marsh around San Diego Bay. Wilbur (1974), "Of 31 egg sets in the San Bernardino County Museum and Western Foundation of Vertebrate Zoology collections, 7 were collected in freshwater marshes and 24 in salt marsh."

C. Special habitat requirements

Repking and Ohmart (1977) noted rails that responded to taped calls were a mean distance of 23 m from a permanent edge such as a road, desert or open water (range 1-92 m). The birds appeared to use the 0-4 m perimeter of the marsh habitat exclusively.

V FOOD

A. Food preferences

Ripley (1977), "The food of the black rail (the species as a whole) consists of insects and some seed of water plants. In marine habitats the

Laterallus jamaicensis (con't.)

bird subsists on small crustaceans." Huey (1916) reported the stomachs of a small series taken in the fall of 1912 near San Diego contained "Isopod crustaceans belonging to the species Alloniscus mirabilis." Taylor (1898) noted a captive bird ate numerous earthworms, but died after eight days, and Taylor believed that the diet was at fault.

VI REPRODUCTION

A. Nesting phenology

Dawson (1924) stated to have only one brood. Wilbur (1974) noted in addition to the egg dates given by Bent, Wilbur found museum sets taken as late as June 4. Huey (1916) knew of egg dates from 24 March to 25 May. Stephens (1909) reported eggs were found between the middle of March and 20 April. Willett (1912) noted nesting occurs from the first to the tenth of April in southern California (i.e., eggs are laid then).

B. Length of nestling period

Heaton (1937) describes several instances of watching young downy rails leave the nest upon hatching. Parents always in attendance and usually nervous and demonstrative in contrast with their shyness when only eggs are in the nest.

VII POPULATION PARAMETERS

A. Clutch size

Willett (1912) noted the sets are usually from four to eight eggs each. Stephens (1909), "Five and six seems to be the usual number, but he (a boy) knew of one set that contained eight eggs." Bent (1926), "The Farallon rail lays from four to eight eggs." Sechrist (1915), "The average sets contain five eggs but they run from four to eight eggs..."

B. Seasonal abundance

Repking and Ohmart (1977), "During the winter census, the birds did not respond as readily (to taped calls) as in the breeding season... In the spring of 1973, densities were 1.14 rails per hectare; in 1974, 1.58 rails; and in the winter of 1973-1974, 0.73 rails."

C. Habitat density figures

Repking and Ohmart (1977), "Most of the approximately 150 hectares of suitable black rail habitat (along the lower Colorado River) is located above Imperial Dam. However, the highest densities of 1.58 rails per hectare occurred below the dam, where vegetation is denser, more robust, and occurs in large tracts."

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Huey (1926) noted a short-eared owl killed in late March, 1911 contained an entire California black rail, swallowed in two pieces. Ewan (1928) reported a black rail was found impaled on a barbwire fence in the Playa del Rey marsh on 25 February 1928, apparently the victim of a loggerhead shrike. Sechrist (1915), "Between the ants, slough mice and short-eared owls a great many of them are destroyed. The owls getting both old and young ones, also the ants, while the mice destroy the eggs."

IX STATUS

A. Past population trends

Willett (1933), "reports recently received from J.C. von Bloeker, Jr., J.M. Dixon and E.E. Sechrist, would indicate that the birds have reappeared in some numbers in their former haunts." (Referring to the flood of 1916 which was thought to have eliminated most of the San Diego Bay population). Sechrist (1915) reported at Sweetwater Slough (the marsh between National City and Chula Vista): "Sometimes I think there are twenty-five or thirty pairs breeding there, then again, another year you cannot locate a single nest." Wilbur (1974), "There is no certain evidence of any change in numbers or distribution of the California black rail." Ingersoll (1909) noted judging from the number of floating eggs and old nests that he found, he believed that thirty pairs of this species existed in the Salicornia marsh along San Diego Bay between National City and Chula Vista in 1909. Bent (1926), "An impression has prevailed during recent years that these rails have disappeared from the limited area in which they were known to breed, the salt marshes of San Diego Bay between National City and Chula Vista. But Griffing Bancroft writes to me that he took a set of their eggs there on May 21, 1922; so it seems that the rails were not entirely wiped out by the flood of 1919."

B. Present population status

Wilbur (1974), "Despite the lack of tangible evidence of population change, there is reason for concern for the California black rail. Both freshwater and saltwater wetland acreage has decreased significantly in California; an estimated 67% of southern California's coastal wetlands have been lost to dredging, filling, and other alterations (Speth, 1971). As one local example, the marsh acreage of San Diego Bay has decreased 86%, from 2450 to 360 acres (Speth, 1971). San Diego Bay has long been considered a primary California black rail nesting area; Ingersoll (1909) once estimated 30 pairs in one segment of this marsh. Similar habitat modifications are occurring elsewhere." Wilbur (1977) noted five California desert sites were checked for this species in April-May, 1977. Black rails (at least 6 individuals) were found only in the seepage marshes west of the Coachella Canal.

Laterallus jamaicensis (con't.)

C. Population limiting factors

Grinnell and Miller (1944), "Most important hazards to existence on salt marshes appear to be extra high tides." Gander (1930) reported a black rail found dead east of San Diego probably flew into adjacent power lines. Heaton (1937) believed the species would invariably desert if molested during nest construction and that nine out of ten would desert if the nest contained only one egg. Huey (1916) believed that this species invariably deserts its nest if it is found before the set is complete. He cited several examples of this from his personal experience. Stoner (1945) noted a black rail captured by the writer alive but stunned was believed to have flown into a smokestack adjacent to a Salicornia marsh near Benicia. Orr (1947) reports black rails from the San Francisco area that were killed by a car and by a cat. Wall (1919) noted a bird picked up in San Bernardino evidently hit an electric light or telephone wire "while migrating". Stephens (1919), "The big flood of January, 1916, covered most of the salt marshes near San Diego and drowned most of the little black rails (Crescicus coturniculus). I have not been able to find one since the flood." Stephens (1909) believed that the nests are frequently inundated by high tides, as he found a floating egg of this species. Ingersoll (1909), "In 1908, there were many eggs of the California black rail floated out of the nests by the high tides. I examined upwards of thirty 'floaters' during May of that year." Repking and Ohmart (1977), "Fluctuation in water level appears to be a critical factor, especially in the spring months... and possibly the breeding season. Rail densities in habitats above Imperial Dam may be explained partly by water fluctuations... The small stature (7-8 cm) of the black rail, combined with a strong preference for habitats with only moist surfaces or very shallow water, indicate that high water levels would probably drive the birds into less suitable habitats. Three-square bulrush stands, shallow water depth, gently sloping shorelines, and minimum water fluctuations appear to be necessary components for supporting black rail populations along the Colorado River."

D. Mortality factors

Arnold (1960) noted a dead bird of this species found near Stockton apparently struck some nearby wires. Emerson (1904) reported a dead black rail was picked up on the street of Santa Cruz by Clark P. Streater in September, 1903, a victim of overhead power lines.

E. Environmental quality: adverse impacts

Repking and Ohmart (1977), "The 40 hectares of habitat which appear suitable at the farm area of the Imperial National Wildlife Refuge are managed for waterfowl, and timing of controlled water level fluctuations appears to be the primary reason for the absence of black rails in this area. We found rails in adjacent habitats in 1974, but not in the waterfowl management block. Higher rail densities around Imperial Dam in 1973 may have been related to more insecticide applications in 1973 in the Mittry Lake area than in 1974. Below Parker Dam the habitat is periodically inundated to supply water and power, and water level fluctuations

Laterallus jamaicensis (con't.)

may be 1 m in a 24 hour cycle. This 1.0-1.5 m daily fluctuation appears to discourage use of this habitat by black rails. In Topock Marsh (Havasu Wildlife Refuge) water levels are relatively stable but very little habitat is available." Grinnell, Bryant, and Storer (1918), "It seems probable that the reclamation of the marshes where it makes its home will be the only factor having to do with any change in its status in the future."

F. Potential for endangered status

In Ripley (1977) the Office of Endangered Species, 1973, considered to be an endangered population.

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YELLOW-BILLED CUCKOO
Coccyzus americanus

I TAXONOMY

A. Type description

Ridgway (1887) reported this form was described from a specimen taken at "Old Fort Crittenden" on the east base of the Santa Rita Mountains, Arizona.

B. Current systematic treatments

Peters (1940) recognized only two races, americanus and occidentalis.

Swarth (1929), "Between the eastern and western races of the yellow-billed cuckoo there is a slight average difference in size, the western bird being the larger and with a somewhat heavier bill. There is a rather wide range of variation in specimens from any one locality... and the largest eastern birds do not fall far short of the maximum measurements of western specimens. Birds from the Pacific Coast are the largest, those from central Arizona near the type locality of occidentalis (the Santa Rita Mountains) are intermediate in size. The subspecies would have a better claim to recognition if restricted to the Pacific Coast... The subspecies is certainly as slightly differentiated as any in our Checklist, and I feel that no violence to the facts would result from suppression of the name."

Synonomies - Coccyzus erythrophthalmus; Coccyzus americanus (Grinnell and Miller, 1944). Bendire (1895) reported this species was formerly called "rain crow"; "rain dove"; "kow-kow"; "wood pigeon"; and "Indian hen". Grinnell and Miller (1944), "Black-billed cuckoo; yellow-billed cuckoo; California cuckoo."

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "Note the flash of rufous in the wings. Known as a cuckoo by the slim sinuous look, dull brown back, white breast; as this species, by rufous in wings, large white spots at tips of black tail feathers (most noticeable below). It has a yellow lower mandible on its slightly curved bill." Under similar species: "Black-billed is duller, has small tail spots, no rufous in wings. Lower mandible black, eye-ring red." Robbins, Bruun, and Zim (1966), "Told from black-billed by large white spots contrasting with black undertail surface, also by the bright rufous flash in the open wing and by the yellow lower mandible."

B. External morphology of subadult age classes

Bent (1940) noted in the first plumage the young cuckoo looks like the adult, except that it is slightly paler above and buffier below, but the tail lacks the conspicuous black and white markings of the side of

Coccyzus americanus (con't.)

the adult's tail, and the markings on the remainder of the tail feathers are not nearly as bold. Nolan (1975), reported nestling yellow-billed cuckoos have dusky gray sheathed down, similar in color to their skin, while nestling black-billed cuckoos have snow-white, hairlike down that contrasts sharply with their black skin.

C. Distinguishing characteristics

Intraspecific - Ridgway (1887) noted the race occidentalis was described on the basis of its larger size and proportionately larger bill than the nominate race.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) - (range of species as a whole), "From southern British Columbia, North Dakota, Minnesota, southern Ontario, Quebec, and New Brunswick south through Mexico, Central America, to Baja California, Sinaloa, Tamaulipas, the Greater Antilles and the northern Lesser Antilles; winters in South America to central Argentina and Uruguay."

AOU (1957) - (range of subspecies occidentalis), "Breeds from southwestern British Columbia (Pitt Meadows, Victoria), western Washington, northern Utah, central Colorado, and western Texas south to the Cape region of Baja California, and to Sinaloa, and Chihuahua (probably farther south in the mountains). Winter home probably in South America; migrates through Mexico, El Salvador, and Costa Rica."

B. California distribution of the species

Grinnell and Miller (1944) reported most occur in California in the larger valleys west of the Sierran divides. Occurrences elsewhere generally are migrants or isolated breeding stations. The main breeding range extends northwest from the Mexican line in western San Diego County along the coastal belt through the San Francisco Bay region as far as Sebastopol, Sonoma County and through San Joaquin and Sacramento Valleys from Kern to Shasta Counties. There are scattered reports from more northern localities. Baumgardt (1951) noted a yellow-billed cuckoo was seen at 5000 feet near Lake Arrowhead in the San Bernardino Mountains, California on 2 June 1950. Gaines (1974b), "The historical breeding range of the yellow-billed cuckoo in California extended northwest from the Mexican line in western San Diego County along the coast belt through the San Francisco Bay region as far as Sebastopol, Sonoma County, and through the San Joaquin and Sacramento Valleys, from the vicinities of Bakersfield and Weldon, Kern County, to the vicinity of Redding, Shasta County. The species has also been recorded from the following isolated, outlying localities: Shasta River, Edgewood and Sisson, Siskiyou County; Bishop, Independence, and Death Valley, Inyo County; Kelso, San Bernardino County; Colorado River near Laguna Dam, Imperial County." McCaskie (1977), "Yellow-billed cuckoos were seen along the Colorado River, where

Coccyzus americanus (con't.)

they nest, until early September (1976)... one on Catalina Island October 5... was unexpected."

C. California desert distribution

In Gaines (1974b), "Guy McCaskie (pers. comm.) suggests that the area above Laguna Dam on the Colorado River may be the 'last stronghold for the yellow-billed cuckoo in California'." McCaskie (1975), "Yellow-billed cuckoos were still nesting on the Colorado River but nowhere else in the region." McCaskie (1976), "A yellow-billed cuckoo, rare in southern California away from the Colorado River, was photographed near Weldon, Kern County, September 13 (KA). Three yellow-billed cuckoos were found in the eastern part of the region with one at F.C.R. (Furnace Creek Ranch in Death Valley), June 13... one more near Tecopa June 15... and the other in Kelso July 1... this species is rare away from the Colorado River Valley. Interesting were single yellow-billed cuckoos at F.C.R. on May 29.. and June 13 (1976)... this species is on the decline in California and records of migrants away from known nesting localities are few indeed." McCaskie (1977), "A yellow-billed cuckoo was at Fort Piute in the Piute Mountains, San Bernardino County, May 25-28... this is as early as the species ever reaches California."

D. Seasonal variations in distribution

Bent (1940) reported early dates of spring arrival in California are 18 April (Petaluma), 5 May (Pico), and 13 May (Berryessa). Late dates of fall departure are 1 September (Murphys) and 22 September (Vineland). Shelton (1911) noted (for Sonoma County), "Of all migratory birds breeding in this vicinity, the cuckoo is the last to arrive in the spring, usually appearing during the latter part of May or the first week of June." Jay (1911) reported (for Los Angeles County), "They leave for their winter home in September, the latest seen being one observed in an orange orchard in Vineland, September 22, 1904. The earliest spring record that I have is one seen in willows along the San Gabriel River at Pico, on May 5, 1907." Hamilton and Hamilton (1965), "At some western localities these cuckoos apparently occupy upland country prior to actual breeding, invading riparian woodland only when it is time to breed."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) reported in California this species occurs in the upper and lower Sonoran life zones. "Most characteristic, riparian jungles of willows of fairly old growth, often mixed with cottonwoods, and with a tangled 'lower story' of blackberry, nettles, or wild grape. Such conditions obtained on the broad lower flood-bottoms of our larger streams." Brandt (1951) noted in Arizona this species was considered to be characteristic of cottonwood bottoms in the desert subzone of the lower Austral life zone. Gaines (1974b), "Cuckoos were

Coccyzus americanus (con't.)

usually found in willows and cottonwoods. These varied from stands 20-30 m high with a dense, woody, and herbaceous understory... to low, shrubby, but dense stands of irregular distribution... On one occasion, a cuckoo was observed in an adjacent walnut orchard. Cuckoos were not found in oaks (Quercus lobata), sycamores (Platanus racemosa), or in areas such as parks where understory vegetation has been removed." Hamilton and Hamilton (1965) reported this species nested along cottonwood and willow-lined streams in southeastern Arizona. Other plant species, including elderberries, walnuts, mulberries, arrowwood, and mesquite occurred in the undergrowth.

B. Altitudinal range

Grinnell and Miller (1944), "Altitudes of known occurrence extend from -178 feet in Death Valley up to 4700 feet in Surprise Valley, Modoc County."

C. Home range size

Gaines (1974b) noted this study confirmed that cuckoos occur in the proximity of willows and water and suggest that extensive riverbottom vegetation, perhaps as much as 10 ha per pair, may be requisite to nesting. Hamilton and Hamilton (1965), "Each pair clearly ranged over several acres and it was impossible to follow any individual long enough to effectively determine its spatial relationship to its neighbors."

D. Territory requirements

Nest sites - Bendire (1895) reported in Arizona nests were placed in willow or mesquite thickets, from 10 to 15 feet from the ground, and they were usually fairly well concealed by the surrounding foliage. Schneider (1900) noted three nests were found in willow trees along the New River, Los Angeles County, California in 1899. Atkinson (1899) reported a nest found at a site 10 miles north of San Jose, California was located nine feet high in a small willow between a stream and a road in a growth of young willow and maple trees. Hanna (1937), "Ideal thickets for nesting seemed to be damp willow thickets mixed with cottonwood trees and with heavy underbrush of nettles, wild-grape vines, and cat-tails." Twenty-four nests were found, all but two being located in willow trees (one of these was in an alder, the other in a cottonwood). The average height off the ground of nests was less than 13 feet, ranging from 4-30 feet. Woodbury (1939) reported five nests in Salt Lake County, Utah were "all of simple construction, composed of a few sticks or twigs. One was in a small cottonwood, 10 feet up, but three others were in the outer boughs of willows a few feet up, and two of them were on limbs overhanging small streams of water." Another nest found on 20 June 1921 with one fresh egg was 6 feet up in the crotch of a scrub oak on a side hill bordering a marshy pasture near the mouth of a river. Shelton (1911) noted cuckoo nests were found along the Russian River, Sonoma County, California in a willow

Coccyzus americanus (con't.)

tree and about 7 feet from the ground in a clump of poison oak in willow riparian habitat. Jay (1911) noted most nests were found in a forty acre grove of second growth willow trees with luxuriant grass near Wilmington, California. The author was puzzled by the fact that some such groves in the area were frequented by several pairs of nesting cuckoos, while others were not. In Los Angeles County nests were found from three to 25 feet off the ground, and of over 40 nests examined, all were in willow trees, generally located near the extremity of a branch.

E. Special habitat requirements

Gaines (1974b), "Cuckoos occur where (1) the riparian vegetation exceeds 300 m in length and 100 m in width; (2) water is present within 100 m; and (3) there is dense understory vegetation and thickets of willow. They are lacking where (1) understory vegetation is sparse or absent; or (2) the vegetation is not sufficiently extensive, as along the 20-100 m wide strip of otherwise suitable habitat that borders the Sacramento River in many places."

V FOOD

A. Food preferences

Bent (1940), "Yellow-billed cuckoos sometimes eat tree frogs and other small frogs, and, in the southern states, an occasional small lizard. Several of the earlier ornithologists accused this cuckoo of eating the eggs of other small birds and produced some evidence of the bad habit, but some modern observers seem to think that they do very little, if any, nest robbing." Hamilton and Hamilton (1965), "The American cuckoo species seem to specialize on insects of fairly sizable proportion available locally in abundance. In North America at times other than the breeding season, a comparatively wide variety of insect and fruit species may be taken." The authors saw one take a sizable Sceloporus lizard in central California. Throughout its range, however, the most regular and characteristic food item of this species is caterpillars. Bendire (1895) observed nestlings being fed (invariably) a large black cricket (Anabus simplex or A. purpuratus). Swarth (1929) reported a female collected in Arizona contained two green caterpillars and a 100 mm lizard in its stomach. The author knew of another instance of this species feeding on a lizard. Nolan and Thompson (1975) reported in Indiana this species gorges on periodical cicadas when an outbreak of that insect occurs. Dawson and Bowles (1909), "Their food consists entirely of caterpillars, spiders, and other insects, this being perhaps the only bird to make war extensively upon the tent-caterpillar." This species does not feed on the eggs of smaller birds, as had been purported by earlier authors. Forbush (1927) noted this species feeds mostly on hairy caterpillars of several species, but including tent caterpillars and the larvae of gypsy moths, the brown-tail moth, and the Io moth, as well as the spiny elm caterpillar.

Coccyzus americanus (con't.)

B. Foraging areas

Gaines (1974a), "Foraging occurred at all heights in cottonwoods and willows."

C. Foraging strategies

Hamilton and Orians (1965), "The yellow-billed and black-billed cuckoos as well as many other species of cuckoos are solitary feeders, hunting much like hawks, with long periods of motionless waiting for sizable prey items to reveal themselves." Hamilton and Hamilton (1965) noted in typical foraging, much time is spent quietly waiting for the prey to reveal itself by movement. Such a preying strategem is suitable only if large prey items are taken, i.e., equivalent in food value to the amount that could be taken during constant active search. Gaines (1974a) noted when foraging cuckoos moved slowly and deliberately, flying but a few feet to a new branch or neighboring tree. Usually they remained motionless and scanned the foliage for food. Prey was taken at an average rate of one per 12 minutes foraging (based on 48 minutes total observation time).

D. Feeding phenology

Forbush (1927) reported this species apparently feeds almost exclusively on insects during the spring and summer, but in autumn and late summer it feeds to some extent on small wild fruits, including raspberry, blackberry, and wild grape.

E. Energy requirements

Nolan and Thompson (1975) noted the large egg of this species may require as much as 30% of the daily intake of the female for production.

VI REPRODUCTION

A. Territorial behavior

Hamilton and Hamilton (1965), "no clear territorial situation was determinable. If territoriality is characteristic of this species, the wide range of each pair, covering many acres, and their secretive and elusive habits will make the description of the spatial characteristics of pairs a formidable task." Prior to nesting, several pairs were seen moving as pairs, and territorial boundaries seemed to be in a state of flux. The loud call of this species is apparently an adaptation to its large territory size.

B. Courtship and mating behavior

Dawson and Bowles (1909), "While standing in an open woodland listening to a pair of cuckoos calling to each other, I saw the male suddenly fly

past with a large green worm in his bill. He flew directly to the female, who was perched in a tree a few yards distant, and for a moment or two they sat motionless a few inches apart looking at each other. The male then hovered lightly over his mate and, settling gently upon her shoulders... placed the worm in her bill." Hendricks (1975) noted copulation by a pair of yellow-billed cuckoos was observed near Bartlesville, Oklahoma on 19 July 1973. The male held a twig in his bill, apparently for balance, throughout the performance (two copulations were observed). Hanna (1937), "... one bird came and perched on a horizontal limb about fifteen feet above us and gave its usual call which was answered by its mate. Soon both birds were side by side on the same limb and the male mounted the female. After what seemed a very long time I took my watch to time them and we both agreed that the coition lasted about eight minutes. The male returned to its perch on the limb for a few minutes and then mounted several times but for shorter periods. During this activity they did not utter their calls but began again after flying back to other parts of the thicket on their quest for caterpillars."

C. Nesting phenology

Shelton (1911), "Upon its arrival, this bird keeps to the higher land, among the oaks and other timber, for a period of two or three weeks before retiring to the willow bottoms to breed. During this period it is wild and shy and difficult to approach... After the birds retire to the willow bottoms to breed, their entire attitude changes... the cuckoos cease to be the wild, shy birds of the upland timber." Bent (1940) noted fifty-five egg dates for California were between 15 May to 20 August, 28 records falling between 17 June to 10 July. Nolan and Thompson (1975) reported observations over numerous seasons in Indiana indicated that differences, both temporal and spatial, in laying dates (peaks) reflected responses to variations in food supply. Hanna (1937), "The earliest nesting date that I have is May 29 (1923), the latest is July 10 (1921), and the average is June 23." Jay (1911) noted this species breeds late, after most other local species have finished nesting. In Los Angeles County the birds generally began nesting about the middle of June, but first sets of eggs could be found as late as the middle of July. The earliest nesting date known to the author was of a nest found on 10 May 1901 which contained three newly hatched cuckoos and two heavily incubated mourning dove eggs. The dove was incubating at the time of discovery and the young cuckoos were dead. The latest nesting date was 7 August 1910, a nest with one fresh egg. The author believed that two broods are usually raised in a season in Los Angeles County, if the birds are undisturbed. Once initiated, all aspects of nesting are apparently accomplished rapidly, compared to other species of similar size. "I know of one case where the nest was built, three eggs laid, and incubation about one-fourth, all in a week... The female frequently begins depositing eggs before the nest is finished, and may be seen carrying twigs to it after the full complement of eggs has been laid." Hamilton and Hamilton (1965) reported the breeding peak is about a month

Coccyzus americanus (con't.)

later in southern Arizona than in southern California, but the two populations apparently arrive and depart at about the same time. Brandt (1951), "That it is a late nester is attested by the fact that our earliest observation of fresh eggs was on June 24; while according to Frank Willard's notes, he placed the height of season at from July 10 to 15, and his latest record is July 17."

D. Length of incubation period

Hamilton and Hamilton (1965) (in Arizona) reported the incubation period was found to be 10 or 11 days. Early estimates of the incubation period of this species as being 14 days are in error and apparently are all derived from a casual statement by Bendire (1895).

E. Length of nestling period

Preble (1957) noted two nestlings fledged from an Ohio nest in a flightless condition after spending 9 days (220 hours) in the nest.

F. Growth rates

Hamilton and Hamilton (1965) reported from the start of incubation to freedom from the nest requires as little as 17 days in this species, one of the shortest developmental periods of any bird, precocial or altricial. Nestling development is exceedingly rapid. The eyes open 3 days after hatching. On the 6th or 7th day the feather sheaths are methodically pulled off by the nestlings, and an overall feathered appearance results almost immediately. The young are capable of fledging at 8 days. From the first day onward the young are capable of making a persistent buzzing call, which is used until fledging. Preble (1957), "One young increased in weight from 8.5 g (one hour old) to 39.2 g, an increase of 361 percent. The young were first observed fully capable of supporting their weight only a few hours before leaving the nest." A loss of weight on the 8th day was attributed to energy required for the rupture of the feather sheaths. Bent (1940) reported because the eggs are laid at somewhat infrequent intervals (and after incubation has begun), the young in a given nest are often of very different ages. Shortly before fledging, young cuckoos develop their plumage very rapidly, and during this period they undergo a pronounced, but temporary, weight loss.

G. Post-breeding behavior

Hamilton and Hamilton (1965), "It would appear... that the adults do not precede the departure of the young (in southward migration in fall) by any considerable degree." Jay (1911), "After the breeding season the cuckoos spread out through the river bottoms and orchards. At this time the note is very subdued, and nothing like the loud call, as heard on the breeding grounds. The birds keep mostly in the tops of the trees and are very likely to be overlooked."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1940), "The California cuckoo lays usually three or four eggs, occasionally only two." Jay (1911), "The largest number of eggs I found in a nest is five, and this only once. Three is about the average number though sets of two and four are not uncommon." Hanna (1937), "From two to seven eggs have been found per nest (sample of 24), with an average of 3.96. The most common numbers were three and four and there are single records each of six and seven." Nolan and Thompson (1975), "The observed clutch in eight nests was 2 eggs; in eleven nests, 3 eggs; in four nests, 4 eggs; and in two nests, 5 eggs. There appears to have been a tendency for clutch-size to be consistent from year to year or possibly within some even shorter interval." (In Indiana).

B. Habitat density figures

Gaines (1974a), "As of March, 1972, approximately 1200 hectares of habitat remained in the Sacramento Valley exclusive of the Feather River. This would support 120 pairs of yellow-billed cuckoos if all habitat were occupied. The surveys suggested 80 percent occupancy, but, because the species was easily overlooked, this figure is uncertain." Stamp (1978) reported there were an estimated 8 pairs of yellow-billed cuckoos per 40 hectares in cottonwood riparian habitat along the lower Verde River, Maricopa County, Arizona.

VIII INTERSPECIFIC INTERACTIONS

A. Parasitism

Bent (1940), "Both species of North American cuckoos often lay their eggs in each other's nests. The eggs of the yellow-billed cuckoo have been found several times in nests of the robin and catbird. (Note: a paper which I have presently near completion indicates that all recorded instances of Coccyzus parasitism on other species involves either the nominate race of the yellow-billed cuckoo or the black-billed cuckoo. LFK). Friedmann, Kiff, and Rothstein (1977), "A sixth instance of cowbird parasitism on this species was reported... the fact remains that the cuckoo is generally unmolested by the parasite." (The existing records are all for the nominate race, being from Kansas, Connecticut, Pennsylvania, Ohio, Illinois, and Michigan).

IX STATUS

A. Past population trends

Grinnell and Miller (1944), "In general, population thinly spread; fairly common to even common in earlier years in a few, most favorable localities." Hanna (1937) reported cuckoos had become exceedingly rare in the San Bernardino Valley by 1937 because of habitat

destruction along major streams there. However, even at the turn of the century, Hanna regarded the species to be rather rare. Gaines (1974b), "Formerly, the yellow-billed cuckoo was a fairly common nesting species in dense riparian vegetation along the lower floodplains of larger streams throughout California. It is probable that the original density of yellow-billed cuckoos in California was greater than the literature implies. By the late 19th century, before the first studies were published, large tracts of floodplain riparian forest had been cut or cleared for fuel or to allow for grazing or crops." Jay (1911) noted in Los Angeles County this species appeared to be extremely local in its distribution. "It may be found breeding commonly in one grove of trees, while in another grove nearby, apparently offering the same advantages for nesting, it may be entirely absent."

B. Present population status

Gaines (1974b), "Destruction of this habitat (dense riparian vegetation) has so reduced its numbers, however, that survival of California's cuckoos is questionable. Populations are known to persist only along the Sacramento River in Colusa, Glenn, Butte and Tehama Counties and along the Colorado River in Imperial County. These populations are threatened by recreational development, agriculture, and flood control programs." Small (1974), "Rare summer visitor... status uncertain as numbers have diminished in recent years despite intensification of field birding; probably still breeds in a few localities in San Joaquin and Sacramento Valleys." Gaines (1974) reported this is one of 12 species that has declined or disappeared in the Sacramento Valley during the present century. In the case of this species the decline is at least partially attributable to the lack of sufficiently extensive river-bottom woodland.

C. Population limiting factors

Hamilton and Hamilton (1965) noted suggestions as to possible limiting factors for the species in Arizona include various aspects of the food supply (its abundance, its energy content, and/or the possibility that the species is not very well adapted to the food types available in Arizona) and physical requirements for nesting, e.g., the presence of riparian habitat, water, etc. "Presumably cuckoos are restricted to areas of high caterpillar density during outbreaks... suggesting a relatively nomadic phase during the period of spring arrival." These authors suggested that breeding in southern California may have been timed to coincide with peak periods of caterpillar (Hemileuca sp.) abundance, which is in June and July. Forbush (1927), "With us the numbers of this species fluctuate considerably from year to year. Doubtless a plague of those hairy caterpillars on which they feed tends to increase their numbers for the time being." Hanna (1937), "It is my opinion that the greatest enemy of this bird in this vicinity is man who, by clearing the land and using the water, has destroyed its food supply and breeding territory." Other mortality factors mentioned included wind, which destroyed nests, cattle upsetting nests, and probably cats, which preyed on nests.

D. Environmental quality: adverse impacts

Grinnell and Miller (1944), "Because of removal widely of essential habitat conditions, this bird is now wanting in extensive areas where once found." Gaines (1974a), "In recent years, sizable areas of riparian forest have been cleared by the Army Corps of Engineers, State Reclamation Board, and private landowners for flood control and land reclamation... These projects, and the pressure to clear more land for orchards, are the two most pressing threats to the yellow-billed cuckoo's habitat in the Sacramento Valley." Gaines (1974b), "Agriculture, urbanization, and low water tables (the result of dams, irrigation projects) have, to a large extent, claimed the habitat of the cuckoo. The area above Laguna Dam is, according to McCaskie (pers. comm.), in imminent danger of destruction since it is becoming a very popular area for recreation, many trees are being felled and brush is being cleared. Along the Sacramento and Feather Rivers, riparian forest is being cleared for orchards, or as part of the Army Corps of Engineer's Sacramento River Bank Protection Project."

E. Potential for endangered status

Arbib (1975) noted for yellow-billed cuckoo: "A wide diversity of opinion prevails concerning the status of this species, with the retention sentiment prevailing by a mere 57% - 43% margin. This is a complete turnabout from the previous year when deletion was favored by 83%; this year no less than 14 regions discerned declining populations." Arbib (1976), "A controversial bird, about whose status everyone has an opinion. Of these better than two-thirds favor retention on the list... There seems to be little pattern to the regional distribution of the opinions, except that in the west -- from the northern Rockies through the mountain west and the Pacific Coast regions, a decline seems real and noteworthy... The species has population cycles that must be carefully studied." Gaines (1974a) reported the California Fish and Game Commission declared the yellow-billed cuckoo to be rare on 21 May 1971. Note: This form is presently on the California endangered species list, I understand, but I cannot find any published reference alluding to this fact, LFK.

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ROADRUNNER
Geococcyx californianus

I TAXONOMY

A. Type description

Saurothera californiana - AOU (1957) Lesson, Compl. Oeuvres Buffon, vol. 6, 1829. California = San Diego, California.

B. Current systematic treatments

AOU (1957) considers the roadrunner a member of the Order Cuculiformes, Suborder Cuculi, Family Cuculidae, Subfamily Neomorphinae (ground cuckoos); is a monotypic species. Peters (1940) considers Geococcyx californianus a monotypic species.

Synonomies - Saurothera californiana; S. bottae; Leptostoma longicauda; Geococcyx mexicanus; G. viaticus; G. affinis, Grinnell and Miller (1944). Ridgway (1916) adds to those listed by Grinnell and Miller - Geococcyx variegata; Diplopterus viaticus; Cuculus viaticus; C. velox; Saurothera marginata; Phasianus mexicanus. Snake-killer; correcamino are added by Dawson (1923) to those of Grinnell and Miller (1944) - ground cuckoo; California roadrunner; paisano; chaparral cock.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun and Zim (1966), "Large, crested, terrestrial bird of arid southwest. Runs rapidly, trailing its long white-tipped tail." Peterson (1961), "A... slender, heavily streaked cuckoo; long, maneuverable, white-tipped tail, shaggy crest, strong legs. In flight the short rounded wings display a white crescent." Ridgway (1916) gives detailed description of adult plumages, molts, and measurements. Dawson (1923), "Recognition marks - crow size; long tail, terrestrial habits... unmistakable."

B. External morphology of subadult classes

Ridgway (1916), "Young (are) similar to adults but markings less sharply defined, especially the streaks on neck and chest, where the ground color is also duller (more grayish)."

C. Distinguishing characteristics

Intraspecific - Folse and Arnold (1976) describe a method of sexing road-runners by external morphology. The post orbital apterium (POA) is white in males and blue in females. Ridgway (1916), "Sexes alike; adult male: length 540 mm; wing 177.7 mm; tail 290.5 mm and female: length 524 mm; wing 173.2 mm; tail 287 mm."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Resident from Del Norte County and from the head of the Sacramento Valley in California, Nevada, southern Utah, Colorado, southwestern Kansas, central and eastern Oklahoma, western Arkansas, and northwestern Louisiana south to Baja California, Michoacan, Puebla, and Vera Cruz." Peters (1940) noted range as "southern portions of the western United States from the upper Sacramento Valley in California, southern Utah, Colorado and southwestern Kansas, eastward to the Gulf coast of Texas, south to lower California and over the Mexican tableland to Michoacan, Puebla, and Vera Cruz."

B. California distribution of the species

Small (1974), "range in California - today, primarily southern half of state at lower elevations; east of Sierras to northern Inyo County, west of Sierras north to north end of Sacramento Valley, and in coastal regions occasionally north to Humboldt County." Grinnell and Miller (1944) noted range as "Greater portion of state at lower elevations south of head of Sacramento Valley. West from Nevada line and Colorado River quite or nearly to seacoast in central and southern sections; northwest from Mexican boundary... to Mendocino County... and east of Sierra Nevada to northern Inyo County." Dawson (1923), "Distribution in California - resident in both arid and lightly timbered sections of the Sonoran life zone, north, east of the Sierras, to Big Pine in Owens Valley... to the Sacramento Valley." Kimsey (1953) reported the occurrence of roadrunners in Del Norte County extends the range of the species in California.

C. Desert distribution

Johnson, Bryant, and Miller (1948), "... found roadrunners to be widely distributed but not abundant in summer and winter, below the pinon belt" (Providence Mountains, California). Brandt (1916), "... characteristic of the chaparral belt and desert. Most abundant in the San Diegan and desert regions..." Grinnell (1914) considered a common resident in the lower Colorado River Valley; noted along the river and on upland mesas and hills from Needles to Pilot Knob. Wauer (1962) noted nesting in Death Valley, sometimes below sea level. "The roadrunner is occasionally found in the low canyons and on the open flats below the pinyon-juniper woodlands" (Panamint Mountains, Death Valley) Wauer (1964). Smyth and Coulombe (1971) reported roadrunners were noted drinking at Upper Carrizo Spring, Riverside County, California. Van Rossem (1911) noted during winter, few birds were noted near the Salton Sea. Gilman (1935) found nesting (nest with eggs) in Death Valley on 2 May.

Guillion, Pulich, and Evenden (1959) reported being called a permanent resident on all southern deserts in Nevada.

D. Seasonal variations in distribution

"There may be a slight downward displacement on steep mountain sides in winter" (no true migration) (Grinnell, 1907). "It is extremely doubtful if they migrate at all, even for very short distances" (Sutton, 1922).

IV HABITAT

A. Biotopic affinities

"Territories... were most frequently located on dry upland sites. They were always associated with brush... 2 to 3 m high... All territories... included 'short grass' areas" in Texas (Folse and Arnold, 1978). Miller and Stebbins (1964), "range both through the upper oak and pinyon scrub and the open dunes and smoke tree-lined washes of the lower elevations" in Joshua Tree National Monument. Small (1974) reported habitat - desert where brush is thicker, edges of chaparral, edges of agricultural land. "Areas of mixed open ground and tracts of brush; arid, open land with scattered bushes or thickets; edges of chaparral, where adjoining sparsely vegetated grassland" (Grinnell and Miller, 1944). Peterson (1961) reported inhabits open country with scattered cover, stony deserts, dry brush, open pinyon-juniper. "... the area inhabited follows very closely the limits of the upper and lower Sonoran life zones" (Brandt, 1916). "... common on the open desert and in the more open woods and brush of the upper Sonoran zone ... it also inhabits farmlands and urban areas... no wanderers have been seen above the Transition zone" in Arizona (Phillips, Marshall, and Monson; 1964). Grinnell (1907), "The roadrunner... seems to follow very closely the limits of the upper and lower Sonoran zones, especially in their arid and semi-arid portions."

B. Altitudinal range

"Most plentiful below 2500 feet, but reported as high as Bear Valley, 6750 feet in San Bernardino Mountains" (Willett, 1933). "Altitudes of known occurrence extend from -250 feet, in Death Valley, Inyo County, up exceptionally to 7500 feet, in Piute Mountains, Kern County" (Grinnell and Miller, 1944). Grinnell and Swarth (1913) noted at 4500 feet in the Hemet Valley (Kenworthy); does not range much higher. Zimmerman (1970) noted during winter to elevations of at least 6000 feet in southwestern New Mexico. "I have found it in the San Bernardino Mountains up to above 6000 feet altitude" (Grinnell, 1907). Richardson (1904), "One was seen in some fallen timber at an elevation of 7500 feet" in Piute Mountains, southern California.

C. Home range size

Folse and Arnold (1978), "Well established pairs apparently stayed on their territories year round." Banding returns showed that most road-runners move less than 2.9 km from the original banding site during a year. Concluded that most roadrunners remain on the same territory throughout the year. Brandt (1916), "... the individual range... of the roadrunner in all probability needs to be computed in square miles."

Geococcyx californianus (con't.)

D. Territory requirements

Perch sites - Bailey (1923) noted roosting 3 feet high on top of a barrel cactus in Arizona. Abbott (1940) noted in San Diego, a roadrunner roosting at night on a window sill, 12 feet above ground. Rylander (1972) notes the use of nests for roost sites during winter in Texas. "Adults... roosted high up in wild grape vines and tangles of other vegetation... never roost in flocks."

Nest sites - Grinnell and Miller (1944) listed nest sites as mesquite, cholla and tuna cactus, catclaw, sumac, buck-brush, and small-sized, thick-foliaged oak trees. Peterson (1961) described nest as a shallow saucer in bush, cactus, or low tree. "A bulky platform of interlaced sticks... 12 - 18 inches in diameter, 4 - 12 inches in depth; placed at moderate heights in cholla cactus, mesquite clump, or live-oak tree, or even cranny in cliff" (Dawson, 1923). Ohmart (1973) reported cholla cactus was the most common nest site near Tucson, Arizona; also included were desert hackberry and palo verde. Nest height was 130 cm (range = 40 - 245 cm). "The nest... is situated in a low tree, thicket, or clump of cactus 3 or 4 to 15 feet from the ground." Notes that nests have been found on the ground (Bent, 1946). Kelsey (1903) describes nest in cholla cactus in the Cholla Valley, California on 25 March 1903. Dawson (1913) noted nesting in a cliff pot-hole in San Luis Obispo County. Gilman (1935) reported nest in Death Valley was placed in a mesquite tree about 3.5 feet high. Sutton (1922) details several nests found in Texas; nests were placed in a wide variety of trees (7 feet) and bushes.

E. Special habitat requirements

Grinnell and Miller (1944), "... requirements include continuous and plentiful presence of terrestrial insects of large caliber and lizards supplemented on occasion with other kinds of animal prey... and thickets, large bushes or small trees, for shade, safety-refuge, roosting."

V FOOD

A. Food preferences

Willett (1951), "Feeds on grasshoppers, crickets, beetles, caterpillars, and other insects; also small birds, their eggs and young; reptiles, mice, gophers; some seeds and fruit." Miller and Stebbins (1964), "Food consists largely of lizards and small snakes... large insects and occasionally eggs and young of small birds." Martin, Zim, and Nelson (1951), "... eats practically no plant material... includes grasshoppers, spiders, lizards, small snakes, mice, and occasionally small birds or their eggs." Robbins et al (1966) reported eats lizards, snakes, insects. Brandt (1916) gives very detailed account of food items. Only 10% was vegetable matter, mainly sourberry (Rhus integrifolia). Beetles accounted for 18% of the diet, 21% grasshoppers, 7% lepidopterous insects, 4% lizards and snakes, and 2% birds. A specimen collected near Needles, California, contained several beetles and a lizard (Cnemidophorus) (Grinnell, 1914). Phillips, Marshall, and Monson (1964), "... its principal diet consists of lizards and grasshoppers

Geococcyx californianus (con't.)

... it will occasionally... eat English sparrows and mice." Herreid (1960) noted predation upon Mexican free-tailed bats in Texas. Zimmerman (1970) noted the taking of house sparrows and other small passerines in New Mexico. Wright (1973) reported seen killing house finches, young quail, snails, and numerous insects in Los Angeles County. Spofford (1976) reported roadrunner catching hummingbirds in flight near a sugar-water feeder in Arizona. Bent (1940), "Lizards, small snakes, scorpions, tarantulas and other spiders, centipedes and millipedes, mice, cotton rats, ground-inhabiting small birds and their eggs and young, young quail, insects ... various fruits and seeds." Bleich (1975) noted the taking of California ground squirrels in southern California; may be an important factor in the diet. Fisher (1904) reported taking of a nestful of young mockingbirds by a roadrunner in San Diego. Woods (1927) reported near Azusa, California, a roadrunner captured an immature, but full-grown, mockingbird. Law (1923) noted killing sparrows in California during cold mornings before insect and reptile activity. Binford (1971) notes a roadrunner taking an orchard oriole at Mesquite Spring in Death Valley (October 1971). Food items given as grasshoppers, crickets, lizards of several types, a few small birds, and cotton rats (Sutton, 1922). Anthony (1897) reported the frequent taking of caterpillars in San Diego. Anthony (1896) notes the killing of Neotoma in San Diego, California.

B. Foraging areas

Roadrunners are cursorial (Folse and Arnold, 1978). In the California desert near the Salton Sea, roadrunners were seen feeding on the ground almost exclusively (Jaeger, 1947).

C. Foraging strategies

Near the Salton Sea, California, roadrunners were seen turning over stones and capturing the insects beneath them (Jaeger, 1947). Michael (1967) notes roadrunners following deer and catching the insects that they stirred up (in Texas). In New Mexico, roadrunners would jump down from trees (5 - 6 feet up) and capture small passerine birds feeding on the ground (Zimmerman, 1970).

D. Feeding phenology

Brandt (1916) reported vegetable matter consumed is highest in November and December, reaching nearly 20% of the diet.

E. Energy requirements

Miller and Stebbins (1964), "The species seems to thrive in arid lands and is not bothered by heat or lack of water. Activity is reduced at mid-day." Brandt (1916) reported needs very little water; in captivity, the birds rarely drink more than twice a week. Calder (1968) noted diurnal activity of roadrunners; reduction in activity at mid-day reduces energy loss. Roadrunners require about 135 ml of water per day. Lasiewski, Bernstein, and Ohmart (1971) noted roadrunners lose 14 - 20% of metabolic heat production through evaporative water loss. Ohmart (1973), "Should the food supply

Geococcyx californianus (con't.)

diminish during the nestling period, the youngest nestlings are consumed by the adults."

VI REPRODUCTION

A. Territorial behavior

Folse and Arnold (1978), "We concluded that roadrunners were territorial due to observations of several boundary interactions..." - gives detailed account. Calder (1967) describes the territorial song of male roadrunners. Territory defense includes crouching, threat posture with the wings and tail. Pemberton (1916) describes a nesting roadrunner simulating a broken leg when its nest was approached (Colton, California).

B. Courtship and mating behavior

Phillips, Marshall, and Monson (1964), "... the courtship... may consist of some sort of side-stepping dance." Bent (1940) describes courtship; gives a series of "coos" as he struts with head held stiff and high, and wings and tail drooping. Will spread wings and bow to the female. Calder (1967) describes courtship behavior. Male takes food to female, who begs and flutters her wings. The male raises his crest and cocks his tail from side to side. He then bows and gives a low "coo" call. Cottam (1941) details roadrunner courtship, which consisted of: pre-copulation (1) the posing of the male with food, (2) the invitation of the female through displays, (3) copulation; post-copulation (4) the passing of food from male to female and (5) the circling of the female by the male.

C. Nesting phenology

Usual nesting season (California) given as April and early May; notes eggs taken from 10 March (Los Angeles) until 12 July (Colton, San Bernardino County) (Willett, 1933). Grinnell (1898), "Nests principally toward the latter part of March" (Los Angeles County). Breeding season covers the months of March, April, and May; nests with eggs have been reported in February (Escondido, San Diego County); 2 broods (Brandt, 1916). Dawson (1923), "Season (California): March to July, but usually April or May; one, two, or three broods." Nest building lasted from 24 to 30 March; young had left the nest by 7 May (San Joaquin Valley, California) (Wilson, 1945). Ohmart (1973), "... a bimodal nesting pattern in the Tucson area - mid-April to mid-June, and late July to mid-September. Extreme heat and aridity in late June and early July, followed by rains in late July, separate the breeding periods." California egg dates given as March 4 to July 16; height of season is in April (Bent, 1940). Bendire (1878) attributed many nests in August and September to a dry spring and the lack of insects in southern Arizona (season = April to September).

D. Length of incubation period

Incubation, by both adults, lasts about 18 days; fresh eggs, small young, and fledglings have been found in same nest, indicating that incubation

Geococcyx californianus (con't.)

starts with the first egg, with much time between layings (Brandt, 1916). In Los Angeles County, reports an incubation period of 16 days (Woods, 1960). Incubation period of 17 - 18 days near Tucson, Arizona (Ohmart, 1973). Bent (1940) gives incubation period as 18 days. Calder (1967) lists incubation as 17 - 18 days; both sexes incubate.

E. Length of nestling period

Near Los Angeles, young left the nest 20 days after hatching (Woods, 1960). Young fledged about 18 days after hatching (Arizona) (Ohmart, 1973). Calder (1967) gives a fledging date of 29 days after hatching.

F. Growth rates

Folse and Arnold (1978) gives growth curves for south Texas roadrunners. Weight increased from about 20 g at hatching to over 90 g at 7 days of age. Development of tarsometatarsus also given. Growth called "highly variable". Ohmart (1973) presents growth rate curve; the mean hatching weight was 14.2 g. Rapid weight increase occurred until day 4, when it leveled off. Weight increase ranged from 10 - 22% per day. At fledging, young weighed only 50% of adult weight. Muller (1971) gives detailed description of growth rates. By 60 days of age, the bird had reached a near adult weight of 340 g. Sutton (1922) gives general account of feather growth and overall development of young roadrunners.

II POPULATION PARAMETERS

A. Clutch size

Folse and Arnold (1978) reported in a south Texas study, clutch size varied from 2 to 7 eggs per clutch. If a clutch was lost, a new clutch was laid from 35 to 39 days later in a new nest. Eggs (3 - 8; 12), white (Peterson, 1961). Clutch size ranges from 3 to 9, and are deposited at intervals of several days (Brandt, 1916). "Eggs: 3 - 9 (12 of record), usually 4... dull white" (Dawson, 1923). Ohmart (1973) noted clutch size in Tucson, Arizona, averaged 4.6 eggs per nest, and ranged from 2 - 7. Clutch size reported as 3 to 6 eggs; feels that more than one female may lay in some nests, such as those reported to contain 12 eggs (Bent, 1940).

B. Nesting success

In south Texas, of 22 active roadrunner nests: 49.4% of the eggs hatched; 47.2% of eggs that hatched resulted in fledged young; and of all eggs laid, 21.5% produced young (1.76 young/pair) (Folse and Arnold, 1978).

C. Mortality rates per age class

Folse and Arnold (1978) constructed survivorship curve for eggs and nestlings. Of all eggs laid, about 22% produced young. Nest predation caused the greatest losses (Texas). Phillips, Marshall, and Monson (1964), "The incubation seems erratic, and the young are therefore of varied size and short life expectancy."

Geococcyx californianus (con't.)

D. Seasonal abundance

"After the period of nesting... the birds are less in evidence than ever... a marked decrease in the number of individuals observed during the winter months" (Sutton, 1922).

E. Habitat density figures

Folse and Arnold (1978), "The mean of 31 territories was 0.7 km (0.4 mile) with a range of 0.4 to 1.0 km" (Texas). Overall density given as between 2.5 and 3.1 birds per km². Brandt (1916), "Probably the maximum numbers per square mile do not exceed 10 or 12 even in favorable localities" (California deserts). Breeding density of 1.0 pair per 250 acres in desert riparian habitat in southern Nevada (Austin, 1970). During the breeding season, from 1 - 5 males per 40 ha were noted in south Texas brushland (Roth, 1977). Grinnell (1907), "The species is most abundant in the San Diegan district. It is nonetheless characteristic throughout the desert regions of southeastern California." Cardiff (1978) noted one roadrunner per 50 acres in a Mohave yucca-staghorn-cholla desert scrub in San Bernardino County (breeding).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Folse and Arnold (1978) reported potential predators in south Texas listed as: coyotes, raccoons, bobcats, skunks, rat snakes, coachwhips, and bull-snakes. Fitch, Swenson, and Tillotson (1946) note roadrunners being taken occasionally by red-tailed hawks. Beside shooting by man, crows and ravens may take the eggs and young of roadrunners. Coyotes and hawks may take adults on rare occasions (Bent, 1940).

B. Parasitism

Pemberton (1925) notes a roadrunner laying an egg in a raven's nest in Kern County.

IX STATUS

A. Past population trends

Willett (1933), "Its numbers... have been greatly reduced by encroachment of civilization and by wanton shooting." Grinnell (1898) notes that roadrunners have already declined in numbers. Grinnell and Miller (1944) reported common under optimum conditions. Allan (1950) notes the eastward expansion of the species into Oklahoma and Louisiana (likely Arkansas, also). Grinnell (1904) called "fairly common" in winter near Palm Springs, California. Price (1899) called common about Yuma and south nearly to the Gulf. Lamb (1912) described as "not common" near Daggett, San Bernardino County, California. Called "common" in the bottomland of the Colorado River (1905) (Hollister, 1908).

Geococcyx californianus (con't.)

B. Present population status

"Hence it appears that the population may fluctuate considerably from year to year" (Folse and Arnold, 1978). Small (1974), "becoming increasingly scarcer in northern portions of its range" (California).

C. Population limiting factors

Ohmart (1973), "Evidence in the study strongly suggests that clutch size in the roadrunner is regulated by food supply."

D. Environmental quality: adverse impacts

Grinnell and Miller (1944), "In parts of the state (California) where formerly common, and which have been thickly settled by people, or heavily hunted, now greatly reduced in numbers or even gone entirely." Near Cima (San Bernardino County), "we were told that roadrunners were very destructive of young quail, and... were killed by local residents at every opportunity" (Johnson, Bryant, and Miller; 1948). Roadrunners were eliminated from urban areas of Tucson, Arizona, due to house cats, human activity, dogs, and vehicular traffic (Emlen, 1974).

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Geococcyx californianus (con't.)

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BARN OWL
Tyto alba

I TAXONOMY

A. Type description

Strix pratincola - AOU (1957) Bonaparte, Geogr. and Comp. List, 1838.

Strix flammea - AOU (1957) Wilson, Amer. Orn., Vol. 6, 1812. New name;
(no locality given = Pennsylvania).

B. Current systematic treatments

Peters (1940) recognizes 34 races of Tyto alba including pratincola, whose range was given as: "North and central America from northern California, Nebraska, southern Wisconsin, southern Michigan, western New York, and southern New England, south to lower California and the Gulf states and through Mexico to eastern Guatemala and probably eastern Nicaragua."

Cory (1918) recognizes 7 races of barn owl, including T. a. pratincola; range given as - "United States and Mexico, south to Nicaragua in winter."

Synonymy - Strix pratincola; S. perlata; S. flammea pratincola; S. f. americana; Aluco flammeus americanus; A. pratincola; Tyto perlata pratincola; T. pratincola; T. alba (Grinnell and Miller, 1944); North American barn owl; American barn owl (Grinnell and Miller, 1944).

Hybridization - Captive male barn owl mated with a striped owl; produced fertile eggs (no young) (Flieg, 1971).

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "Field marks: Our only owl with a white heart-shaped face; unstreaked whitish or pale cinnamon underparts and golden-buff or rusty upper plumage... 14-20 inches." Measurements were noted as: length 14-20 inches; wingspread 45 inches (Walker, 1974). Ridgway (1914) gave a detailed description of adult and subadult plumages; sexes alike.

B. External morphology of subadult age classes

Ridgway (1914), nestling - entirely immaculate pure white.

C. Distinguishing characteristics

Interspecific - "Similar species: short-eared owl (marshes) is streaked, has darker face and underparts, yellow eyes, shorter legs" (Peterson, 1961).

Intraspecific - Earhart and Johnson (1970) gave a detailed analysis of size and weight of barn owls: Male: wing = 311.7 mm; weight = 442.2 g and Female: wing = 316.1 mm; weight = 490.0 g.

Tyto alba (con't.)

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Tyto alba pratincola breeds from southwestern British Columbia, North Dakota, southern Minnesota, southern Wisconsin, southern Michigan, extreme southern Ontario, southern Quebec, and Massachusetts, south to Baja California, through Mexico to eastern Guatemala, probably eastern Nicaragua, and from Texas through the Gulf states to southern Florida (AOU, 1957).

B. California distribution of the species

Grinnell and Miller (1944), "Far and wide over low-level portions of State; metropolis lies in warm southern and interior sections. Humid coast belt north of Marin County rarely or but recently occupied; high altitudes, open deserts, and heavy forests avoided." Small (1974), "range in California - length of state at low elevations." Fairly common during May at San Jacinto Lake, Riverside County, California (Willemt and Jay, 1911).

C. California desert distribution

Mailliard and Grinnell (1905) noted during winter near Victorville, California. Common in the rocky canyons and about the mines in Kern County, California (Sheldon, 1909). Fairly rare during winter near the Salton Sea, California (Van Rossem, 1911). Lamb (1912) noted a barn owl in mesquite on 1 October in San Bernardino County, California (Mojave desert). "Fairly common resident throughout most of the open Sonoran zones except in the deserts of the southwest" (Phillips, Marshall and Monson, 1964).

D. Seasonal variations in distribution

Bent (1938) noted as permanent resident over most of range; wanders, especially in northernmost locations, in fall and winter. Gallup (1949) summarizes band returns from Escondido, San Diego County, California, and the age and distance traveled by the birds.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - grassland, hay fields, or open hill-sides... for food; thick-foliaged trees, or brush thickets, or buildings for day-time roosting." Peterson (1961), "Woodlands, groves, fields, farms, towns, canyons, cliffs." Bent (1938), "Barn owls are distinctly birds of the open country, rather than woodland birds."

B. Altitudinal range

Grinnell and Miller (1944), "... from - 240 feet, at southeast end of Salton Sea, up to 5500 feet, at Whitaker's Forest, 10 miles northeast of Badger, Tular County." Gullion, Pulich, and Evenden (1959) noted a barn

Tyto alba (con't.)

owl at 3200 feet in the Dead Mountains of southern Nevada. Miller (1955), "Barn owl - heard at 5000 feet in the oak belt of Mexico." Van Rossem (1914) notes barn owls breeding at 5280 feet in San Bernardino Mountains, California.

C. Home range size

Barn owl pairs retained essentially the same home ranges throughout the year. Owls hunted over areas as far as 1.5 - 2.3 miles from nest or roost sites (Smith, Wilson, and Frost, 1974). Evans and Emlen (1947) noted hunting range of a barn owl at Davis, California, given as 165 acres.

D. Territory requirements

Perch sites - Cunningham (1960) reported a barn owl used a Canary Island date palm (Phoenix canariensis) for roosting near Santa Monica, California. Fitch (1947) reported a barn owl found roosting in a large eucalyptus tree in Madera County, California. Barn owl found roosting in a Washington palm (Washingtonia filifera) near Davis, California (Evans and Emlen, 1947). Summer (1940) noted barn owls used barns, churches, and eucalyptus groves in southern California for roosting. Robertson (1931) cites use of eucalyptus trees as daytime roost sites.

Courtship and mating sites - Smith, Wilson, and Frost (1974), "copulation took place on a high, open platform within the nesting territory."

Nest sites - Grinnell and Miller (1944), "cavities for breeding, such as pot-holes in cliffs, holes in earth banks, holes in tree-trunks, and, as latterly available, human-built enclosures or shelters..." Nest sites: hollows in trees, holes in clay banks on cliffs, burrows, old wells, mining shafts, barns; nest height extremely variable (Bent, 1938). Peterson (1961), "Nest: on litter of fur pellets in barn, belfry, hollow tree, cave, hole in bank." No nest construction noted: "Instead, nests consisted of a mixture of broken pellets and fecal material... most nests were located in man-made structures" (Smith and Marti, 1976). Hollow tree cavities, barns, holes in banks, any concealed crevice. "Data - Santa Clara County, California, April 14, 1891. 4 eggs. Nest in hollow of an oak tree, 15 feet up" (Reed, 1965). Small (1974) noted "trees, caves, tunnels, mines, buildings, bridges, and verticle holes for... nesting." Barn owl found nesting on the ground in a box (2 feet wide, 3 feet long, 2 feet deep) in a Salicornia marsh at Playa del Rey, Los Angeles County, California on 8 May, 1951 (Quigley, 1954). Dixon (1922), "nest was placed in the tank on the bones, fur, pellets, and refuse that had accumulated." Nest sites near San Francisco included burrows in earth banks, nest boxes, and buildings (Smith and Hopkins, 1937). Behle (1941) notes barn owls nesting in cavities in mud banks formed by water seepage. Sharp (1907) noted nesting in trees, ledges, pigeon boxes, and mine shafts in Escondido, San Diego County, California.

V FOOD

A. Food preferences

Marti (1974) gave a detailed analysis of prey; mammals (especially Peromyscus and Microtus) accounted for about 98% of total prey biomass; birds were seldom

Tyto alba (con't.)

taken. Smith, Wilson, and Frost (1974) noted 68.9% meadow voles, 5.1% starlings, and 11.7% deer mice (major prey items). Microtus pennsylvanicus and Peromyscus spp. most frequent mammalian prey; Sturnus vulgaris most common avian prey; good data on food brought to nestlings (Smith and Marti, 1976). Earhart and Johnson (1970) found barn owl takes (primarily) small mammals (voles, mice, wood rats, cotton rats, shrews, rabbits, gophers); birds are occasionally taken, while amphibians, reptiles, and insects are rarely eaten. Alcorn (1942) lists food of barn owl from Nevada; Dipodomys (58%), Thomomys bottae (34%) of mammals taken; Brewer blackbird (78.6%) of birds taken. Analysis of barn owl food habits in central California; small rodents (especially Thomomys and Perognathus) most numerous prey; remains of young barn owls found in adult pellets (died in nest? - ed.) (Hawbecker, 1945). Reeder (1946) notes remains of a California mastiff bat (Eumops perotis californicus) in a barn owl pellet in the Hollywood Hills, Los Angeles County, California in August. Evans and Emlen (1947) gave a detailed description of food items of barn owl at Davis, California: mammals comprised 95.5%, birds 2.5%, and insects 2%. In Fresno County, California, food given as: Thomomys, Perodipus, Perognathus, and Peromyscus (Dixon, 1922). Bent (1938) gave a summary of food habits; prey heavily on small rodents; in California, gophers are favorite item. Food items from Baja California and various California locations included bats, Thomomys, Perognathus, weasel, petrels, murrelets, and killdeer (Banks, 1965). Barn owls selected against the white phase of Mus; more effectively captured conspicuous prey in dense vegetation (Kaufman, 1974). Finley (1906) reported consumption of large numbers of rodents; article describes general habits of barn owls. Fitch (1947) gives a detailed analysis of barn owl food items (Madera County, California). Composition by weight included: pocket gopher (71.4%), pocket mouse (8.5%), kangaroo rat (7.8%). Microtus comprised 77.29% of barn owl diet in Oregon; few birds taken Maser and Broide, 1966). Marti (1973) notes Microtus, Peromyscus, and Reithrodontomys were major items in diet; data broken down by years (1953; 1961-1970) from Colorado.

B. Foraging areas

Small (1974), "must have open fields, meadows, lawns, desert, and even short-grass marshy meadows and beaches for hunting." Bent (1938), "find their best food supplies in the open fields and meadows... buildings in villages, towns, and even cities." Cunningham (1960), "the birds foraged largely in the chaparral-covered Santa Monica Mountains."

C. Foraging strategies

Marti (1974), "Barn owls hunted strictly after dark... hunting on the wing in open areas." Smith and Marti (1976), "We did... observe some instances of diurnal hunting." Collins (1976) noted the "stockpiling" of prey when excess was available; not true caching, for is noted most often at nest sites. Payne (1962) reported sound orientates the owl towards the prey... laboratory study of hunting methods. Harte (1954) noted feeding at 1500 in January in New York.

Tyto alba (con't.)

D. Feeding phenology

Percent frequency of Peromyscus declined, while percent Microtus increased, from March to December (Marti, 1974). Fitch (1947) gave an analysis of seasonal changes in barn owl prey in Madera County, California: "the numbers of pocket mice taken increase, in relation to gophers, in the dry season... expected, since pocket mice hibernate." Evans and Emlen (1947) gave a detailed analysis of items taken seasonally by barn owls in Davis, California. Changes in prey consumed related to changes in prey abundance. Foster (1927) reported few differences in prey taken by season; variation in rain patterns indirectly affected prey captured. Barn owls were opportunistic, exploiting seasonal abundance of prey (adult birds during migration, nestlings during breeding, for example) (Otteni, Bolen, and Cottam, 1972).

E. Energy requirements

Wallick and Barrett (1976) reported barn owls ingested 74.1 g wet weight per day (21.5 g dry weight); assimilation energy was 86.0 kcal/day. Bartholomew, Lasiewski, and Crawford (1968) documents the role of gular flutter during heat stress in Tyto alba. Barn owls consumed 150 g of food per day (about $\frac{1}{2}$ adult body weight) at Davis, California (Evans and Emlen, 1947). Marti (1973) reported mean food eaten/day = 46.4 - 74.0 g and % of body weight eaten/day = 8.1 - 12.0%.

VI REPRODUCTION

A. Age of first breeding

Henny (1969) noted apparently will breed at one year of age. Barn owl found breeding only 10 months and 9 days after it had been banded as a nestling (Stewart, 1952).

B. Territorial behavior

Smith, Wilson, and Frost (1974), "Pairs... were weakly territorial and commonly defended only 15-30 feet around the nesting vicinity."

C. Courtship and mating behavior

Smith, Wilson, and Frost (1974) details courtship and mating behavior: "flew in wide circles... copulating at the culmination of the courtship flight."

D. Nesting phenology

Smith and Marti (1976), "Barn owls may breed at any time of the year if conditions are favorable." Smith, Wilson, and Frost (1970) notes nesting on 4 October; reviews other late nesting records. Egg dates - California: 100 records, 17 January to 7 June; 50 records, 9 March to 16 April, indicating the height of the season (Bent, 1938). Davis (1933) reported the

Tyto alba (con't.)

average nesting date as 9 April; the first nesting date as 25 March; the last nesting date as 20 April in California. Tyler (1915) notes second brood of barn owls (laid in early June) in Fresno County, California. Smith, Wilson, and Frost (1974), "the nesting cycle from the deposition of the first egg through the fledging of the last young of a nest required slightly over 3 months." Poole (1930) reported young found in the nest during October and January in eastern United States. Young found in nest on 26 November in Ohio; second brood (Goetz, 1932). Stewart (1952) notes have been found breeding during all months of the year (majority in March - April); will sometimes raise a second brood. In Los Angeles and San Bernardino Counties, California, egg dates ranged from 17 January to 16 April; mean date given as 10 March (Hanna, 1954). Stewart (1954) reported peak nesting period as March in southern California. Captive pair produced 6 clutches in 22 months; took 3 months from time of egg laying to fledging (Maestrelli, 1973). Barn owls may nest at anytime during the year; often lay second clutches if first successful; 4 months are required from egg laying to fledging in Connecticut (Ames, 1967).

E. Length of incubation period

Smith, Wilson, and Frost (1974) reported eggs were laid about every 2 days; incubation began with the deposition of the first egg; incubation period averaged 30.8 ± 0.94 days (range = 27-34 days). Incubation period given as 32-34 days; lists errors in periods previously published (Nice, 1954). Bent (1938) reported incubation begins with first egg; period from 21-24 days.

F. Length of nestling period

Smith, Wilson, and Frost (1974), "average time of 64.3 ± 0.45 days (range = 62-67 days) from hatching to fledging." Potter and Gillespie (1925), "Departure from nest - seven and one-half to eight weeks subsequent to hatching." Young barn owls fly from nest site between 60 and 70 days of age (Pickwell, 1948).

G. Growth rates

Summary of young development by days; complete wing and tail feathers acquired in 5 to 5.5 weeks (Bent, 1938). Summer (1929) gives an analysis of growth rates; young attain greater weight than adults at fledging; includes graph of growth rates in California. Potter and Gillespie (1925) summarize development: "pin feathers" in 12 days; primaries in 3 weeks; complete wing and tail feathers in $5\frac{1}{2}$ weeks. Pickwell (1948) reported detailed analysis of growth rates of barn owls near San Jose, California. Greatest weight was attained after 40 days in the nest (about 600 g); weight then decreased until flight.

H. Post-breeding behavior

Smith, Wilson, and Frost (1974), "September, after which the young began to leave the colony." Behle (1941) reported barn owls congregated in large

Tyto alba (con't.)

caverns at the termination of the nesting season in Utah; up to 30 owls were found roosting together. Stewart (1952) documents post-breeding dispersal of young and adult barn owls in eastern United States.

Colonial breeding - Smith, Wilson, and Frost (1974), "barn owls are usually solitary nesters but may also gather in loose associations... a small colony ... utilizing an abandoned steel mill."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1938) noted clutch size: average = 5-7; 9-11 have been found. Peterson (1961), "eggs (5-7;11) white". Clutches averaged 4.9 ± 0.7 eggs, range = 2-9 eggs; renesting clutches averaged 4.0 ± 0.46 eggs, range = 3-5 eggs; "most studies have reported larger average clutch sizes"; includes summary (Smith, Wilson, and Frost, 1974). Smith and Marti (1976), "clutch size averaged 4.4 ± 0.9 eggs (range, 2 to 9)." Clutch size = 4-6 eggs, pure white; size 1.70 x 1.30 inches (Reed, 1965).

B. Fledging success

Henny (1969) noted brood size averaged from 2.75 to 4.71 in southern California. Keith (1964) reported from 1932-1960, brood size averaged 4.4 young/nest (range = 1-11). Smith, Wilson, and Frost (1974) noted from 1968 to 1970, 1.1 to 2.0 young fledged per nest: "The productivity of the... colony was comparatively low"; gives summary of previous studies. Smith and Marti (1976), "1.95 young per successful nest." Young per nest, from 1928 to 1946 in San Diego County, California given as: $\bar{x} = 4.2$ young per nest; range = 3.3-4.6 young per nest; n = 87 nests (Yocom, 1949).

C. Mortality rates per age class

Henny (1969) reported overall yearly mortality rate in southern United States as 34.3%. Smith and Marti (1976), "reasons for the nesting failure included nest desertion, destruction of eggs, and death of the adults." Smith and Marti (1976), "causes of mortality of adult barn owls... included collisions with automobiles, shooting, accidents, and severe winter weather." Barn owls starved during heavy snowfall; cannot survive without food (during cold weather) for more than 3-4 days (Stewart, 1952). Howell (1934) noted three barn owls were killed by cars in less than 12 miles (location not given; apparently western United States - ed.).

D. Longevity

Summer (1940) reported maximum age: 10 years, 4 months; average age: 3 years, 2 months. Data collected near Pasadena, California (n = 11). The average life span, based on band returns, given as 1 year, 5 months, 25 days; one lived over 11 years (Stewart, 1952).

Tyto alba (con't.)

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bond (1936) notes killing of barn owls by prairie falcons (Falco mexicanus) in Kern County, California. Man, great horned owls, and prairie falcons are chief enemies (Bent, 1938). Fitch (1947) notes predation of barn owls by great horned owls in Madera County, California. Carnie (1954) notes barn owl preyed upon by golden eagle in California.

B. Competition

Bond (1946) notes peregrine falcons striking at barn owls near former's nest site. Smith and Marti (1976) feel barn owls are unable to compete with great horned owls (Bubo virginianus) in many locations. Silliman and von Bloeker (1937) notes possible territorial (winter feeding) attack of marsh hawk upon barn owl; owl driven away.

IX STATUS

A. Past population trends

Grinnell and Miller (1944), "status - resident; common, even (for an owl) abundant. Quite probably more numerous and widespread now than originally, by reason of increase in number and extent of suitable breeding sites; also locally because of reduction in numbers of owl-persecuting falconids such as prairie falcon." Resident throughout year in California (Small, 1974).

B. Present population status

Arbib (1976) reported as declining over much of its range, except for the southwest and Pacific Coast regions ("see no difficulties" in west).

C. Population limiting factors

Smith and Marti (1976), "barn owls... absence from the western desert areas may be due to a lack of suitable habitat." Fitch (1947), "Factors which limit the population probably include distribution of favorable nesting sites in relation to tracts of open grassland, and predators" in Madera County, California. Henny (1969), "Production per successful nest in southern California was highly oscillatory, suggesting that food availability may be a major factor."

D. Environmental quality: adverse impacts

Sumner (1940) cites shooting as a major cause of mortality in southern California.

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Tyto alba (con't.)

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SCREECH OWL

Otus asio

I TAXONOMY

A. Type description

Megascops asio cineraceus - AOU (1957), Ridgway, Auk 12(4), Oct., 1895; northwestern Mexico and contiguous border of United States = Fort Huachuca, Arizona.

Otus asio yumanensis - AOU (1957); Miller and Miller, Condor 53(4), July, 1951; ten miles west of Pilot Knob, one mile south of United States - Mexican border, Baja California.

Otus asio inyoensis - AOU (1957), Grinnell, Auk 45(2), April, 1928; Independence, Inyo County, California.

B. Current systematic treatments

Peters (1940) recognizes 22 races of Otus asio, including inyoensis and cineraceus; yumanensis not differentiated. Cory (1918) recognizes 14 races of Otus asio, including cineraceus; yumanensis and inyoensis not differentiated. Ridgway (1914) recognizes 12 races of Otus asio, including (only) cineraceus, "Arizona Screech Owl".

Davis (1959), "the relationships of xantusi are clearly with the races yumanensis and cineraceus." Behle (1948) notes a transition (in plumage) between inyoensis and cineraceus; problems exist in distinguishing these races. Miller and Miller (1951) recognize 8 races of Otus asio in the lower Colorado River drainage basin and watersheds of the trough of the Gulf of California (Utah, Nevada, southern California, Sonora, Baja); included O. a. cineraceus and O. a. inyoensis and described new race yumanensis.

Bent (1938) discusses life histories of 15 races. Grinnell and Miller (1944), "we find it impossible to distinguish birds from northern Arizona from those of southeastern mountains of that state and therefore consider mychophila (Oberholser, Joun. Wash. Acad. Sci. 27, 1937:356) a synonym of cineraceus."

Marshall (1967) gives a detailed analysis of the taxonomic relationships of Otus.

Synonymy- Megascops asio (Ross, 1969); Megascops asio cineraceus, Otus asio gilmani, Otus asio mychophilus (Miller and Miller, 1951); Cory (1918) Arizona screech owl = Mexican screech owl.

II DESCRIPTION

Peterson (1961), "Field marks: A common widespread small (7-10 in.) owl with conspicuous ear tufts. Young birds lack conspicuous ears. Similar species: (1) In southeastern Arizona and southwest New Mexico see whiskered owl, (2) see also flammulated owl."

Otus asio (con't.)

Otus asio cineraceus: Reed (1965) "a gray form with little or no buff, and more numerous barred below." Earhart and Johnson (1970) give a detailed analysis of the size and weight of this race: Male: wing = 155.7 mm; weight = 111.2 g and Female: wing = 159.1 mm; weight 122.7 g.

Otus asio yumanensis: Marshall (1967), "this is a pale pinkish-gray, fine-textured, thinly streaked, small owl... bill black." Miller and Miller (1951), "Similar to O. a. cineraceus but size smaller."

Otus asio inyoensis: Miller and Miller (1951), "Coloration similar to O. a. cineraceus but background colors of underparts whiter and white areas about face and legs more extensive." Earhart and Johnson (1970) give detailed analysis of size and weight of this race: Male: wing = 163.5 mm; weight = 132.5 g and Female: wing = 165.5 mm; weight = 154.6 g.

III DISTRIBUTION

A. Overall distribution of the species

Otus asio is "resident, from southeastern Alaska, southern British Columbia, southern Manitoba, southern Ontario, southern Quebec, and Maine south to the Cape district of Baja California, Jalisco, Hidalgo, southern Tamaulipas, and Florida" (AOU, 1957).

Otus asio inyoensis is found in the Inyo region of California, principally Owens Valley north to the Carson Sink area of Nevada; apparently extends across central Nevada to northwestern Utah (Miller and Miller, 1951). Hall (1938) noted in Churchill County, Utah and stated that this race extends into northeastern Utah. AOU (1957) found this race in central Nevada (Fallon) and northwestern Utah to the Inyo region of California, between the Sierra Nevada and Death Valley. Also in eastern California from the White Mountains south to Owens Valley and southeastward to the Panamint Mountains; Nevada; and northern Utah (Peters, 1940).

Otus asio cineraceus is found in southern Nevada south to latitude 38° (exclusive of lower Colorado River Valley), southern Utah, probably southeastern Colorado, and southwestern New Mexico, south throughout Arizona, except the Colorado River Valley south of Fort Mojave area, to central Sonora and to western Texas west of the Pecos River (Miller and Miller, 1951). AOU (1957) reported in southern Nevada (Grapevine Mountains), exclusive of Colorado River Valley, and central and southern Utah south through central and eastern Arizona and southwestern New Mexico to central Sonora and western Texas. Also in the mountains of central and southern Arizona, southern New Mexico and central-western Texas (Peters, 1940).

Otus asio yumanensis is found in the lower Colorado River Valley from vicinity of Fort Mojave in extreme southern Nevada and western Arizona, south to the delta in Sonora and Baja California and the Colorado desert of California west to Shaver's Well (near Mecca) (Miller and Miller, 1951). AOU (1957) reported in the lower Colorado and Gila River Valleys and adjoining deserts in

Otus asio (con't.)

extreme southern Nevada, southeastern California (west to Coachella Valley), southwestern Arizona, northwestern Baja California, and northwestern Sonora. "Colorado desert, lower Colorado River, and northwestern Sonora" (Marshall, 1967).

B. California distribution of the species

Otus asio- "Range in California - length of state at lower elevations, except in north central portion and most of eastern and southeastern portion" (Small, 1974).

Otus asio inyoensis- "enough is known to show that the form ranges beyond the Inyo region... over a large sector... Great Basin" (Miller, 1941). Grinnell and Miller (1944) found in "Inyo region, east and southeast of southern Sierra Nevada; includes Owens Valley and mountains to eastward to edge of Death Valley. Northernmost known station in state, Roberts Ranch, 8250 feet, Wyman Creek, White Mountains, extreme northern Inyo County; southernmost, Walker Creek, 5200 feet, 4 miles southwest of Olancho, Inyo County; easternmost, near Lee Pump, 6000 feet, in northern section of Panamint Mountains, Inyo County."

Otus asio cineraceus- "Known to be present in but two localities: Grapevine Mountains, Inyo County; Clark Mountain, San Bernardino County, 6300 feet" Grinnell and Miller, 1944.

C. California desert distribution

Otus asio is heard in trees around Palm Springs, California, during February (Grinnell, 1912). Van Rossem (1911) noted near Brawley, Salton Sea region, California, during the winter. Clary (1933) notes this race in Coachella Valley, California in December. Miller (1928) discusses desert distribution of O. a. gilmani (= yumanensis of AOU, 1957). Screech owl was noted January at Twentynine Palms, San Bernardino County, California by Carter (1937). "A race occurs in the Inyo region of Owens Valley and mountains eastward to edge of Death Valley. Breeds" (Small, 1974). Wauer (1962) had several records in the mountains surrounding Death Valley, but few records from the Valley, proper (at Cow Creek in November). Phillips et al (1964) discusses ranges of Screech owls in Arizona deserts, including cineraceus, yumanensis, and inyoensis (the latter of which is absent from Arizona).

Otus asio yumanensis is found "west of Cottonwood Springs in the Little San Bernardino Mountains of Riverside and San Bernardino Counties. A sparse population occurs in the pinon and scrub oak belt" (Miller and Miller, 1951). Marshall (1967) found "at Whiteriver and Cottonwood Springs in the Colorado Desert of California."

D. Additional distribution records

Otus asio yumanensis was noted in the Mohave Valley of southern Nevada in October (Gullion et al, 1959).

Otus asio cineraceus was noted at 1800 feet in Clark County, southern Nevada, in November (Gullion et al, 1959).

Otus asio (con't.)

E. Seasonal variations in distribution

Van Camp and Henny (1975) mentioned that there was no evidence from banding data to suggest that screech owls (in northeastern United States) migrate.

IV HABITAT

A. Biotopic affinities

Screech owl habitat is usually woodlands, farm groves, shade trees, or wooded canyons (Peterson, 1961). Otus asio is given as rare and irregular in pine-oak; has a preference for dense oak groves with numerous open places (Marshall, 1957). Small (1974) noted the habitat as broken woodland of oaks, conifers, or mixed hardwoods and conifers, savannah, riparian woodland, pinon pines and junipers, suburbs, small towns, farms, and ranches. Marshall (1956) listed the habitat as the encinal (oak) woodland in Arizona. In the western deserts Otus asio ranges "from the oak and pinon belts of the mountains down through the desert scrub habitat of the lowest basins and river valleys. Mesquite brush,. . and widely spaced palo verdes, iron-woods and the larger cacti are adequate plant cover" (Miller and Miller, 1951). Dixon (1922) often noted them near human habitations, perhaps being influenced by the abundance of mice often found near buildings. "On the mountains, tracts of pinon pines; in Owens Valley, riparian woodland and planted trees (poplars and cottonwoods) at towns and ranches" (Grinnell and Miller, 1944). Johnson (1965) mentioned "at 8100 feet, from a mixed forest-woodland composed of ponderosa pine, bristlecone pine, white fir, pinon, and mountain mahogany" in southern Nevada. Also in pinon and juniper woodland (Grinnell and Miller, 1944). Marshall (1967) noted in the thick stands of willow and tamarisk along the lower Colorado River above Imperial Dam, Arizona. "It occurs in riparian trees at... oases."

B. Altitudinal range

Miller and Miller (1951) reported a specimen taken at Roberts Ranch, Wyman Creek, White Mountains, Inyo County, 8250 feet. Grinnell and Miller (1944) noted "altitudes of recorded occurrence in Owens Valley, down to 3900 feet, at Independence." Also noted up to the Upper Sonoran and Transition zones, elevation 6500 feet in Arizona (Jenks and Stevenson, 1937). Miller and Miller, (1951) described a specimen taken on southeast side of Clark Mountain, San Bernardino County, California, at 6300 feet as well as a specimen taken in Cedar Canyon, 5000-5300 feet, in the Providence Mountains, California.

C. Territory requirements

Territory - "Screech owls live on small territories in woodlands and open forests, where they are the most abundant birds of prey" (Marshall, 1967). "Male owls stationed on territories may be spaced by less than one hundred yards apart... more commonly two hundred to four hundred yards" (Miller and Miller, 1951).

Perch sites - Allard (1937) describes arrival and departures at roost sites (nest boxes). A study population in Ohio used wood duck nest boxes for

Otus asio (con't.)

roosting and feeding stations during winter as described by Van Camp and Henny (1975). "When hunting, the screech owl perches on twigs projecting slightly from the foliage... or beneath the canopy" (Marshall, 1957). Robertson (1931) cites use of eucalyptus trees as daytime roost sites.

Courtship and mating sites - McQueen (1972) reported copulation took place on a tree branch.

Nest sites - Hanna (1936) reported a nest site on Mojave desert, San Bernardino County: 5 feet up in the trunk of a joshua tree in May. Sumner (1933) described an owl nest 20 feet from the ground in a hole in the dead limb of a eucalyptus tree, while Hanna (1940) found a nest in an old hole 10 feet up in a dead joshua tree in the Mojave desert, San Bernardino County, California in April. In California, they often use flicker holes as nest sites (Dixon, 1922). A study population in Ohio used nest boxes established for wood ducks (Van Camp and Henny, 1975). Reed (1965) reported nesting in hollow trees, barns or other buildings while Peterson (1961) noted "in tree cavity, woodpecker hole." Also found nesting in sahuaro cactus in Arizona (Willard, 1912).

V FOOD

A. Food preferences

"This species feeds upon insects (grasshoppers, crickets, beetles, moths, caterpillars) plus other arthropods (scorpions, spiders, centipedes, crayfish) and vertebrates (fishes, amphibians, reptiles, birds, mammals)." There is a great deal of variation in food habits between subspecies (Earhart and Johnson, 1970). Ross (1969) gave a detailed analysis of the food habits in western North America with an extensive literature review.

Centipedes (Scolopendra) and wolf spiders (Lycosa) were the most abundant arthropod (non-insect) prey taken; grasshoppers, crickets, beetles, and moths were most often taken insect prey; vertebrate prey included frogs, lizards, small birds, and mice. "Food remains in 48 stomachs... were 83 crickets, 39 grasshoppers, 30 mole crickets, 24 caterpillars, 19 spiders, 18 beetles, 18 centipedes, 16 moths, 12 other insects, 8 walkingsticks, 7 katydids, 5 scorpions, 4 praying mantids, 4 roaches, 3 sowbugs, 3 large orthoptera, 2 mice... one small bird, nocturnal snake, and a nocturnal lizard" in southern Arizona (Marshall, 1957). Dixon (1922) reported feeding primarily upon mice and the larger insects in California while Bent (1938) described food as kangaroo rats, gophers, mice, rats, small birds, frogs, lizards, snakes, crawfish, scorpions, grasshoppers, and beetles. Prey fed nestlings included birds (majority of items), Microtus, Hyla, and Heterodon (Stewart, 1969).

Frazar (1877) noted an owl taking fish and Kaufman (1974) reported owls selected against white phase of Mus; more effectively captured conspicuous prey in dense vegetation. In southern Arizona food was described as Hemiptera, spiders, vinageroues, scorpions, grasshoppers, beetles, and cicadas' (Campbell, 1934). Earhart and Johnson (1970) mentioned that unlike most subspecies of Otus asio, Mexican screech owls feed almost entirely upon arthropods.

B. Foraging areas

Marshall (1957) reported food taken at or near the ground in pine-oak woodland in Arizona.

Otus asio (con't.)

C. Foraging strategies

Van Camp and Henny (1975) reported the earliest time feeding began was 2025, and the latest was 2112; earliest time feeding ceased was 0250, and the latest was 0415. "Small arboreal horned owls that fly from a branch to catch mostly invertebrate prey on the ground or in foliage" (Marshall, 1967). Ross (1969) described the methods by which Otus asio captures prey as: (1) visual detection of ground-dwelling and vegetation-inhabiting prey and (2) individual pursuit and capture of winged insect prey in flight. Screech owls were classified as members of the "ground-insect" foraging guild in Los Angeles County, California (Salt, 1953). Treat (1889) noted a screech owl that was killed while trying to remove fish from a trap in the water.

D. Feeding phenology

"During the nesting season migrant birds replace mammals in importance, and during the late summer insects become important" (Van Camp and Henny, 1975).

E. Energy requirements

Mosher (1976) reviews respiratory water loss in screech owls; cites other works.

VI REPRODUCTION

A. Age of first breeding

Van Camp and Henny (1975) estimated that 77 to 83% of birds nested at 1 year of age.

B. Courtship and mating behavior

McQueen (1972) details courtship behavior of screech owls..."male... was... approached by the female." Marshall (1967) notes that Otus asio are duetting (song); male and female songs often closely matched, ending together. There is a general account of nesting in New York where adults secured new mates rapidly due to surplus of unmated birds (Allen, 1924).

C. Nesting penology

Bent (1938) reported egg dates in California: 127 records, 7 March to 5 June; 64 records, 7 April to 3 May. Davis (1933) reported the average nesting date as 15 April; the first nesting date as 8 March; and the last nesting date as 9 May. A nest box was occupied from 6 February to 25 June in Alameda County, California (Allen, 1943). Pairs were noted at nest boxes in early February; egg laying peaked about 15 March; hatching took place from mid-April to early May; young had left nests by early June (Van Camp and Henny, 1975). Reed (1965) described nesting during April or May.

Otus asio (con't.)

D. Length of incubation period

Van Camp and Henny (1975) reviews literature on incubation period; average length of incubation about 26 days. Nice (1954) gave incubation period as 26 days; lists errors in periods previously published.

E. Length of nestling period

Van Camp and Henny (1975) reviews literature on nestling period; young leave the nest at from 30 to 35 days of age.

F. Growth rates

Test (1945) gives short comment on growth of juvenile feathers in screech owls while Sumner (1928) gives an analysis of screech owl development at Claremont, California (O. a. quercinus); includes description of behavior, plumage, food; growth curve shown. Analysis of growth rates; young had not attained adult weight at fledging; includes graph of growth curves (Sumner, 1929). Sherman (1911) documents growth rates (by weight) of young owls by day.

G. Post-breeding behavior

Young owls begin leaving their natal areas in late summer or early fall; adults do not leave nesting area (Van Camp and Henny, 1975).

VII POPULATION PARAMETERS

A. Clutch size

Peterson (1961), "eggs (4-5;7) white". Clutch size = 4 or 5 eggs in California (Dixon, 1922). Bent (1938) reported clutch size in California equal to 3-5 while Reed (1965) reported clutch size equal to 5-8 eggs, white; size 1.35 x 1.20 inches. Clutch size averaged 4.43 eggs and ranged from 2-10 in this study by Van Camp and Henny (1975) with further data given on clutch size from other locations. Murray (1976) reported clutch size decreases to the north along the west coast; clutch size averaged about 3.63 in southwest.

B. Fledging success

Van Camp and Henny (1975) reported 3.80 young fledged per successful nest; 69.2% of the nesting attempts were successful; 2.55 to 2.63 young were fledged per breeding pair in Ohio. Four screech owls fledged from a nest box in Alameda County, California (Allen, 1943). Clabaugh (1925) notes near Berkeley, California, fledging success ranged from 58 to 100%.

C. Mortality rates per age class

Approximately 32.8 to 39.0% of the adult population dies annually (Van Camp and Henny, 1975). About 65.9% of first-year young died (Van Camp

Otus asio (con't.)

and Henny, 1975). Van Camp and Henny (1975) give causes of nest losses as: (1) deserted or destroyed (majority), (2) raccoon predation, (3) hatching failure, (4) young dead in nest, and (5) human predation. Hawbecker (1938) felt screech owls near Santa Cruz, California suffered a great deal of mortality from striking cars. Eighty-two of 113 deaths were caused by hitting cars (Sutton, 1927).

D. Longevity

Sumner (1940) reported maximum age: 13 years; average age: 5 years; with data collected near Pasadena, California (n = 5).

E. Habitat density figures

Balda (1970) reported 3 pairs of screech owls per 100 acres in an oak woodland in southern Arizona.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Predators of Otus asio given as hawks, great horned owls, and tree-climbing mammals (Marshall, 1967). Orians and Kuhlman (1956) also reported screech owls were preyed upon by great horned owls. Remains of Otus asio found in a spotted owl pellet (Marshall, 1942). Fitch (1947) notes predation by great horned owls on Otus asio in Madera County, California. Minor component of great horned owl diet. Whitfield (1934) notes taking of a screech owl by a gopher snake in Arizona.

B. Competition

Ross (1969) concluded that, due to the abundance of arthropod prey, food competition does not take place among sympatric members of the genus Otus. "The screech owl... will yield dense woodland of mountain slopes and canyons to (Otus) trichopsis" (Marshall, 1957). Dixon (1922) notes screech owls were found to drive other species out of nest boxes in California (note: possible shortage of nest holes - ed.). American kestrel apparently drove a screech owl from a nest hole in the Mojave desert in San Bernardino County, California (Hanna, 1940). Sumner (1933) noted near Sacramento, California, four American kestrel young and one young screech owl in the same nest (possible nest-site competition - ed.). A screech owl was noted on the Mojave desert taking-over an American kestrel nest (Hanna, 1936).

C. Miscellaneous comments

Hall (1947) notes screech owl egg in active crow's nest near Fullerton, California; all eggs appeared fertile.

Otus asio (con't.)

X STATUS

A. General comments

Small (1974) notes resident throughout California. Alcorn (1946) reported Otus asio inyoensis: a common, but not abundant, resident in Churchill County, Nevada. Grinnell and Miller (1944), "status - resident. Fairly common locally" also "status - resident, probably permanently, of restricted areas along Nevada boundry."

B. Population limiting factors

Miller and Miller (1951), "daytime concealment and nest sites are probably the needs that limit these owls to the vicinity of the dense, larger-trunked... desert shrubs or to the large cacti or streamside cottonwoods in which woodpecker cavities are frequent."

C. Environmental quality: adverse impacts

Van Camp and Henny (1975) noted screech owls in nothern Ohio had low (relative) pesticide residues (eggs), and did not display eggshell thinning; reviews literature. Screech owl eggs had low pesticide residues, and did not show shell thinning in Ohio (Klaas and Swineford, 1976).

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ELF OWL
Micrathene whitneyi

I TAXONOMY

A. Type description

Athene whitneyi - AOU (1957) Cooper, Proc. California Acad. Sci., ser. 1, 2, (before December) 1861. Fort Mojave, latitude 35°, Colorado Valley (Arizona).

B. Current systematic treatments

Peters (1940) recognizes 4 races of Micrathene whitneyi; range of M. w. whitneyi: "desert areas of southeastern California, southern Arizona, southwestern New Mexico and northern Sonora."

Cory (1918) recognizes 3 races of elf owl, including whitneyi; range given as - "southeastern California, Arizona and southwestern New Mexico, to Sonora, Mexico."

Synonomies - Grinnell and Miller (1944), Micropallas whitneyi; M. w. whitneyi. Whitney owl; elf owl; Whitney elf owl; Whitney dwarf owl.

II DESCRIPTION

A. External morphology of adults

Ridgway (1914) gives detailed description of adult and subadult plumages; sexes alike. Northern (1965) noted M. w. whitneyi: wing, 110.7 mm; tail, 51.6 mm; culmen (from cere), 8.9 mm. Miller (1935) describes syringes of elf owls, including size and functioning. "Field marks: a tiny (5-6 inch), small-headed earless owl, size of a chunky sparrow. Under parts softly striped with rusty; 'eyebrows' white" (Peterson, 1961).

B. External morphology of subadult age classes

Ridgway (1914) noted young - similar to adults... underparts... irregularly marbled or clouded with white and light brownish gray narrowly barred with darker.

C. Distinguishing characteristics

Interspecific - Peterson (1961), "similar species: ferruginous and pygmy owls have longer tails, extending well beyond wing-tips. Have black 'eyes' on hind neck, stripes on flanks."

Intraspecific - Ridgway (1914) gives two color phases; gray phase and brown phase, the latter being the Type... specimen, from Fort Mojave, Arizona. Earhart and Johnson (1970), detailed analysis of size dimorphism in Arizona elf owl. Male: wing = 107.6 mm and female: wing = 110.2 mm. Northern (1965) details plumage differences among races of Micrathene whitneyi.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) reported breeding from lower Colorado River Valley of California and Arizona, southern Arizona, southwestern New Mexico, and southwestern Texas south to Sonora, Guanajuato, Mexico, and Puebla. Casual at Cottonwood Springs, Riverside County, California. Winters largely or entirely south of United States. Moore (1938) notes two male M. w. whitneyi taken in March and April at Guirocoba, Sonora, Mexico, extend the range of this race 200 miles farther south.

B. California distribution of the species

Ridgway (1902) notes specimen of elf owl taken in Kern County, California, on 10 May, 1882. "In general, valley of Colorado River. More definitely, has been found (birds and eggs obtained) on the California side of that river only within about 25 miles north of Yuma - vicinity of Laguna Dam and Bard" (Grinnell and Miller, 1944).

C. Desert distribution

Small (1974), "range in California - formerly lower Colorado River Valley; now only known from a few oases in northern Colorado Desert." Elf owl noted on 16 April at Cottonwood Springs, California (by Arnold Small) (Anonymous, 1955). Ligon (1968) reported "They breed... apparently sporadically, in extreme southeastern California... at Cottonwood Springs, in Joshua Tree National Monument, California. This is apparently the westernmost record for the species." Miller (1946) notes breeding of a pair of elf owls at Cottonwood Springs, Joshua Tree National Monument, Riverside County, California, 6 May. Pair of elf owls at Bard, Imperial County, California (April, 1915); frequented cottonwood trees (Kimball, 1922). Loomis (1902) reported elf owl 20 April in San Bernardino County at 2000 feet. Brown (1904) found nesting in low numbers on Duncan Flats (Senator Mine Basin), California, in May. Phillips, Marshall, and Monson (1964), "scarce to rare in Colorado Valley below Davis Dam."

Brown (1903) reported encounters with elf owls in Arizona; found nesting in cactus and trees above Yuma, Arizona.

James and Hayse (1963) found elf owl nesting in south Texas; had been previously reported from area (early 1900's).

D. Seasonal variations in distribution

Grinnell and Miller (1944), "... the tenure of the species within the confines of this state (California) may be impermanent." An adult male elf owl collected 11 January in central Sinaloa was 500 miles northwest of the nearest reported wintering locality (Ely and Crossin, 1972). Ligon (1968) reported migrating to southern Mexico and wintering in the Rio Balsas Basin.

Micrathene whitneyi (con't.)

Taken near Gulf Coast in Hidalgo County, Texas, 5 April (unusual habitat) (Sennett, 1889). Phillips (1942) notes does not winter in southern Arizona; entire population apparently migrates into Mexico.

IV HABITAT

A. Biotopic affinities

Bent (1938) reported common in the low, hot, dry lower Sonoran plains of the river bottoms and tablelands (of Arizona); mesquite, creosote, small cacti, and saguaro covered areas preferred. Grinnell and Miller (1944), "habitat - portions of Colorado desert where woodpecker excavations, notably in giant cactuses, afford nesting places and day-time shelter." Peterson (1961) notes "habitat: saguaro deserts, wooded canyons." Small (1974) reported "habitat - riparian woodland, oases, saguaro cacti." "They inhabit extremely hot, arid areas... They occur in the mountains (in pine-oak woodland), in the low desert, and in various intermediate habitats" (Ligon, 1968). Occurs in all types of woodland, preferring hillsides (Marshall, 1957). Dixon (1959) noted as a breeding species in open desert scrub bisected by a dry streamcourse (south Texas); plants included Condalia and Acacia. Marshall (1956) reported habitat of elf owls as the encinal (oak) woodland in Arizona. Campbell (1934) noted nesting in upper Sonoran grasslands in southern Arizona; elf owls are thus not limited to the sahuaro cactus belt. Sutton (1943) noted in oak and other deciduous woodland in Arizona. Elf owl habitat in Arizona: flat mesa, covered with creosote bushes, and with scattered clumps of sahuaro cactus (Willard, 1912).

B. Altitudinal range

Miller (1955) noted elf owl at 5000 feet in the oak belt in Mexico. Bent (1938) found nesting to 6100 feet (Santa Rita Mountains, Arizona). Marshall (1957) reported reaches its uppermost altitudinal limit within pine-oak woodland (in southern Arizona). Ligon (1968) noted to inhabit pine-oak woodlands in southern Arizona up to 7000 feet. Miller (1929) notes "they breed in the mountains up to altitudes far above the saguaro belt." Sutton (1943) noted at 4000-5000 feet in May in Arizona. Smith (1907) noted to 5000 feet in Arizona in August.

C. Home range size

Territories are small and centered around the nest hole; two pairs held adjacent territories with the nest trees only 86 feet apart (Ligon, 1968).

D. Territory requirements

Perch sites - uses acorn woodpecker holes as roost sites; perches on low bare or dead branches of trees and bushes (Marshall, 1957). Ligon (1968) noted bushes or trees (dense foliage) used for roosting during the day.

Nest sites - in woodpecker holes (often in saguaro), usually from 15-20 feet from the ground (Bent, 1938). Peterson (1961), "nest: in woodpecker

Micrathene whitneyi (con't.)

hole in saguaro or tree." Nest located in California was 20 feet high in a woodpecker hole in a sahuaro cactus (Brown, 1904). Miller (1929) noted breeding in holes in cottonwoods in southern Arizona. Miller (1946) noted pair of elf owls selected woodpecker hole in cottonwood tree (6 May) for nesting at Cottonwood Spring, Riverside County, California. Nest hole located 14 feet from ground in a saguaro (Yuma County, Arizona); had been excavated by a gilder flicker (Walker, 1943). Ligon (1968) gives detailed description of nest site measurements; all nests were in woodpecker holes, from 5.35-18.38in ($\bar{x}$ = 10.33 inches) above ground. Uses acorn woodpecker holes for nest sites (Marshall, 1957). Nest in deserted woodpecker holes in trees and large cactus (Reed, 1965). Willard (1923) notes elf owl nesting in woodpecker hole in a mesquite tree (20 feet up). Normally nests in cactus; nests also found in sycamore, cottonwood, mesquite, and other trees (woodpecker holes); in Arizona (Fowler, 1903). Willard (1912) describes encounters with nesting elf owls in Arizona; includes photo of nest site in sahuaro cactus. Swarth (1905) found nesting in holes in mesquite trees in Arizona. Gilman (1909) reported found nesting in trees along the Gila River, Arizona (used woodpecker holes).

E. Special habitat requirements

Raitt and Maze (1968), "the elf owl... absense from the study area and other creosotebush communities appears to be a result of the extreme scarcity of any plants over six feet tall." Dixon (1959) reported elf owls are restricted (primarily) to the oak belts in many desert areas. "Elf owls appear to be completely dependent on woodpeckers for nest sites" (Ligon, 1968).

F. Miscellaneous requirements

Ligon (1968) reported elf owls seldom use gular flutter; cavities in saguaro cactus makes it possible for them to live in deserts without meeting the extremely high temperature which prevails there seasonally.

V FOOD

A. Food preferences

Earhart and Johnson (1970) reported feeds principally upon insects (beetles, grasshoppers, moths, crickets) and other arthropods (scorpions). Marshall (1957) notes prey: scorpions, grasshoppers, moths, crickets, roaches. Food items of nesting elf owls in Yuma County, Arizona, given as insects, spiders, and scorpions (Walker, 1943). Insects form the major prey of elf owls; the taking of scorpions, lizards, and snakes is also noted (rarely taken) (Ligon, 1968). Campbell (1934) notes food items in southern Arizona given as - bot fly pupae, Hemipterans, and vinogerones. Food items in Arizona: Lepidopteran larvae and centipedes (Bruner, 1926). Swarth (1905) reported of 20 elf owls examined in Arizona, all contained only insects and beetles.

B. Foraging areas

Marshall (1957) noted feeds from perches overlooking clear ground, grass. "Foraging by flying over open ground is common in areas where ground vegetation is sparse" (Ligon, 1968).

C. Foraging strategies

Earhart and Johnson (1970), "elf owls... capture insects with their feet." When hunting (nocturnal), the bird moves rapidly between perches; often catches insects on the wing (Marshall, 1957). Ligon (1968) gives detailed description of feeding methods and frequency of use; owls fly from perches in pursuit of flying insects, flutter and hover among foliage, and normally use feet in prey capture. Walker (1943) noted "fly-catching" near a century plant bloom; also hung upside down from bloom and picked-off insects; includes photos.

D. Feeding phenology

Ligon (1968), "In early July noctuid moths and crickets were the primary items in the diet, but by mid-July scarab beetles formed most of the food... This change in diet is correlated with the onset of summer rains when... beetles emerge."

E. Energy requirements

Mosher (1976) reviews respiratory water loss in elf owls. Ligon (1968) gives detailed analysis of body temperature, oxygen consumption, metabolic rates, and evaporative cooling. Lower critical temperature of elf owls given as 33° C (Kendeigh, 1969).

VI REPRODUCTION

A. Territorial behavior

Marshall (1957) reported most territory behavior takes place at or near the nest hole, which is located within hearing distance from the next pair. Ligon (1968) gives detailed description of territory behavior in elf owls; "territoriality probably functions primarily in formation and maintenance of the pair bond." Walker (1943) reported elf owls were not strongly territorial, either inter - or intraspecifically.

B. Courtship and mating behavior

Ligon (1968) gives detailed description of pair formation, pair relations, site selection, copulation, and general breeding behavior. Summary: "male elf owls appear to arrive on the breeding grounds, locate cavities, and set up territories prior to the arrival of the females... pair formation appears to take place rapidly, within a single night... male elf owls sing from potential nest sites... females are fed by their mates. Miller (1946) describes courtship and mating behavior of elf owls in California; male noted bringing food to female.

C. Nesting phenology

Ligon (1968) reported mean laying date was 1 June in 1965, 26 May in 1966. "The insectivorous elf owl may also demonstrate a relationship between air temperature and time of laying... A temperature drop to below freezing would

Micrathene whitneyi (con't.)

temporarily decrease the food supply." Bent (1938) reported egg dates in Arizona: 28 records, 3 May to 9 June; 14 records, 22 May to 26 May, indicating the height of the season. Brewster (1883) noted in Arizona, fresh eggs found from 10 May to 27 June (breeds rather late in season). Nesting season in California begins in early May (Brown, 1904). Hanna (1935) noted egg dates: 14 April to 8 June in Arizona.

D. Length of incubation period

Ligon (1968) reported incubation given as 24 days; eggs are layed on alternate days; the eggs normally hatch within 24 hours of each other (in 3 egg clutches). Bent (1938) noted incubation period given as "about 2 weeks".

E. Length of nestling period

Ligon (1968), "The nestling life of elf owls ranges from 28 to 33 days."

F. Growth rates

Ligon (1968) gives detailed analysis of growth rates; most rapid growth during first 14 days after hatching; young weigh about 40 g at fledging (includes figure of growth curve).

VII POPULATION PARAMETERS

A. Clutch size

Reed (1965) reported clutch size = 3-5 eggs, slight gloss; size 1.02 x 0.90 inches. Peterson (1961), "eggs (3-4) white." Clutch size: average = 3; range = 2-5 (Bent, 1938). Ligon (1968) noted most common clutch given as 3 eggs; range of 1-5 eggs. Hanna (1935) noted clutch size averaged 2.78 eggs per nest in Arizona; range = 2-4.

B. Fledging success

Ligon (1968) reported nest success was very high; only nest failures caused by the investigator.

C. Seasonal abundance

Called the numerous of all owl species in southern Arizona during breeding; entire population migrates south in winter (Phillips, 1942).

D. Habitat density figures

Balda (1970) reported elf owl: 3 pairs/100 acres in an oak - juniper - pine woodland in southern Arizona. "Four dead Chihuahua pines in one-half mile were occupied" (Marshall, 1957). Walker (1974) described as very dense at one time; over 11 nests found in one square mile of desert in Arizona.

Micrathene whitneyi (con't.)

I INTERSPECIFIC INTERACTIONS

A. Predation

Ligon (1968) notes attacks of robins upon adult and young elf owl; owls escaped.

B. Competition

Phillips et al (1964), "they defend their favorite nest sites in sycamores from the intrusions of spotted screech owls" in southern Arizona. Elf owls gained possession of an acorn woodpecker hole shortly after excavation by the woodpecker (Ligon, 1968). Marshall (1957) noted appears to tolerate extensive range overlap with Otus asio in pine-oak woodlands of southern Arizona.

IX STATUS

A. Past population trends

Grinnell and Miller (1944), "status - summer resident. On this, western, margin of the range of the species, individuals are probably few in total number." Small (1974) noted very rare summer visitor to California; breeds. Once very common in Arizona; has been declining since the 1950's (Walker, 1974).

B. Present population status

Barlow and Johnson (1967) reported elf owls may be extending their range northward in Texas, New Mexico, and Arizona; summarizes sight records.

C. Population limiting factors

Marshall (1957), "its only limitation seems to be intolerance to pure stands of pine."

D. Environmental quality: adverse impacts

Ely and Crossin (1972), "The cause of the affliction... may possibly have resulted from the intake of some chemical poisoning during feeding." Walker (1974) noted decline in Arizona might be due to increased habitat destruction and/or insecticide use.

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WESTERN BURROWING OWL
Athene cunicularia

I TAXONOMY

A. Type description

Strix hypugaea - AOU (1957), Bonaparte, Amer. Orn., Vol. 1, 1825. Western United States = plains of the Platte River.

B. Current systematic treatments

Peters (1940) recognizes 18 races of Athene cunicularia, including hypugaea; range given as: "Plains and prairies of western North America including islands off the coasts of southern California, lower California and western Mexico from southern British Columbia, southern Saskatchewan and western Manitoba, east to the eastern border of the Great Plains, south to Honduras."

Cory (1918) recognizes 15 races of burrowing owl, including hypugaea; range given as: "Unforested parts of North and Middle America, from British Columbia and Saskatchewan to Panama, and in United States from the Pacific coast and islands of Santa Barbara, Guadeloupe, etc., east to eastern border of the Great Plains."

Synonymy - Peters (1940), Speotyto cunicularia hypugaea; Grinnell and Miller (1944), Strix californica; S. cunicularia; Athene socialis; A. hypogaea; A. cunicularia; Speotyto cunicularia; S. hypogaea; S. cunicularia obscura; S. c. hypugaea. Grinnell and Miller (1944), large-headed burrowing owl; burrowing owl, North American burrowing owl; dusky burrowing owl; ground owl.

II DESCRIPTION

A. External morphology of adults

Ridgway (1914) gives detailed description of adult and subadult plumages; sexes alike. Peterson (1961), "Field marks: note the very long legs. A small brown owl... round head, long legs, stubby tail. Bobs and bows when agitated; (9-11 inches)." Walker (1974) notes measurements: length 9-11 inches; wingspread 24 inches.

B. External morphology of subadult age classes

Ridgway (1914) reported young - remiges and rectrices as in adults; mostly plain grayish brown to buffy brown; band across throat uniform brown.

C. Distinguishing characteristics

Interspecific - Peterson (1961) reported similar species - about the size of a screech owl.

Intraspecific - Martin (1973) notes males were heavier (7.9 g), and lighter in coloration, than females. In Zarn (1974), detailed description of plumage, size, and molt of different age classes. Thompson (1971) reported males

Athene cunicularia (con't.)

averaged 172.0 g; females 168.0 g: "the only useful field criterion of sex was the more extensive barring of breast and belly of the female." Earhart and Johnson (1970) reported with a detailed analysis of size and weight of western burrowing owl. Male: wing = 168.7 mm, weight = 158.6 g; Female: wing = 165.8 mm, weight = 150.6 g.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), reported breeding from southern interior British Columbia, southern Alberta, Saskatchewan, and central southern Manitoba south through eastern Washington and Oregon, Rogue River Valley of Oregon, and California, including the Farallon Islands and Channel Islands, and Baja California, including coastal islands and Guadalupe Island, east to eastern border of Great Plains in Minnesota, northwestern Iowa, central Kansas, Oklahoma, central Texas and Louisiana, south at least to central Mexico, and wintering over much of breeding range except in northern Great Basin and Great Plains regions. In migration to southern Louisiana, southern Mississippi, and western Florida, and south through southern Mexico and western Central America to western Panama.

B. California distribution of the species

Grinnell and Miller (1944), "Suitable, that is, level and treeless, areas, almost throughout state, from Oregon line east of Siskiyou Mountains south to Mexican line, and from Nevada line and Colorado River west quite to ocean shore; includes practically all the islands, from the Farallones southward." Small (1974), "range in California - length of state except mountains and northwest humid coastal forest; occurs on larger offshore islands." Rett (1947) notes occurrence of A. c. hypugaea on San Nicolas Island, California. Sooter (1940) reported a western burrowing owl near Lower Klamath Lake, California, on 20 January.

C. Desert distribution

Wauer (1962) noted an A. cunicularia as a permanent, breeding resident in Death Valley. Gilman (1935) noted only once in Death Valley, California, from 23 October to 9 May. Sheldon (1909) reported common south of Poso Creek, Kern County, California. Van Rossem (1911) described as abundant around the Salton Sea, California, in winter.

Gullion, Pulick, and Evenden (1959) described as a regular breeder near Cataract Spring (2480 feet) in southern Nevada.

D. Seasonal variations in distribution

Grinnell and Miller (1944), "probably most of those breeding at higher altitudes, move southward for winter." Martin (1973) notes migratory behavior of burrowing owls in California is unclear; may migrate in late October. Thompsen (1971), "Seasonal movements other than migration occur."

Athene cunicularia (con't.)

Bent (1938), reported "more or less" migratory in northern (Washington, Idaho, Oregon) portions of range; resident in southern areas. Brenckle (1936) noted burrowing owls in California do not migrate, according to band returns; summarizes returns from Great Plains.

IV HABITAT

A. Biotopic affinities

Peterson (1961), "habitat: open grasslands, prairies, dikes, desert, farms." Grinnell and Miller (1944), "habitat - open, dry, nearly or quite level, grassland; prairie; desert floor." Preferred habitat given as prairies and open plains; does not occur in cultivated areas to great extent (Bent, 1938). Small (1974), "habitat - dry, open, rolling hills, grassland, desert floor, agricultural land, open bare ground." Wauer (1964), "prefer burrows along the washes at the bases of the alluvial fans and they seldom move into the canyons" (in the Panamint Mountains, California). Coulombe (1971) details habitat of burrowing owls in California; "a conspicuous feature of the irrigated farm lands of the Imperial Valley." Abbott (1930) noted roosting, feeding, and breeding in residential areas of San Diego, California. Phillips, Marshall, and Monson (1964), "Rare and local summer resident in Sonoran zone grass- and farm-lands" in Arizona.

B. Altitudinal range

Grinnell and Miller (1944), "from over 200 feet below sea level, in Death Valley... up regularly to 5300 feet, in Lassen County." Range (only) below 1000 feet in the Panamint Mountains, Death Valley, California (Wauer, 1964). Smith (1917) reported ranges to 5500 feet in western Texas.

C. Home range size

Martin (1973), "The distance to the closest breeding neighbor averaged 166m... an accurate indication of territory size." In Zarn (1974), "Butts, 1973 notes territories as small as 0.1 acre; size apparently ranging up to one nest per 1.7 acres."

D. Territory requirements

Thompson (1971), "A territory (breeding) consisted of the burrow and a certain amount of surrounding property and air space... six territories averaged 1.98 acres" (range of 0.1 - 4.0 acres). James and Seabloom (1968) noted each family group used 2-10 burrows; besides the main nest hole, other holes were 25-75 yards away.

Perch sites - Coulombe (1971) reported adjusting perch sites in accordance with thermoregulatory behavior, perching on the ground in early morning, and moving either to the shade of a burrow or to a high object (telephone lines, guy wires, and poles) at midday. Gullion (1948) noted burrowing owl roosting under a bridge during the winter in Oregon. Stoner (1933) reported near Dixon, Solano County, California, finding burrowing owls roosting in burrows in hay stacks in October.

Athene cunicularia (con't.)

Nest sites - Peterson (1961), "nest: in rodent burrow in open ground." Martin (1973), "Rock squirrel (Spermophilus variegatus) burrows are used exclusively by the owls...breeding burrows were in the bottom, the wall, and the lip of an arroyo." Coulombe (1971), "The ground squirrels provide many possible 'starts' for the burrowing owls to utilize for their own nest sites... is not known whether burrowing owls construct their own burrows." Thompson (1971), "Spermophilus beecheyi provided most of the owls' burrows... western burrowing owls... occasionally do dig their own burrows... more commonly they enlarge and improve existing holes." Stoner (1932) reported near Benicia, Solano County, California, nest sites of burrowing owls were in Citellus douglasii burrows. Reed (1965) reported deserted prairie dog burrows used for nesting; burrows often lined with grass and feathers, dung. Dixon (1922), "Old burrows of ground squirrels are usually chosen, and the nest, made almost always of finely broken horse manure." Robertson (1931) notes use of irrigation pipes as nest and roost sites (due to elimination of burrowing mammals) in Orange County, California.

V FOOD

A. Food preferences

Grinnell and Miller (1944), "depends... on insect and reptilian food sources." Marti (1974) gives detailed analysis of prey; mammals (especially Peromyscus and Microtus) accounted for 62.1 to 86.8% of total prey biomass; insects were most frequently taken, but accounted for less than 14% total biomass. Smith and Murphy (1973) note food items: 87.3% arthropods, 10.7% mammals, 1.6% birds, 0.05% reptiles. Earwigs (Dermaptera) were major food item during both winter and early summer months. Other items included: Perognathus spp., Mus musculus, Thomomys bottae, Agelaius phoeniceus, Sonora semiannulata, Hyla regilla, Bufo cognatus (Coulombe, 1971). Earhart and Johnson (1970) reported takes insects (especially Coleoptera and Orthoptera), scorpions, lizards, a few small mammals (Microtus, Mus, Peromyscus, Reithrodontomys) and occasional birds. Thompson (1971) gives detailed analysis of food habits; meadow vole (Microtus californicus) and immature jackrabbits (Lepus californicus) accounted for majority of mammalian prey; Coleoptera (especially Carabidae) were most common insect prey. Glover (1953) reported frequency of occurrence of prey from Maricopa County, Arizona, were: scorpions (63%); beetles (Scarabidae; 62%); locusts (55%); ground beetles (Carabidae, 33%); Heteromyidae (22%). Analysis of prey taken in Nevada: major items were Scaphiopus (toad), Coleoptera, several small rodents, and various other insects (Bond, 1942). Rett (1947) noted food of A. c. hypugaea on San Nicholas Island, California, given as small grasshoppers and Peromyscus. Gullion (1948) notes burrowing owl found feeding on barn swallows in Oregon during winter. Lists food taken by western burrowing owl in Denver, Colorado; diet included crayfish, insects, frogs, western kingbirds, and several small mammals in June (Hamilton, 1941). Neff (1941) notes food items of burrowing owl in Colusa County, California; items were: black tern (64 wings), tricolored blackbirds (16 wings), a small snake, a pocket gopher, 2 water beetles, and a scorpion. Stoner (1932) reported food items from Solano County, California, included (23 April; nesting): crickets, beetles, newts, pallid bat, least sandpipers.

Athene cunicularia (con't.)

Stoner (1933) noted food items found 23 April near Benicia, California were: black-headed grosbeaks, pocket mice (Perognathus), Microtus, frogs, centipedes, crickets, and beetles. Sperry (1941) reported eating (regularly; 11% frequency in pellets) Scaphiopus in Montana during summer and fall. In Zarn (1974), provides literature review of burrowing owl prey.

B. Foraging strategies

Marti (1974), "Burrowing owls were observed to hunt by direct flights to prey from a perch on the ground or fence post, by hovering..., by running down prey on the ground, and by flights from a perch to flying insects." Martin (1973), "Foraging behavior was greatest from sunset to 2400, than from 2400 to dawn... flying low over a field until a prey item was observed." Coulombe (1971), "Burrowing owls are primarily crepuscular in their foraging ... hover for periods of several minutes at heights of 8-15 inches; may pursue arthropods on the ground." Thompson (1971) notes seasonal methods of foraging behavior; ground feeding (winter), hovering (late spring and summer), and occasionally, flycatching, were methods noted. In Zarn (1974), "utilize four basic hunting methods: ground foraging, hovering, observational foraging, and flycatching." Robertson (1929) notes catching of insects as high as 150 feet above ground in June in California).

C. Feeding phenology

Marti (1974) documents seasonal variation in diet; percent Peromyscus declined through the summer, while percent Carabidae remained roughly constant (prey by percent of numbers). Detailed analysis of variation in the prey items of burrowing owls from Maricopa County, Arizona; showed a general similarity in the foods taken.

D. Energy requirements

Mosher (1976) reviews respiratory water loss in burrowing owls. Coulombe (1971) documents drinking and activity patterns: "Utilization of free water could permit these owls to maintain normal body temperatures, through increased use of gular flutter in environments of severe heat stress." Thompson (1971), "the owls... showed little signs of being affected by the weather." Mean food eaten/day = 19.9-33.7 g; % of body weight eaten/day = 11.9-19.9% for captive animals (Marti, 1973).

VI REPRODUCTION

A. Territorial behavior

In Zarn (1974), "Burrowing owls exhibit only intraspecific territoriality... defense may continue until fledging." Martin (1973), "Males and females exhibited intrasexual territoriality... continued until egg laying." Coulombe (1971), "were not observed to defend their burrow sites against other species except potential predators." Thompson (1971), "As pairs formed, they investigated new burrows. Territory boundaries were in flux, but began to take form as pairs chose their burrows."

Athene cunicularia (con't.)

B. Courtship and mating behavior

Martin (1973) details site selection, nest preparation, courtship, pre-copulatory, and copulatory behavior. Coulombe (1971) details courtship behavior, including photographs; "The male owl displays to the female." Thompson (1971) details courtship behavior: during courtship, the pairs investigated several burrows for possible nesting sites. In Zarn (1974), "Display consists of primary song given by the male at a burrow entrance from sunset and continuing throughout the night." Martin (1973) presents an analysis of burrowing owl calls during breeding; have at least 17 calls.

C. Nesting phenology

Martin (1973), "egg laying began about the third week of March." Bent (1938) reported egg dates in California: 41 records, 1 April to 17 June; 21 records, 14 April to 2 May. In Zarn (1974), eggs laid from late March to early May. Breeding dates in Escondido, San Diego County, California: 23 March to 16 June (commenced) (Sharp, 1907).

D. Length of incubation period

Thompson (1971) reported incubation commences with the laying of the first egg, and lasts about 3 weeks. Appeared that only the female incubated. In Zarn (1974), incubation solely by female for about 4 weeks.

E. Growth rates

In Zarn (1974), young emerge from burrow at about 2 weeks of age, are able to run about by 3 weeks, and begin flying by 4 weeks.

F. Post-breeding behavior

Martin (1973), "Few cases of family structure remaining intact throughout September were observed... young were completely independent." Thompson (1971) noted young slowly left the family group between September and January. In Zarn (1974), "By September, pairs, families, and colonies begin to break up. During the winter... are more often seen singly."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1938) reported clutch size varies from 6 to 11; 7 to 9 more common. Peterson (1961), "eggs (5-9; 12) white." Clutch size = 6-10 eggs, white; size 1.25 x 1.00 inches (Reed, 1965). In Zarn (1974), clutch size averages 7-9 eggs; range 6-11. Murray (1976) reported clutch size increases to the north; clutch size averaged about 7.06 eggs per nest in southwest.

B. Fledging success

Martin (1973) notes 94.9% of young fledged; mean reproductive success was 4.9 young per pair. Thompson (1971) reported young/breeding adult = 1.7-2.2 and young/adult = 1.0-2.0.

Athene cunicularia (con't.)

C. Mortality rates per age class

Thompson (1971), "Juvenile mortality was 70 percent September through April." In Zarn (1974), "Butts, 1973, notes 88% of the fledglings in Oklahoma survived through 6 weeks of age." Thompson (1971) reported adult mortality was 19% from September to April.

D. Seasonal abundance

Coulombe (1971) documents seasonal variation in Imperial Valley burrowing owls. Population declined from a high of 23 owls per square mile during breeding to a low of 3 owls per square mile in winter.

E. Habitat density figures

Coulombe (1971) gave detailed analysis of population density and fluctuations. The total study population (Imperial Valley, California) averaged 12-13 owls per square mile during breeding, and declined to about 3-4 owls per square mile in fall and winter. In Zarn (1974), "Butts, 1973, found a population density of one adult owl per 4.8 acres of prairie dog town in... Oklahoma study area, while the population density of owls living at least one mile from prairie dog towns was only one adult per 5683 acres."

VIII INTERSPECIFIC INTERACTIONS

Thompson (1971) reported owls driving-off weasels and striped skunks; no actual predation noted. Predation by gopher snakes of eggs and young noted; striped skunks and a badger also noted digging into burrows (Coulombe, 1971). Martin (1973), "potential predators... prairie falcons, red-tailed hawks, Swainson's hawks, ferruginous hawks, marsh hawks, golden eagles, great horned owls, domestic dogs and cats, and people." Fowler (1931) notes frequent predation of prairie falcons on burrowing owls during nesting.

IX STATUS

A. Past population trends

In Zarn (1974), "Burrowing owls were once common throughout the West. But they are declining in many areas of former abundance." Robertson (1931) cites decline of burrowing owls in Orange County, California; decline due to habitat destruction, ground squirrel elimination. Bent (1938), "the encroachments of agriculture have greatly restricted its former range" (now reduced in numbers).

B. Present population status

In Zarn (1974), mammal damage control projects and habitat destruction play major role in determination of burrowing owl populations in western United States. Grinnell and Miller (1944), "Status - resident in most parts of its breeding range. Numbers in favorable localities large; originally common,

Athene cunicularia (con't.)

even 'abundant'. Latterly becoming scarce in settled parts of state (California)." Small (1974) notes resident throughout California. Arbib (1976) reported as declining over entire range except in Florida and southwest.

C. Population limiting factors

Grinnell and Miller (1944), "Also there is conspicuous dependence... in its subterranean nesting needs, upon the larger burrowing mammals... the California ground squirrel." Coulombe (1971), "The major factor controlling the abundance of burrowing owls in the Imperial Valley seems to be the availability of burrow sites." Although they may occasionally dig their own burrows, these owls are apparently dependent upon burrowing mammals for the most part (Thompson, 1971).

D. Environmental quality: adverse impacts

Grinnell and Miller (1944) reported population decline in California attributed to "roadside shooting, anti-vermin campaigns, elimination of ground squirrels - hence of nesting places for these owls." Thompson (1971) noted burrowing owls have been eliminated by civilization from some sites, although bayfill projects (such as the Oakland Airport) are utilized by the species. Elimination of the prairie dog in southeastern Arizona has sharply decreased numbers of burrowing owls (Monson, 1942). Arnold (1937), "Western burrowing owl... nearly exterminated in Pleasant Valley by indiscriminate .22-rifle... only a few pairs remaining."

E. Potential for endangered status

In Zarn (1974), "status, as given by the U. S. Dept. of Interior, has ranged from rare (1966) to 'status - undetermined' (as of 1974)." Also in Zarn (1974), gives "species and habitat management recommendations" for burrowing owls; includes establishment of refuges for owls and burrowing mammals, control of shooting near prairie dog towns, reduction of poisoning.

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SHORT-EARED OWL

Asio flammeus

I TAXONOMY

A. Type description

Strix flammea - AOU (1957) Pontoppidan, Danske Atlas, Vol. 1, 1763 Sweden.

B. Current systematic treatments

Peters (1940) recognizes 9 races of Asio flammeus, including flammeus, whose range is given (in part) as: "Breeds in the British Isles and in Europe and Asia north to about latitude 70° N... in North America breeds from the Aleutian Islands, northern Alaska, northern Mackenzie and Ungava, south locally to California, Colorado, southern Kansas, Missouri, northern Indiana, northern Ohio and the coast of New Jersey; Greenland."

Cory (1918) recognizes 2 races of short-eared owl, including A. f. flammeus; range given as - "Whole of North and South America and whole of Palaearctic Region."

Synonymy - Strigiceps uliginosus; Otus brachyotus; Brachyotus cassinii; B. palustris; B. p. cassini; Asio accipitrinus; A. flammeus (Grinnell and Miller, 1944). Northern short-eared owl; marsh owl (Grinnell and Miller, 1944).

II DESCRIPTION

A. External morphology of adults

Ridgway (1914) gives detailed description of adult and subadult plumages; sexes alike. Walker (1974) reported measurements: length 13-17 inches; wingspread 42 inches. Peterson (1961), "Field marks: nearly crow-sized (13-17 inches)... The streaked tawny-brown color and irregular flopping flight identify it. Large buffy wing patches show in flight."

B. External morphology of subadult age classes

Ridgway (1914) noted young - above dark sooty brown, the feathers broadly tipped with ochraceous-buff; face uniform brownish black; under parts woolly plain pale dull ochraceous or buffy; tinged anteriorly with smoky grayish.

C. Distinguishing characteristics

Interspecific - Peterson (1961), "Similar species: (1) barn owl has pale breast, white face, dark eyes. See also (2) female marsh hawk and rough-legged hawk - both are tawny marsh hunters."

Intraspecific - Earhart and Johnson (1970) give detailed analysis of size and weight of short-eared owls: Male - wing = 295.7 mm, weight = 314.7 g; Female - wing = 297.1 mm, weight = 378.0 g.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) notes breeds in the Old World from Iceland, latitude 70° N in Norway, northern Finland, northern Russia, across northern Siberia to Anadyr and Kamchatka, south to England, Wales, Eire, France, Italy, Sicily, Malta, Macedonia, Rumania, Crimea, Caucasus, Kazakh, Afghanistan, and Sakhalin; in North America from northern Alaska, northern Mackenzie, District of Keewatin, southeastern Baffin Island, Labrador, and Newfoundland south to southern California (San Diego County), northern Nevada, Utah, northeastern Colorado, Kansas, Missouri, southern Illinois, northern Indiana, southern Ohio, northwestern New York, New Jersey, and Virginia. Winters occassionally almost throughout breeding range, south to the Mediterranean, northern Africa, Palestine, northern India, and southeastern China, and from southern British Columbia, east-central Washington, Montana, South Dakota, Minnesota, Wisconsin, southern Michigan, southern Ontario, and Massachusetts south to Baja California, Oaxaca, Texas, the Gulf Coast and Florida.

B. California distribution of the species

Grinnell and Miller (1944), "As breeding, interruptedly entire length of state west of the deserts; in migrations and in winter, suitable ground whole length and breadth of state, but numbers largest west of Sierran divides. Records of actual nesting are as follows: ... Siskiyou, Mono, San Mateo, Merced, Fresno, Orange, and San Diego counties..." Small (1974), "range in California - for breeding, formerly at least, length of state; now known primarily as a nonbreeder."

C. Desert distribution

Grinnell and Miller (1944), "Some desertward record stations are: Death Valley, Inyo County, December 8; Brawley, Imperial County, December and January." Gilman (1935) noted only once in Death Valley in 1933-34; 8 December at Furnace Creek. Van Rossem (1911) reported very common (in dry places) near the Salton Sea, California, during winter.

Johnson and Richardson (1952), "A nest with week-old young found in Washoe Valley on May 5, affords proof that this species is resident" in Nevada.

Monson (1944) reported one short-eared owl noted on 27 November in Yuma County, Arizona. Phillips, Marshall, and Monson (1964), "Generally rare winter visitant in open grassland, marshes, swales, and fields... also records for extreme desert" in Arizona.

D. Seasonal variations in distribution

Bent (1938), "As rodents are the favorite food... it generally migrates south to grassy and weedy regions" - winters near Fresno, California.

Asio flammeus (con't.)

V HABITAT

A. Biotopic affinities

Peterson (1961), "Habitat: prairies, marshes (fresh and salt), irrigated land, dunes, tundra." Grinnell and Miller (1944), "Habitat - swamp lands, both fresh and salt; lowland meadows; in irrigated districts, alfalfa fields. Tule patches or tall grass needed for nesting and for day-time seclusion." Small (1974), "habitat - salt-water marshes, tall grass meadows, fresh-water marshes, agricultural lands." Bent (1938) reported prefers open plains, marshes, and sand dunes.

B. Altitudinal range

Jollie (1945) noted at 8000 feet in Colorado.

C. Territory requirements

Perch sites - Potter (1935) reported short-eared owls seldom perch on anything higher than a fence post. Potter (1927) states that short-eared owls often perch on posts and hay stacks. Bent (1938) noted often perches on fence posts, tree stubs, in tufts of grass, or the bare ground.

Nest sites - Peterson (1961), "nest: a grass-lined hollow in meadow, marsh, tundra." Reed (1965) reported nest usually in marshy location, on the ground, under a bush or close to an old log. Pitelka, Tomich, and Treichel (1955) noted nesting on the ground in areas of good drainage in Alaska. Nest of Asio f. flammeus found in marsh grass near Mc Gee Creek, Mono County, California, on 19 May (Rowley, 1939). Goelitz (1918) describes several nests located in wheat and oat fields in Canada. Nest: a slight excavation in the ground lined with grass, in a marsh. Includes pictures of nest, eggs, young (Kitchin, 1919). Bent (1938), "nests on the ground generally in a slight depression very sparsely lined with grasses and weed stalks... in an open field or marsh."

V. FOOD

A. Food preferences

Bent (1938) reported Microtus major prey; small birds also frequently taken. Earhart and Johnson (1970) noted feeds chiefly on small mammals (Microtus, Lemmus, Peromyscus, Mus, Rattus, Reithrodontomys) plus occasional birds and a few insects. Food during nesting in Washington consisted primarily of small birds (Kitchin, 1919). Sooter (1942) reported short-eared owls found feeding on "road-killed" rabbits in Oregon. Short-eared owls, wintering in Georgia, preyed heavily on birds and Mus (Tomkins, 1936). Errington (1932) gives detailed analysis (Wisconsin); took mice, snow buntings, and meadow-larks; primarily small rodents. Food items brought to young in Montana included: voles, mice, small birds, rabbits (Saunders, 1913).

Johnston (1956) noted mammals (primarily Microtus and Rattus) 75%, birds 20%, and insects 5% of items consumed near San Francisco, California, during

Asio flammeus (con't.)

winter. Winter diet was 51.7% birds in 1971-72 and 87.9% in 1972-73 (Page and Whitacre, 1975). Fisler (1960) reported short-eared owls in Contra Costa County, California, took 69.5% mammals (Microtus californicus = 50.6%), 24.2% birds, and less than 10% insects. Johnston (1956) noted short-eared owls described as a minor predator upon song sparrows in marsh habitat.

B. Foraging areas

Fisler (1960) noted short-eared owls feeding in garbage dumps in Contra Costa County, California. Reed (1965), "hunts, over the marshes and meadows, on dark days and toward dusk," Fed along tidal sloughs during winter on San Francisco Bay, California (Johnston, 1956).

C. Foraging strategies

Quay (1972), "Behaviorally, short-eared owls are not so strictly nocturnal as most other species of owls." Often feeds by day; feeding methods resemble the marsh hawk; will circle close to ground, hover, etc. (Bent, 1938). Most common hunting method in San Francisco Bay, California in winter, was by slow flight followed by dropping onto prey when discovered; would also sally forth after prey from a perch (Johnston, 1956). Page and Whitacre (1975) reported total birds decreased while California vole increased between November and March in the diet of short-eared owls in central coastal California.

D. Feeding phenology

Fisler (1960) noted most prey items were taken at a constant rate over the five year study period; removal of a nearby garbage dump reduced the number of Rattus in the diet. Snyder and Hope (1938) reported short-eared owls feeding on Microtus in Canada during population peak of the latter.

E. Energy requirements

Page and Whitacre (1975), "an average of 100 g of prey per night was taken by each short-eared owl." Mosher (1976) reviews respiratory water loss, oxygen consumption, and food balance in short-eared owls. Irving (1955) documents temperature variations (T_b) in short-eared owls.

VI REPRODUCTION

A. Territorial behavior

Pitelka et al (1955) detailed a description of territorial behavior given; most territory defense conducted by male. Urner (1923) discusses encounters with nesting short-eared owls in New Jersey; adults tumble and call when nest is visited.

Asio flammeus (con't.)

B. Courtship and mating behavior

Pitelka et al (1955) documents courtship behavior (hooting and aerial displays) of short-eared owls in Alaska. DuBois (1924) describes aerial song and courtship behavior in Montana.

C. Nesting phenology

Reed (1965), "They nest, in different localities, from March to May." Bent (1938) reported egg dates (all from areas north of California):- 20 March to 30 June; height of season in mid-May. Pairing began first week of June; eggs noted 11 June; entire nesting cycle required 11 or 12 weeks in Alaska (Pitelka et al, 1955).

D. Length of incubation period

Pitelka et al (1955) noted average incubation period given as 26 days. Incubation period given as about 21 days (Bent, 1938).

E. Length of nestling period

Pitelka et al (1955) reported nestling period variable, from 12 to 31 days; often leave at intervals. Bent (1938), "the young fly in from 31 to 36 days... and remain in the vicinity of the nest for six weeks." Nestling period given as from 31 to 36 days in New Jersey (Urner, 1923).

F. Growth rates

Saunders (1913) presents growth rate data from day 3-14; describes plumage development in Montana.

G. Post-breeding behavior

Pitelka et al (1955) noted period of parental care of young after flight reviewed; takes at least 1-2 weeks for young to gain independence.

H. Miscellaneous

Urner (1925) discusses general encounters at 5 nests in New Jersey.

VII. POPULATION PARAMETERS

A. Clutch size

Peterson (1961), "eggs (4-9) white." Reed (1965) noted clutch size = 4-7 eggs, pure white; size 1.55 x 1.25 inches. Clutch size: average of 5-7; range = 4-9 (or more) (Bent, 1938). Murray (1976) reported clutch size increases to the north; clutch size averaged about 3.50 eggs in the southwest. Rendall (1925) noted clutch size increased from 6 eggs/nest to 9 eggs/nest during population increase of voles.

Asio flammeus (con't.)

B. Seasonal abundance

Johnston (1956) reported population density changes for short-eared owls on San Francisco Bay, California, given as: average = 5-6/100 acres and Dec. - Jan. = 7-8/100 acres.

C. Habitat density figures

Johnston (1956) noted an average of 5 or 6 short-eared owls per 100 acres given for San Francisco Bay, California. Kendeigh (1941) noted one short-eared owl found on 50 acre study site in Iowa. Johnston (1956) described 4-10 short-eared owls wintered on a 200 acre study plot on San Francisco Bay, California.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Sooter (1942) notes billing of short-eared owl by peregrine falcon in Oregon. Killpack (1951) reported remains of a short-eared owl in a great horned owl nest in Utah. Murie (1934) notes predation by snowy owls upon short-eared owls. Great horned owl preys upon short-eared owl at Berkeley, California (Hunt, 1918). Short-eared owl preyed upon by golden eagle during nesting season in Montana (McGahan, 1968).

B. Competition

Fisler (1960) noted mobbing by gulls forced short-eared owls to feed primarily at night, or not utilize the dump area. Bildstein and Ashby (1975) notes a short-eared owl taking the prey of a marsh hawk in Wisconsin. Marsh hawk forces short-eared owl to release Microtus by diving at it in Wisconsin (Berger, 1958).

C. Miscellaneous

Johnston (1949) reported short-eared owl seen chasing a large buteo over a large field in Idaho in June.

IX STATUS

A. Past population trends

Grinnell and Miller (1944), "Status - occurs in two roles: (1) resident, in very small numbers, locally, and breeding; (2) winter visitant, common and widely distributed. Formerly abundant in winter, but of late years notably reduced." Depending upon location, apparently occurs as a resident, or winter visitor, or transient; formerly breed throughout much of state, now known primarily as a nonbreeder (Small, 1974). Alcorn (1946) reported Asio f. flammeus: A winter visitor, frequently seen from September to February, inclusive, (also seen 5 July) in Churchill County, Nevada.

Asio flammeus (con't.)

B. Present population status

Arbib (1976) noted believed to be declining over much of its range.

C. Population limiting factors

Williamson (1957), "the abundance of this species probably depends on the abundance of microtine rodents."

D. Environmental quality: adverse impacts

Grinnell and Miller (1944), "main cause of reduction, killing by duck-hunters."

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LESSER NIGHTHAWK

Chordeiles acutipennis

I TAXONOMY

A. Type description

Chordeiles acutipennis texensis, Texas lesser nighthawk: Chordeiles texensis Lawrence 1856, Ann. Lyc. Nat. Hist. N.Y., 6, p. 167 - Texas; restricted to Ringgold Barracks, near Rio Grande City, by Oberholser, antea, p. 104 (from Peters 1940).

Synomonies - Chordeiles virginianus, Chordeiles popetue, Chordeiles texensis, Chordeiles texensis henryi, Chordeiles virginianus henryi; Texas nighthawk, western nighthawk, Texas sharp-winged nighthawk, Texas trilling nighthawk (Grinnell and Miller 1944).

B. Current systematic treatments

Order Caprimulgiformes, family Caprimulgidae, subfamily Chordeilinae, genus Chordeiles Swainson, 1831, in Swainson and Richardson, Fauna Bor.-Am 2:496 (Peters 1940).

C. Recent taxonomic revisions

The supplement to the AOU "Checklist of North American Birds" (1973, Auk 90:411-419) does not indicate that nighthawk systematics have been revised since the 5th edition of the Checklist (1957).

II DESCRIPTION

A. External morphology of adults

Caprimulgids are characterized by an "ample tail, large eyes, tiny bills, huge gapes, and very short legs" (Peterson 1961). They are cryptically colored in a mottled "dead leaf" pattern. The lesser nighthawk in particular is a gray-grown bird with a notched tail and white wing bars (buffy in female) across the pointed wing (Peterson 1961; see also Pickwell and Smith 1938). The males possess a white throat patch and a white tail base.

B. External morphology of subadult age classes

Even in juvenile plumage, the sexes are not alike. "Both sexes are decidedly lighter and more closely mottled than in the adult" with the throat patch and tail-bars in the male bring buff-colored, rather than white as in the adult; the female shows an even darker buff (Oberholser 1914).

C. Distinguishing characteristics

Interspecific - C. acutipennis is smaller than Ciminor and possesses the white wing bar nearer the tip of the wing than the bend; the wing bar is midway between the bend and the tip in C. minor (Bent 1940). In addition,

Chordeiles acutipennis (Cont'd)

C. minor uses a plunging "booming" flight in courtship, whereas C. acutipennis doesn't dive in courtship and uses a trilling vocalization (Bent 1940, Peterson 1961).

Intraspecific - Chordeiles acutipennis texensis is the "large, pale race of the species Chordeiles acutipennis" (Bent 1940).

D. Special morphological features

No information located.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Chordeiles acutipennis "breeds in the southwestern United States and northern and central Mexico from the interior valleys of California, southern Nevada, extreme southwestern Utah, central Arizona, southwestern New Mexico and southern Texas, south to northern Lower California, Nayarit, Zacatecas, Guanajuato, Puebla, Mexico and western Vera Cruz" (Peters 1940).

B. California distribution of the species

The lesser nighthawk is "most numerous in the southern half of the state, notable in San Diegan district, on parts of Colorado and Mohave deserts, and in San Joaquin Valley" (Grinnell and Miller 1944).

C. California desert distribution

(See above (California distribution, IIIB)

Miller and Stebbins (1964) reported that the lesser night hawk was "seen... principally at Twenty-nine Palms and at Cottonwood Spring" in Joshua Tree National Monument. Wauer (1962) observed this night hawk in death valley also. Smyth and Coulombe (1971) recorded the lesser nighthawk as a summer resident in the San Jacinto Mountains of Riverside County.

D. Seasonal variations in distribution

The lesser nighthawk "winters from central and southern Mexico southward over all of Central America to Western Columbia" (Peters 1940). Early spring arrival dates in California are: Mecca, 20 March; Buena Park, 22 March; Pasadena, 31 March; Azusa, 2 April (Bent 1940). Late fall departures are: Clovis, 18 September; Buena Park, 1 November (Bent 1940).

IV HABITAT

A. Biotopic affinities

The lesser nighthawk is restricted to the Lower Sonoran Life Zone in

Chordeiles acutipennis (Cont'd)

California (Grinnell and Miller 1944) where it replaces the common night-hawk, C. minor (Selander 1954), and occurs in habitats characterized by the presence of Lepidospartum squamatum even when these Lower Sonoran habitats are islands surrounded by Upper Sonoran areas (Pickwell and Smith 1938).

"C. acutipennis is truly a lowland inhabitant. It is confined almost entirely to desert scrub vegetation ...in the southwestern United States and northern Baja California" (Caccamise 1974).

B. Altitudinal range

West of the Sierra, lesser nighthawks are rarely found above 1000 feet. "On the Mohave Desert and in Inyo County, they go up over 5000 feet" (Grinnell and Miller 1944).

C. Home range size

No specific information located.

D. Territory requirements

Roost site - Lesser nighthawks return to the roost site "regularly for their daytime rest" (Bent 1940). These roosts may be on willow limbs, in arrowweed thickets or on gravel near bushes. Pickwell and Smith (1938) reported that males persistently occupied one space on the ground near the nest.

Grinnell and Miller (1944) described the typical California roost site or nest site as being located on a gravel-surfaced desert floor or broad, pebbly wash-bottoms with sparse shrubby vegetation."

Courtship and mating sites - No specific information located. Aerial displays constitute the most significant portion of courtship (Miller 1937, Pickwell and Smith 1938) and do not require any special topographic features.

Nest site - As indicated above, nest sites are frequently located in the same areas as perch sites. The eggs are "load on the bare ground, without any attempt at nest building or even scooping out a hollow, in some open sandy or gravelly spot, and usually with little or no cover to shade them from the full glare of the sun" (Bent 1940; see also Pickwell and Smith 1938). The eggs are cryptically colored to reduce the possibility of predation (Pickwell and Smith 1938). Lesser nighthawks have also been reported to nest on the flat roofs of adobe houses in Texas (Bent 1940).

E. Special habitat requirements

Chordeiles acutipennis is particularly noticeable in "arid desert regions ...along the river bottoms and dry washes, and.. about the sloughs and coursing over the alfalfa fields" (Bent 1940).

F. Seasonal changes in habitat requirements

Dickey and van Rossem (1938 in Bent 1940) found wintering lesser nighthawks in the Arid Lower Tropical Life Zone and locally in the Arid Upper Tropical Life Zone in San Salvador. The nighthawks occurred up to an altitude of 3600 feet, but were usually seen along the seacoast.

G. Physiological ecology

Caprimulgids have been observed in a torped state in the wild; and a few laboratory experiments have demonstrated hypothermia in prescribed conditions. Austin (1970) induced hypothermia in a lesser nighthawk by depriving the animal of food until it reached 78% of original body weight and then exposing it to cold ambient temperatures. Under these conditions, body temperature fell to 12.8°C without ill effect, although no spontaneous arousal was seen and rewarming occurred by raising ambient temperature and handling the bird.

Bartholomew and Dawson (1953) reported a respiratory water loss of 7.5% of body weight over a 24-hour period at an ambient temperature of 25°C and humidity of 37%. This degree of respiratory water loss agrees favorably with other desert dwelling birds such as Pipilo sp., Lanius, Mimus, although it is higher than for Otus sp., Zenaidura, and Lophortyx sp. Lasiewski and Dawson (1964) observed evaporative water loss values of 9.3 mg/g. hr. at 40°C, 3.0 mg/g. hr at 35°C and 1.3 mg/g. hr at 5°C.

Lesser nighthawks have not been observed drinking in the field (Smyth and Coulombe 1971).

V FOOD

A. Food preferences

Caccamise (1974) took weekly samples of stomach contents for 7 contiguous weeks from June 7 to July 25 during the lesser nighthawks breeding season in New Mexico. He found that the birds are totally insectivorous and consumed the following main insect groups: Cicadidae, Pentatomidae, Elateridae, Scarabacidae, Formicidae.

B. Foraging areas

Lesser nighthawks have been observed foraging "above marshlands, stream bottoms, pastures, irrigated alfalfa fields and ricelands, and lower foothills" (Grinnell and Miller 1944).

C. Foraging strategies

Lesser nighthawks are opportunistic feeders and prey on the most abundant and easily caught insects (Caccamise 1974). They are not territorial and

may seek out and utilize food sources some distance from the roost or nest site (Caccamise 1974). The birds are "strikingly crepuscular" appearing before 2100 and after 0430 (Pickwell and Smith 1938) and hunt through three air levels: "high in the air at sundown, closer to the ground at dusk, and on the ground after dark" (von Rossem 1927).

D. Feeding phenology

Caccamise (1974) provided data on the differential consumption of insect groups in June and July: Cicadidae (June, 80.7 to 96.5% of weight of total food consumed; July, 0 to 19.6%); Pentatomidae (less than 1% except mid-July, 55.9%); Elateridae (mid-June, 11.2%; less than 3% during the rest of the sampling period); Scarabaeidae (mid-July, 90.6%; less than 1% for the rest of the time); Formicidae (July, 4.8 to 99.8%; high in early and late July, low in the middle).

E. Energy requirements

C. acutipennis is similar to C. minor in its energetics (Lasiewski and Dawson 1964). The following information is for C. minor and is derived totally from Lasiewski and Dawson (1964). Resting metabolic rate for ambient temperatures between 30° and 40°C is about 1.2 cc O₂/g.hr. Below 30°C, metabolic rate slowly rises in a curvi-linear fashion² as ambient temperature declines. Below 22°C, the slope of oxygen consumption vs. ambient temperature is -0.11 cc O₂/g. hr.°C.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

Territorial defense is not conspicuous and may not play a prominent role in breeding (Caccamise 1974). Food and water are dispersed and are not defendable (Caccamise 1974).

C. Courtship and mating behavior

Courtship in the lesser nighthawk involved "pursuit at close range, of the female by the male, with accompanying vocal notes and peculiar flight posture" (Miller 1937). The male is positioned behind the female and a few feet above her. He makes a short plunge toward the female, uttering trills of increasing intensity and flashing his white throat patch (Miller 1937).

Caccamise (1974) reported that lesser nighthawks utter a quiet trill while foraging, which might serve for individual recognition and as a pairbond maintenance mechanism.

Chordeiles acutipennis (Cont'd)

During nesting nighthawks respond to the appearance of potential predators by self-concealment, intimidation displays and distress simulation (Pickwell and Smith 1938).

D. Nesting phenology

Lesser nighthawks arrive in California in late March to begin nesting (Bent 1940). Bent (1940) recorded the following egg dates for California: "60 records, April 21 to July 11; 30 records May 11 to June 12, indicating the height of the season."

E. Length of incubation period

Pickwell and Smith (1938) reported incubation periods of 18 days (1 nest and 19 days (1 nest).

F. Length of nestling period

The young take short flights after 21 days, but remain around the nest for 4 more days (Pickwell and Smith 1938).

G. Growth rate

No information located.

H. Post breeding behavior

Lesser nighthawks migrate south by the end of October (Bent 1940).

VII POPULATION PARAMETERS

A. Clutch size

Pickwell and Smith (1938) reported a clutch size of 2 eggs (n = 2 nests). "Two broods are evidently raised, as an immature bird, in company with an adult, was flushed on August 9" whereas the first brood was observed after hatching in mid-May (Wood 1924).

B. Fledgling success

No information located.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

Chordeiles acutipennis (Cont'd)

E. Seasonal abundance

Pickwell and Smith (1938) reported that lesser nighthawks were present on the breeding grounds from April 10 to September 13 in Santa Clara County. Bent (1940) reported extreme dates for southern California of March 20 (spring arrival) and November 1 (fall departure). This species is absent in the winter.

F. Habitat density figures

No information located.

VIII INTERSPECIFIC INTERACTION

A. Predation

No information located.

B. Competition

Chordeiles B. minor is usually excluded from desert habitats in the presence of C. acutipennis; although C. minor is more aggressive, the time and energy spent excluding C. acutipennis from territories places it at a competitive disadvantage (Caccamise 1974).

C. Parasitism

Little information located.

Williams et al (1975) reported that haemoproteids had not been observed infecting C. acutipennis in Mexico.

IX STATUS

No information located on any of the subtopics under this heading: population trends (past and present), population limiting factors, environmental quality, or potential for endangered status.

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BLACK-CHINNED HUMMINGBIRD
Archilochus alexandri

I TAXONOMY

A. Type description

Archilochus alexandri - AOU (1957) Bourcier and Mulsant. Black-chinned hummingbird type specimen Trochilus alexandri, Ann. Sci. Phys. Nat. Agr. Ind., Soc. Roy. etc., Lyon, 9, 1846. Sierra Madre (Occidental), Mexico.

Palmer (1928) noted originally found in the Sierra Madre of Mexico and dedicated to discoverer Dr. Alexandre of Mexico by Bourcier and Mulsant in 1846.

B. Current systematic treatments

Synonomies - Grinnell and Miller (1944), Trochilus alexandri; Mellisuga alexandri. Peters (1945), Trochilus alexandri; Trochilus cassini. Cory (1918), Trochilus alexandri. Grinnell and Miller (1944), purple-throated hummingbird. Dawson (1923), sponge hummingbird.

C. Hybridization

Lynch and Ames (1970) noted A. alexandri x Selasphorus sasin: 2 males on 5/16/68 at Courtland, Sacramento County. At least 10 intergeneric hybrids reported in North America. This hybridization is viewed as result of recent attainment of sympatry of the species in Sacramento Valley.

II DESCRIPTION

A. External morphology of adults

Peterson (1969), "male: black throat with conspicuous white collar below it. The blue-violet band on lower throat shows only in certain lights. Female: greenish above, whitish below. Cannot be safely told from Costa's or ruby-throat in field." Bent (1940) reported male - black chin and sides of head with conspicuous white collar separating the square cut gorget and rather dark underparts. Violet gorget, seen only when light strikes it just right. White spot just behind eye. Brilliant metallic violet helmet, the top of the head, throat, and elongated feathers on the sides of the gorget. Gorget feathers may change in colors ranging from purple, magenta, blue, green, depending on angle of light." Ridgway (1911) gives detailed description of adult male, female, young male, and female. Measurements: length of skins 80-88 mm; wing: 41.5-44 mm; tail: 23.5-28 mm; and exposed culmen: 18-20.5 mm. Oberholser (1919) reported record: taken near Kerrville, Texas 7/30/13. No. 241043 in United States Natural History Museum. Adult female - pure white.

B. External morphology of subadult age classes

Beal (1933), "pale-yellow brown caterpillars with widely gaping mouths" - description of nestlings.

Archilochus alexandri (con't.)

C. Distinguishing characteristics

Interspecific - Robbins (1966), "only North American hummingbird with a truly black throat; throats of other species may look black in poor light. The purple stripe confirms the species. Female C. anna is larger and plumper than female A. alexandri." Female - much like female C. anna, but smaller. Can only be told from female C. costae by comparative amount of green on the two outer pair of tail feathers (Bent, 1940). Distinguishing characteristics between female C. anna and immature A. alexandri is both appear grey with slightly iridescent backs and shoulders green. C. anna is larger and stockier; C. anna has a sweeter and more bell-like vocalization than A. alexandri (Rongren, 1972).

Intraspecific - Bent (1940), "young female is similar to young male, but throat usually immaculate or with the dusky spots or streaks smaller and less distinct." Nestling description: shorter bill than adult, crown grayish buff and dusky; back dusky and glossy green; throat and abdomen dull white. This plumage is much like adult female. Gorget begins to appear as early as July 20 the same year and has not been completed as late as May 15th of next year.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Ridgway (1911) noted range is western United States and southern British Columbia east to southern Alberta, western Montana, western Colorado, western and middle Texas. Breeds in Transition and upper Sonoran zone (except in Pacific Coast district from middle California northward), south to southern California (San Diego, San Bernardino, and Riverside Counties), northern lower California, Arizona (Santa Rita, Huachucas, Camp Lowell), southern New Mexico, Nuevo Leon, Chihuahua, Sonora. Winters in Durango, Zacatecas, Sinaloa, Jalisco, and Guerrero. AOU (1957), "Breeds from southwestern British Columbia and northwestern Montana, south through western Montana, central Idaho, western Colorado, New Mexico, and southwestern and south-central Texas to northern Baja California and extreme northwestern Chihuahua. Winters from southeastern California (Palm Springs), northern Baja California and Sonora to Michoacan, Guanajuato and Distrito Federal; recorded in migration or wandering east to Nuevo Leon, and Tamaulipas and south to Guerrero and Vera Cruz; accidental to Louisiana (Baton Rouge)." Bent (1940) noted breeds from southern British Columbia and western Montana, northern Mexico, and western Texas... comparatively rare over most of its range, most abundant in southern part of range, southern California, southern Utah, Arizona, and parts of New Mexico. Peterson (1969) reported breeds from southeastern British Columbia (rare), Idaho, northwestern Montana, to northern Mexico; east to western Colorado, New Mexico, central and southern Texas. Winters in Mexico (rarely southern California). Miller (1955), "common in desert area at base of mountains." Linsdale (1951) noted summer resident in 3 stations in western Nevada: Pyramid Lake, Fish Lake Valley, Fort Mojave. Anthony (1892), "not common about the blossoms of mescales in August. A female taken July 9 showed signs of having incubated quite recently." Tanner (1927) noted migrants have been collected in April.

Archilochus alexandri (con't.)

B. California distribution of the species

Common throughout most of the year but never found nesting (Arnold, 1937). Southern California, west of deserts, San Joaquin and Sacramento Valleys, Coast Range north to about San Francisco (Small, 1974). Grinnell and Miller (1944), "Roughly southern and interior portions of state, mostly at lower levels and altogether east of humid coast belt north of San Francisco Bay. Most numerous in San Diegan district and in parts of San Joaquin and Sacramento Valleys." Also noted summer resident; March (at south) or April, to September. In most places of occurrence common; sometimes "fairly swarming". Wilson (1950) reported a female in 4/24/46, also on 4/19/48. Summer visitor in small numbers (Richards, 1924).

C. California desert distribution

Seen in Colorado Valley during last week of March; first week of April species was abundant in desert washes (Bent, 1940). An adult was taken on upper Santa Ana River July 31, 1906. At Cushenbury springs on the desert side of mountains, the species was identified August 11, 1905 and was common at Cactus Flat, August 15 to 17, 1905, where young males in process of moult were secured (Grinnell, 1908). In Grinnell and Miller (1944) Grinnell, 1904 notes one winter record: Palm Springs, Riverside County, December 17, 1904. Summer resident in valleys of Colorado and Mojave Rivers, Owens Valley, and interior valleys of southern California. Winter in southern part of their range, i.e. Palm Springs (Beal, 1933). Found in Sonoran desert and Chihuahua desert (Dixon, 1959).

D. Seasonal variations in distribution

Summer visitor locally at lower altitudes (Grinnell and Storer, 1924). Summer visitor, April to September (Small, 1974). Is a summer resident arriving March/April (Audubon Field Notes, 1970). Wave of migratory hummingbirds through southern Santa Clara County. Height of season 5/3 to 5/6/33. A. alexandri seen every day although not numerous (Unglish, 1933). Many A. alexandri leave the lowlands for higher mountains by mid-to late July (Stiles, 1971). Phillips (1964), "as is generally the case with migratory birds, female A. alexandri arrive later than males, usually late March. Occurs in southern Arizona from middle of March (rarely earlier) through September; most adult males leave in mid-summer; latest record for state 10/2/47 Patagonia (adult male)."

IV HABITAT

A. Biotopic affinities

Woods (1927), "... is typical of the foothills and canyons of the less humid portions of the west and is said to be more dependent upon the presence of water than any other species," (author notes an occasion when he observed the hummingbird in a drought probing the cluster of leaves at the ends of live oak twigs). Bent (1940), "mouths of canyons, with sycamores, also in willow patches along dry washes." Small (1974) noted riparian woodlands, brush-bordered oak canyons, orchards, edges of

Archilochus alexandri (con't.)

agricultural land where bordered by trees. Peterson (1969), "semi-arid country near water; semi-wooded canyons and slopes, chaparral, river groves, foothill suburbs."

B. Altitudinal range

In Grinnell and Miller (1944), "Edwards, 1914 notes breeding life-zone, mainly upper Sonoran, locally lower Sonoran. Altitudes of nesting, near sea level at Santa Barbara up to 5600 feet, on Barley Flats, San Gabriel Mountains." Grinnell (1908), "... an upper Sonoran species, as it was not observed higher in the mountains until the last of July, when the general scatter-movement begins. At Bluff Lake, 7500 feet altitude, a juvenile is taken July 23, 1905." Nest records: Ramsey Canyon, Huachucas altitude 5000 feet in lowest Austral zone (Brandt, 1951). In southwestern Utah, along Virgin River 2700-3100 feet (the lower Austral zone of Sonoran zone in west) (Tanner, 1927).

C. Territory requirements

Stiles (1971), "The most important feature of the males territory seems to be the physiognomy of the vegetation - an open, flat to gently sloping area approximately 15-30 m in diameter, flanked (usually) at least two sides by much taller vegetation, in or on which the bird perches. Male breeding territories are established on lower north- or east-facing canyon slopes in tall, broken, chaparral mixed with oaks, or in canyon bottom clearings." Grinnell and Miller (1944), "Habitat of males in general neighborhood of that of nesting females, but drier, as up canyon sides, often amid live oaks and chaparral plants, or on desert washes where mesquite and catclaw thickets occur. Females seen in deciduous trees along stream bottoms, canyon bottoms, also irrigated orchards." Males displaying in canyon mouths, open mesquite and catclaw. Specimen taken 4/27, 4/23 with testes 2 mm (Miller, 1955).

Nest sites - Females breed in willow association along river (exclusively) while male seen only in mesquite association and up desert washes (Bent, 1940). Four to eight feet from ground in shrubbery near small creeks, or springs frequently overhanging the water. Two favored locations (in wild): 1) canyon filled with sycamores in bottom and surrounded with hillsides of flowering sage and 2) dense willow thickets, which border streams and lakes. Stiles (1971) noted nest site height averages considerably lower than that of C. anna. Females nest in canyon bottom woodlands with strong tendency to place nests over water. Physiognomy is important: in absence of a convenient stream, nest will be placed in vegetation overhanging any suitably flat, bare area, i.e. road, walk, path, or clearing. Grinnell and Miller (1944) reported near presence of water appears to be a requirement for nest location. Nests in willow, cottonwood, alder, sycamore, valley oak. Grinnell and Storer (1924) noted 4½ feet from ground in crotch of apple tree. Nest measurements: 1 inch height by 1-3/8 inch diameter made of plant down, bud scales, seed pods bound by spider web. Grinnell (1908), "it was nesting in the lower Santa Ana canyon at least as far up as the Narrows, and along Mill Creek up to the mouth of Mountain Home

Archilochus alexandri (con't.)

Creek. At the latter point a nest was seen June 9, 1906, on an alder bough overhanging the stream." In San Diego County nest built on same site (on an electric wire) for four successive years. Other nest sites: under old log bridge; in small ravine in stunted sycamore (Carpenter, 1919). Phillips (1964), "principally among willows, cottonwoods and sycamores along streams and in olive trees in town." After mid-May along streams in foothills (Willett, 1913). Of 39 nests, 26 were built in live oak, and 11 were built in sycamores (Pitelka, 1956a).

D. Seasonal changes in habitat requirements

Bent (1940), "by first of July, when vegetation of foothills becomes dry, A. alexandri are found in thousands at higher elevations (6000 to 8500 feet) according to Grinnell, 1898." Stiles (1970), "After mid-July, most of the A. alexandri... have left for the mountains." Bene (1940), "as seasonal changes and climate influence the rhythm of the brooding cycle, so meteorological conditions affect the rhythm of the brooding routine." Phillips, Marshall, and Monson (1964), "common summer resident in certain deciduous associations of Sonoran zones, including cities, generally absent from deserts."

V FOOD

A. Food preferences

Bent (1940), "feeding about... blossoming palos verdes." Insects and nectar from various flowers especially Nicotiana glauca. In Santa Rita Mountains, Arizona, Bailey, 1923, saw them feeding on honeysuckle (Anisocanthus cardinalis). Also seen feeding on ocotillo. In Colorado River Valley on palos verdes, ironwoods and Lycium andersoni. In Texas on Texas buckeye, Texas redbud, Texas mountain laurel according to Simmons, 1925. Stiles (1970) reported a list of about a dozen different cultivated and chaparral plants available to the species during its nesting season in April. A. alexandri are not attracted to red more than any other color. Color preference may be conditioned by training (Bene, 1941). Occasionally visits Larrea divaricata near Tucson, Arizona (Anderson and Anderson, 1946).

B. Foraging areas

Grinnell and Miller (1944) reported both sexes, and young, forage about many kinds of flowering shrubs and vines, introduced and cultivated as well as native. The non-native tree tobacco is notably attractive.

C. Foraging strategies

Bent (1940) noted sallys for insects.

D. Feeding phenology

Bene (1945) reported feeding mechanism is not fully developed in young until at least 2 weeks after leaving nest. Initial foraging begins while perched and later hovering. Flower selection is governed by experience. Only one trial is necessary to establish an associational pattern.

VI REPRODUCTION

A. Territorial behavior

Stiles (1970) reported in late May, adult A. alexandri were still on breeding territories and juveniles were becoming abundant. Through early and mid-June breeding territoriality of A. alexandri waned rapidly. By end of month chaparral almost entirely deserted and were now in gardens, N. glauca stands, or (presumably) in high mountains. Male C. costae went off breeding territory in late June and early July, and all individuals seen thereafter were in heavy molt.

B. Courtship and mating behavior

Bent (1940), "courtship flight mainly long swinging pendulum-like swoops with some variations. Care and feeding of young depend entirely upon female, including building of nest." Beal (1933) noted male does display flight and takes no part in nest building or raising of young.

C. Nesting phenology

Bent (1940) reported egg dates in California: 105 records April 3 to September 3. Height of season May 8 to June 6. In Texas April 4 to June 12; height 4/12 to 4/21. Nesting season rarely before July to height of season: July. "James Dixon has found three-storied nests presumably the bird had returned to the same nest for three successive seasons, building a new nest on foundations of old." Stiles (1971) reported nesting season as late April to July in chaparral (Santa Monica Mountains) with a large peak of egg laying from mid-May to early June. Stiles (1970), "all through June considerable nesting activity. During July females declined greatly latest A. alexandri nest fledged young on 25 July 1967." Began nesting activity in late April. Egg dates: 24-25 April 1967. Fledglings seen on 25 June 1967 (Trabcas) and 15 July 1967 (Stone). Unglish (1932) noted 3 sets taken: 5/5/07, 5/14/07, and 5/12/07. Pitelka (1956a) reported graph of distribution and dates of nest building and eggs of 90 A. alexandri. Audubon Field Notes (1970) noted three nests found on 7/21/70; one with young, two with eggs. Males were still displaying. Grinnell and Storer (1924) noted at Dudley, 6 miles east of Coulterville: arrives in mid-June; nesting takes place late in season. Three nests 7/14/20, 2 fresh eggs. Earlier in season, at lower altitudes nesting is more common.

D. Length of incubation period

Incubation about 13 days (Bent, 1940). Thirteen day incubation (Bowles, 1910). Incubation two weeks (Beal, 1933). Incubation approximately July 16-29 (13 days) (Cogsweel, 1949).

E. Length of nestling period

Grinnell and Storer (1924) reported 2 fresh eggs 7/14/20. Full grown young collected 7/26 and 8/7/20. Beal (1933) noted fledged in 3 weeks.

Archilochus alexandri (con't.)

Young leave nest at about 3 weeks (Bent, 1940). Fledgling length of time July 29 to August 20 (Cogswell, 1949).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1940) reported clutch normally 2, occasionally 3 or 1. Egg description "elliptical-oval, pure white, without gloss". Two or three broods per season. In Bent (1940), "Bendire, 1895 noted second or third sets are found." Brandt (1915) reported 2 eggs. Beal (1933), "not infrequently 2 broods are raised in one season."

B. Seasonal abundance

Stiles (1970), "... was first recorded in Franklin Canyon, Santa Monica Mountains, on 7 April 1967 (first annual siting), males were common by the 16th and were nearly as abundant as C. anna two months earlier) (the peak of C. anna breeding)." Scarce in western Arizona after mid-June (Phillips, 1964). Grinnell (1908), "... was common in June in the lower foothill canyons on the Pacific side of the mountains."

C. Habitat density figures

In preferred nesting habitat density of nest may average every hundred feet (Bent, 1940). Two nests 528 feet apart (Woods, 1936). Breeding distribution: 40 nests/17 acre stand of mature live oak. Distance between active nests: A. alexandri and A. alexandri (23 nests) 15-75 feet; A. alexandri and Selasphorus sasin (8 nests) 18-40 feet; and A. alexandri and Calypte anna (3 nests) 20-25 feet (Pitelka, 1956a).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Stiles (1970), "most of the early nests (in Trancas Canyon) failed due to predation by orioles." Edwards (1919) reported 9 nests destroyed by jays after 1 egg was laid; 2 nests destroyed by man; and 10 nests by a heavy storm.

B. Competition

Grinnell and Storer (1924), "driving a green-backed goldfinch away from his (A. alexandri) favorite perch."

IX STATUS

Phillips (1964), "They used to be abundant along the Santa Cruz River near Tucson, but were greatly reduced in the early 1940's through destruction of the batamote thickets, tree-tobacco, and other streamside plants." Summer resident, March (in south) or April to September in most places common, sometimes swarming (Miller, 1944). Robbins, Bruun, and Zim (1966), "... common in western mountains."

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COSTA'S HUMMINGBIRD

Calypte costae

I TAXONOMY

A. Type description

Calypte costae- AOU (1957) Bourcier. Costa's type specimen = Ornismya costae Bourcier. Rev. Zool., 2, no. 8, October 1839. Magdalena Bay, Baja California.

B. Current systematic treatments

Synonomies - Calypte costae Bourcier; Ornismya costae Bourcier; Calypte costae Gould (Cory, 1918). Ornismya costae; Atthis costa; Trochilus costae; Selaphorus costae; Zephyritis costae (Miller, 1944). Ornismya costae Bourcier (Peters, 1945). Costa's Hummingbird; Ruffed Hummingbird; Coast Hummingbird (Miller, 1944).

C. Hybridization

Huey (1944) reported a hybrid Costa's x broad-tailed hummingbird during 6/21/32 in Rincon Mountains, Pima County in Arizona. Specimen #15883 in San Diego Society of Natural History.

II DESCRIPTION

A. External morphology of adults

Adult male's head is brilliant metallic purple, underparts greenish bronze, bill dull black, iris dark brown, feet dusky. Length of skins: 77-90 mm. Wing: 43-45.5 mm. Tail: 22-24.5 mm. Exposed culmen: 16-19 mm (Ridgway, 1911).

B. External morphology of subadult age classes

In Bent (1940) Wheelock, 1904 noted when hatched they are nearly naked and blind, only a narrow yellowish down along each side of the back, which spreads until after 12 days they are fairly well feathered. Woods (1927) reported newly hatched - minute grub-like creature is black above and brownish below, with body entirely bare except for a row of yellowish filaments along each side of the median line of the back. The bill is yellow and triangular, its length being but slightly greater than its width at the base. The eye-sockets project beyond the base of the bill. "About the 6th day pin-feathers appear, the most noticeable change, aside from increase in size, is... lengthening and darkening of the bill."

C. Distinguishing characteristics

Interspecific - Peterson (1969), "similar species: 1) male C. anna is larger; C. anna also has throat and crown rose-red, not purple; 2) male A. alexandri has no colored (brightly) crown; 3) females are best told by different nest construction. Male - purple or amethyst throat and

Calypte costae (con't.)

crown. Feathers of gorget project at sides. Female - inseparable from black-chinned in field." Bent (1940) reported in C. anna and C. costae alone among the species occurring in the United States, the crown is like the throat in color, but the two differ from each other not only in color of gorget, but in its shape. C. costae's is decidedly concave and its ruff is narrower and more prolonged. Except for calliope, Costa's is smallest North American species. Stiles (1971) noted interspecific differences can readily be seen in the position held by the tail and amount of movement of it. C. anna hold tail down (vertical, nearly like body). C. costae and A. alexandri nervously flick tail open and shut and pump it up and down while hovering. Robbins (1966), "female C. anna is larger and slightly darker below and often has red flecks on throat... Immature calliope and other species commonly found in Costa's range have rufous sides and tail base." Woods (1927), "Costa's... shows a wide variation in its coloring according to the conditions of light. The head and gorget of an... individual will sometimes appear violet-blue and at other times magenta, approaching the color of Anna's."

Intraspecific - Bent (1940), "full juvenal plumage is like adult female, but feathers are margined with grayish buff; tail is double rounded, throat is spotted, and young males may have violet feathers on the throat. Complete prenuptial molt takes place in late winter or early spring, when young become indistinguishable from adults. Young female is similar to adult female except for buffy margins on feathers of the upper parts. To distinguish from other young males - young females have an immaculate instead of spotted throat. Field marks - Male by full crown and elongated sides of gorget of brilliant violet; young male is like female but has some violet feathers about the head; adult female is almost impossible to distinguish in the field from the black-chinned female." Woods (1921) noted variation in color of gorget in same individual may range from bluish violet to magenta.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from central California (southern Monterey, Merced, and Inyo Counties), southern Nevada (from Toiyabe Mountains), and southwestern Utah (Beaverdan Mountains) south to the Santa Barbara Islands, southern Baja California including all near-shore islands, southern Arizona (south from Fort Mojave and Fort Grant) and southwestern New Mexico to Sonora, including Tiburon and San Esteban Islands and Sinaloa. Winters over most of the breeding range, from southern California (Ventura, Los Angeles, Riverside, and San Diego Counties) and southwestern Arizona (Williams River) southward. Casual in San Francisco Bay region." Breeds in western North America in upper Austral zone from southern California and southwestern Utah to southern Baja California, Arizona, and southern New Mexico. Winters on southern Baja California and northwestern Mexico (Peters, 1945). Is a breeding bird of southern Nevada in desert riparian biotic community (Austin, 1970).

Calypste costae (con't.)

B. California distribution of the species

Breeds in southern portion of state including southeastern deserts, coastal region north to Santa Barbara County, and drier western edge of San Joaquin Valley north to Stanislaus County (Small, 1974). Miller (1944), "Breeds, north, east of Sierra Nevada, as far as Silver Creek, Owens Valley (west base White Mountains), Inyo County (Dawson, 1924 and 1947). Nest sparsely west side of upper San Joaquin Valley and in arid valleys somewhat farther westward."

C. California desert distribution

Small (1974), "primarily a summer resident, late February to September; some winter in the Colorado and Sonoran deserts but also occurs in drier foothills of brush and chaparral in the interior valleys." The C. costae is attaining the status of "resident on our southern California desert areas" (Miller, 1935). Miller (1944), "Essentially, San Diegan district northwest through Ventura County, and Colorado and Mohave deserts. Also relatively small numbers remain through winter on Colorado desert, (is otherwise chiefly a summer resident). A few individuals winter on the Colorado desert northwest of Palm Springs (Riverside County) and further east to Azusa and Point Mugu." Stiles (1971), "Found breeding in Borrego desert as early as mid-February, early March nests seen, and by late March fledged young were seen. By April C. costae had virtually disappeared from the Borrego desert, except a few juveniles. Over its whole range C. costae is probably most abundant in desert areas." Miller (1934) found in desert 6 miles northeast of Amboy on 12/27/32. Near Clement Well in Orocopia Mountains on 2/11/34 (male and female). Carter (1937) noted one male seen 3/13/34 on blooming bladderpod (Isomeris) on desert. Also one in palms on 3/16/34.

D. Seasonal variations in distribution

Miller (1944), "Chiefly summer resident, March to September; but also relatively small numbers remain through winter on Colorado desert." Present in summer in southern one-half of state. Possible through winter in Colorado River Valley (Linsdale, 1951). Phillips (1964), "Aside from extreme southwest, it evidently does not normally occur between early August and late January, contrary to the statement (AOU Checklist) that it 'winters over most of breeding range'. In migration (in Arizona) through February and March; end of May they have disappeared from deserts and supposedly gone to Baja California. Common breeding bird in the deserts of central and western Arizona, excluding Huachuca Mountains region. Disappears by early July in western Arizona, and reappears in October in Pima County and Yuma County." Huey (1926), "most abundant hummingbird of coastal region." Adult male and immature taken at Sierra San Pedro Martir on 6/23/26. This is an example of post-breeding migration. Stiles (1970), "Spring migrant C. costae arrived in Santa Monica Mountains early to mid-March." Bent (1940) noted males arrive last of March according to Woods, 1924a, and leave early June. Females and young seen sometime thereafter. Woods (1921), "has returned to same location at Azusa for three years. Arrives in March and leaves in June."

IV HABITAT

A. Biotopic affinities

In Bent (1940), "R. Hoffman, 1927 noted in foothills of southern California at mouths of canyons. These stony plains are overgrown by cactus, sumac, and occasional junipers... in May and June... with scarlet larkspur, yuccas,... white ball-sage." "Less dependent on presence of water than other hummingbirds, and seems to prefer more arid regions in deserts, the chaparral, the sagebrush plains, and desert washes." Typically deserts or desert-like washes, mesas or side-hills, especially while sages, encelias, yuccas, cholla cacti abound; are Xerophilous in extreme degree. On deserts resorts to blooms of desert thorn (Lycium sp.), bee sage (Hyptis emoryii), Fouquieria, Chilopsis. On coastal California, resorts to black-sage and white sage (Miller, 1944). Bancroft (1930), "very abundant; two distinct breeding habitats: 1) open country, cacti and sage (as in California); 2) nests found - probably most are transients on their way north and 2) oases, in jungles of the oases." Phillips (1964), "is the dry desert hummingbird, lives in habitat favoring ocotillos, chuparosa, and cacti." Stiles (1971), "C. costae shows a strong preference for the drier and more open areas in and around the mountains (Santa Monica Mountains), including southern and western exposures, sage-covered slopes near the sea, oak savanna and sage on the north side of the mountains." Costa is a species characteristic of deserts and dry, broken chaparral (Pitelka, 1956a).

B. Altitudinal range

Miller (1944) reported breeding life zone, restrictedly lower Sonoran, sometimes rare invasion of upper Sonoran. Altitude of nesting from near sea level (Imperial Valley) up to 5500 feet in Providence Mountains (eastern San Bernardino County).

C. Home range size

Male breeding territories are large, 2 to 4 acres (Stiles, 1971).

D. Territory requirements

Perch sites - Stiles (1971), "in breeding territories (male) vegetation is generally low and uniform in height. With higher perches scattered throughout... with higher perches, typically yucca stalks."

Nest sites - In Bent (1940), "Dixon personal correspondence notes in more arid regions are often a long way from water." "Bendire, 1895 notes in desert regions of southeastern California various cacti, species of sage (Artemesia) and greasewood (Larrea) while in canyons ash, sycamore, scrub oak, palo verde, cottonwoods, and willows." In many kinds of trees, shrubs, and weedy plants among them oaks, alders, bays, walnuts, willows, gums, sumacs, sycamore, hollyberry, hackberry, orange, lemon, olive, avocado, Paraguay guava, sage, dead yuccas, Opuntia echinocarpa, Opuntia ramosissima, other cacti. "Favorite location - dead yucca stalks nest

Calypste costae (con't.)

in hard dead framework of last year's dead stalk, some 4-5 feet from ground. It does not seek nesting sites near habitations and seems to like the wild isolated areas best." Jaeger (1961) reported female nesting in creosote bush along edge of rocky gorge, where breeze would sway nest back and forth even with young in it. Tyler (1920) noted nests found in arid hills near Dos Palos on sage bushes. Breeding range extended northward along east slope of these hills to nearly the 37th parallel. Stiles (1971), "females are the only hummingbird to build nests in the chaparral itself, near male's breeding territory if there are abundant feeding areas. Favorite nest sites are at some kind of break in chaparral, i.e. either along an edge or in bushes taller than the surrounding vegetation, such that the female has a clear view of the immediate vicinity from her nest." Woods (1927), "When a bush or small tree is selected, as is frequently the case, the nest is invariably located at a height of approximately half the total height of the tree, but near the outside rather than the center, and in a position from which a reasonably clear outlook may be obtained." Trees of dense foliage for this reason are not chosen. In a large tree the nest is located on a small twig near the end of a lower projecting limb. In Azusa, California, nests have been found at heights ranging from 2-9 feet, the mode being 4 feet.

E. Seasonal changes in habitat requirements

Stiles (1970), "Many of the post-breeding C. costae are found through the summer at more open locations, especially in N. glauca stands. During most of July, juvenile costae were present in large numbers (in chaparral) but restricted almost entirely to stands of N. glauca."

V FOOD

A. Food preferences

Miller (1944), "A great variety of blossoming plants is resorted to: on the deserts, desert thorn (Lycium sp.), the bee-sage (Hyptis emoryi), Fouqueria, and Chilopsis; on the coastal side of California, the black sage (Salvia mellifera) and the white sage (Salvia apiana). In Bent (1940), "Grinnell, 1914 notes in Colorado Valley feeding about Lycium andersoni (profusely laden with blossoms), Asclepias subulata, and the sage Hyptis emoryi." "Bendire, 1865 notes in Inyo County C. costae seems to be found about the flowers of squaw cabbage, Stanleya sp., wild rose, plum, cherry bushes, as well as other shrubs found in desert regions." Minute insects, i.e. small Diptera and Hymenoptera. Woods (1927), "Costa's for some reason seems less partial to N. glauca than do larger species of hummingbirds. During nesting the female visits flowers less than does the male, but she may be seen buzzing inside non-flowering trees and shrubs, while the search may be for nesting materials, numerous minute insects and spiders might incidentally be obtained." Major food plant in Borrego desert (February to late March) is Beloperone (Stiles, 1971). Jaeger (1961), "seen probing for sap while red-breasted sapsucker was away from hole." Pickens (1929) noted also feeds on Delphinium cardinale (larkspur), Dudleya brauntoni, Nicotiana, Penstemon

Calypste costae (con't.)

spectabilis, Circsum californicum, Mimulus glutinosus. Woods (1923) noted after orange blossoms disappear, C. costae feed on white sage, stone crop, Penstamon, and scarlet larkspur until July (most males leave during June).

B. Energy requirements

A large hummingbird expends more energy to hover per unit time than a small hummingbird, i.e. C. costae (Hainsworth and Wolf, 1972). Weight of bird = 0.0032 kg and the metabolic rate = 1.1 kcal/24 hr (Lasiewski, 1967).

C. Pollination of plants

Bent (1940), "in probing flowers in search of food, C. costae is only one of the hummingbirds that also pollinate the plants; often the bills and heads of the birds being smeared with pollen." C. costae is an important pollinator for white sage; possible adaptations by sage for such pollination (Pickens, 1929).

VI REPRODUCTION

A. Courtship and mating behavior

Bent (1940), "same general pattern as other hummingbirds consisting of spectacular swoops, dives and loops in vicinity of observing mate. When males find a perched female in breeding season, he will ascend to about 100 feet to one side of the female and then turn and swoop down passing within a few inches of the female... this is continued until female becomes impatient." U-shaped nuptial flight performed (by male) 5 times in succession lasting 1½ minutes but no vocalizations except when both female and male were perched (Huey, 1924). "Nuptial flights" may be a misnomer since it may be directed toward both sexes. The Costa hummingbird displays but does not sing (Pitelka, 1942). Woods (1927), "no male Costa's has ever in my experience shown enough interest in family affairs to indicate his relationship to any particular brood. His mate... finds no difficulty in managing without his aid."

B. Nesting phenology

Bent (1940) reported egg dates in California: March 11 to June 29; height of season May 12 to June 10. Brandt (1951) noted starts nesting two weeks before A. alexandri. Earliest egg date: 4/22; peak season: mid-May; latest record: 7/4 (in southeastern Arizona). Woods (1923) noted female seldom leaves nest when incubating and is not relieved by male. Male leaves for southward migration soon after eggs are laid. First adult male seen 3/16/23; nest building 3/29/23; first egg 4/6/23. According to Gould in Ridgway, 1890 two broods are produced per season; incubation being 12-14 days with one case of 18 days. Woods (1927) noted eggs, 2; white, tinged with pink when freshly laid, and oblong in form. An interval of about two days separated the laying of the eggs.

Calypte costae (con't.)

C. Length of incubation period

Incubation begins with the laying of the first egg and the young are usually hatched out a day or more apart. Five years of census in San Gabriel Valley: The normal incubation period is about 16 days, lengthening to about 18 days but never falling below 15 days. This is a longer time than is required of commoner passerine birds, notwithstanding the larger size of the latter. These figures also do not differ materially from the 17 days incubation quoted for Anna's by Dawson, who states that Anna's incubation is substantially longer than any other hummingbird (Woods, 1927). Bent (1940) reported incubation is about 16 days.

D. Length of nestling period

Dawson (1923), "Under favorable circumstances the young birds fly in from ten to fourteen days" near Santa Barbara. Woods (1927), "growing period... is more prolonged than is the incubation. Statistics for 8 broods: remained in nest 20 to 23 days after hatching, with all but two approximating the higher figure."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1940) noted 2 eggs; one record of 3 eggs and one record of a third egg laid after the second had fallen out of nest. Description: dead white, without gloss, elliptical ovate. Average measurements of 52 eggs: 12.4 x 8.2 mm. Range: 14.0 x 7.8; 12.7 x 9.4; 11.6 x 7.6; and 11.4 x 7.8 mm.

B. Nesting success

Woods (1927), "The number of young fledged is almost exactly one-third of the number of eggs laid (informative table of 29 nests watched over five years). Some of those whose eggs were destroyed undoubtedly built new nests. In no case has a second brood been successfully raised, and only twice have eggs been found late enough in the season to have represented an attempt to do so." Stiles (1971), "it seems not unlikely that many C. costae may raise one brood in the desert in early spring, then move into the chaparral in mid to late April and breed again... certainly its stay in Colorado desert is insufficient to permit the raising of more than one brood. This species also does not appear in numbers in the higher mountains during late spring."

C. Seasonal abundance

Common in migration in April in California (Bruner, 1926).

D. Habitat density figures

Comparative breeding species densities of the Colorado desert and Sonoran desert (Arizona subdivision). 1941: 35/37 acres, Colorado; 38/37 acres,

Calypte costae (con't.)

Sonoran (Hensley, 1954). In Bent (1940), "Dixon noted in favored locations are prone to colonize... 6 pairs within a 100 feet radius near edge of open water in dead cocklebur." Colonial nesting unlikely (Pitelka, 1942).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1940), "seem to have few enemies." Thirteen nests destroyed by jays. Six by heavy rainstorm (Edwards, 1919).

B. Competition

Male C. costae drove off A. alexandri male and established a breeding territory, but no female was seen 3/4/42 (Bene, 1942). Male adult chased male adult C. anna from feeder (Woods, 1934). In pursuit of trespassers in his territory C. costae mounts vertically into air until almost out of sight, then descends like a bullet at the object of his attention, here a cliff swallow (Woods, 1924). Cody (1968) noted in 10 acre flat desert wash in Granite Mountains of Mohave desert that Costa's occupied 8 acres. March: 3 males, 2 females Costa's and 3 males, 2 females rufous hummingbirds. April: 4 males, 3 females Costa's, 2 males calliope, 1 male broad-tailed, and 4 males, 3 females rufous hummingbirds. Fifteen hummingbirds in a 100 x 50 feet area: 10 male rufous, 1 male Costa's, 1 male Anna's, and 3 female rufous and/or Allen's hummingbirds. Territories were non-overlapping and vigorously defended. Stott (1942) reported 5 species of hummingbirds feeding in eucalyptus in August 13-14 in San Diego. About 100 individuals total of C. costae, A. alexandri, and rufous and maybe C. anna and calliope. Stiles (1970), "even after reaching its greatest density in late March and April, C. costae was much less numerous than anna." Stiles (1971) noted micro-habitat differences can help to separate sympatrically breeding species. 1) C. anna breeds earlier, occupies most of the habitat; 2) C. costae chooses driest and most open part of area, i.e. chaparral; hilltop; south and west facing slopes); and 3) A. alexandri chooses the dampest situations.

IX STATUS

A. Present population status

Miller (1944) noted chiefly summer resident, March to September, but also relatively small numbers remain through winter in Colorado desert. Common, abundant in some places. Robbins (1966) reported common in southwest deserts. Brandt (1951) reported not common in southeastern Arizona, but when found, is in sycamore and mesquite stands at canyon mouths.

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Calypste costae (con't.)

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ANNA'S HUMMINGBIRD

Calypte anna

I TAXONOMY

A. Type description

Calypte anna - AOU (1957) Lesson. Anna's hummingbird type specimen.

B. Synonomies

Ornismya anna (Lesson); Trochilus anna; Calypte annae; (Cory, 1918).
Ornismya anna; Trochilus anna; Calliphlox anna; Selasporus anna; Mellisuga anna; Althis anna; Zephyritis annae; Grinnell and Miller (1944).

C. Hybridization

Berlioz (1930) reported California has listed 4 kinds of hybrids: C. anna x Archilochus alexandri = Trochilus violajugulum (Jeffreis); C. anna x Selasphorus sasin = Selasphorus floresii (Gould); C. costae x A. alexandri; S. rufus x Stellula calliope. A new hybrid: C. anna x Stellula calliope specimen shot by C.C. Lamb at Vallecitos, Sierra San Pedro Martir, Baja California at 7500 feet on 6/19/26. Williamson (1957) noted C. anna x Selasphorus sasin is described and overlap in breeding and ecologic distribution is mentioned. "Hybridization may be more frequent than is now known." Taylor (1909) noted Selasphorus allenii x Calypte anna = Selasphorus floresii in Marin County on 2/26/09; detailed description. Also gives previous records for this type of hybridization: 1) at Oaxaca, Mexico described by Gould and is specimen upon which the description is based; 2) in San Francisco, by W.E. Bryant; and 3) in Hayward by W.O. Emerson. Dawson (1923) reported several hybrid forms have been recorded. The most famous is that between C. anna and Selasphorus allenii, of which four examples, all probably Californian. Another described from Santa Barbara, Archilochus violajugulum (Jeffries) probably represents a union of C. anna and Archilochus alexandri.

II DESCRIPTION

A. External morphology of adults

Ridgway (1911) gives detailed descriptions of plumages and measurements of adults and nestlings. Stiles (1971) reported Male: exposed culmen 17.78; wing length 49.76; tail length 30.26; (mm) - weight 4.4 g. Female: exposed culmen 18.66; wing length 49.26; tail length 25.42; (mm) - weight 4.08 g. N = 25.

B. External morphology of subadult age classes

Bent (1940), "soon after fledging, outline of gorget becomes visible on male. The area becomes sooty black, with glints of red, slowly growing more red. In fall, the first gorget is complete, although not as bright as an adult's gorget. This 'juv.' gorget is immediately shed for a full adult gorget."

C. Distinguishing characteristics

Interspecific - Bent (1940), "... in Anna's and Costa's hummingbirds, alone among the species occurring in the United States, the crown matches the throat in color, but the two differ from each other not only in the color of the gorget, but in its shape. Anna's is deeper and its lower border forms a nearly straight line. The area of the crown is separated from that of the throat by a light streak running backward and downward from the eye. Anna's hummingbird is the largest species found within its ordinary range, but there is integration in measurements with all but the calliope hummingbird. Both sexes of Anna's can be separated from the rufous, Allen's, and broad-tailed hummingbirds by the entire absence of rufous or brownish coloring in the plumage. The male differs from the black-chinned and Costa's in the color of its throat and crown and in the fact that the gorget is bordered below by gray instead of white. The adult female usually has a central patch or scattered spots of luminous red on the throat; otherwise it can generally be distinguished from Costa's by its larger size and darker underparts, and from the black-chinned by its stouter form. In size and general appearance, including the color of the throat, Anna's is probably most like the broad-tailed, but the normal ranges of the two species are entirely separate." Peterson (1969), "Male: the only United States hummingbird with a red crown. Throat red. Usually a bit larger in its California range. Female: similar to females of other California hummingbirds, but larger and darker green above. Usually grayer below and with a more heavily spotted throat than female Costa's or black-chinned. Often a central patch of red spots on throat. Similar species: 1) adult males of broad-tailed (east of Sierra), 2) ruby-throated (east of Rockies) lack red crown." Woods (1927), "the color of the head and throat of Anna's is less changeable than are the colors of some species." Robbins, Bruun, and Zim (1966), "Forehead as well as throat is red. Female's green tail is broadly tipped with white; throat usually has a few red feathers. Female is larger and stouter than black-chinned; larger and darker below than Costa's. Male is the only California hummingbird with a real song (sung when perched)." Stiles (1971), "one should not attempt to distinguish female C. anna and A. alexandri and juvenile C. anna. Certain color differences present between two species in one area may not hold good in others. Microhabital differences can help to separate sympatrically breeding species. 1) C. anna breeds earlier, occupies most of the habitat. 2) C. costae chooses driest and most open part of area (chaparral) i.e. hilltops, south and west facing slopes. 3) A. alexandri choose the dampest situations, i.e. canyon bottoms, woodlands, north and east facing slopes. Further species differences can be determined in position at which the tail is held and amount of tail movement. C. anna holds tail down in nearly same plane as body. C. costae and A. alexandri nervously flick tail open and shut and pump it up and down while hovering."

Intraspecific - Bill texture is a reliable character for aging hummingbirds. Corrugated bills: less than one year old; smooth bills: more than one year old. Highly ridged bills are juvenile and a character applicable practically to all species of hummingbirds (Ortiz-Crespo, 1972). Bent (1940), "Individual

Calypste anna (con't.)

variations seem more pronounced than most birds. The color of the back ranges from slightly bluish metallic green to bronzy green; the rose red of the crown changes to purple as a secondary color in some instances, and frequently gold and greenish lights are seen."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Winters over the breeding range; additionally, north to Humboldt Bay, and to islands off the coast of California (Farallons and Santa Barbara group) and Baja California (Los Coronados, Todos Santos, Guadalupe, Cedros, and Natividad Island) and on the Baja California mainland south at least to Catavina at latitude 29°45' N. Also winters in considerable numbers eastward from southern California across southern Arizona to northern Sonora (Punta Penascosa and Los Pinitos). Accidental in Texas (Chisos Mountains, October 1936). Breeds in California west of Sierra Nevada and southern coastal mountains from Humboldt, Shasta, Tehama Counties south to the Sierra San Pedro Martir and San Quentin in northwestern Baja California, extends to Santa Cruz Island and Guadalupe Island in Baja California." Peters (1945), "Upper austral zone of California, chiefly west of Sierra Nevada, and northwestern portion of Baja California. Winters throughout the greater part of its breeding range, withdrawing but slightly from northern parts." Phillips (1964), "Has not been found east of Huachuca Mountains, Fort Grant (Henshaw), and Roosevelt Lake (Willett), nor along Colorado River farther north than Imperial Dam." Common in November and end of October. Two young males and 1 female taken near Caborca 10/31/51. These records extend the autumn range slightly to the south (Phillips and Amadon, 1952).

B. California distribution of the species

Common resident in upper Sonoran areas west of the Sierran divide (thus encircling the Sacramento-San Joaquin Valley); north coastwise to and including San Francisco Bay region; sparingly resident on the Santa Barbara Islands. The post-breeding altitudinal migration involves neighboring mountains, even to Boreal zones, while not wholly depleting the breeding range. Winters sparingly in the northwest humid coastal district and on the Colorado desert (Dawson, 1923). Miller (1944), "Central and southwestern parts of state almost altogether on Pacific drainage; northwest from Mexican boundary in San Diego County through coast district to and including counties bordering on San Francisco Bay; north on lower west flank of Sierra Nevada from Kern County, and along innermost coast ranges north of Carquinez Straits, to head of Sacramento Valley, in Tehama and Shasta Counties." Arnold (1937), "is a resident, but has never been found nesting."

C. California desert distribution

Miller (1944), "Some marginal, out-of-bounds stations of recorded occurrence are: Clark Mountain, eastern San Bernardino County, May 18, 1939

Calypste anna (con't.)

(M.V.Z.); Palm Springs, January 1, Mecca, January 4, and Brawley, December 18 on Colorado desert (Grinnell, 1904; van Rossem, 1911); Fort Yuma, Imperial County, October 25, 1925 (Ellis collection)."

D. Seasonal variations in distribution

Phillips (1947) reported list of records of C. anna seen in Arizona from 1938-1944. Is considered a visitor from fall to December. Van Rossem (1944), "Although by far the greater part of the population of Anna's hummingbird is doubtless resident within the breeding range of the species in coastal and interior California, there is a definite, frequently noted, post-breeding exodus of uncertain degree from that area. Eastern records showing that Anna's migrate eastward across southwestern California as far as southern Arizona and northeastern Sonora... this movement starts as early as latter part of June." Phillips, Marshall and Monson (1964), "Migrates in rather small numbers into southern Arizona in September and early October and winters there until December and rarely early March. Anna's is the only regularly wintering hummingbird in Arizona... but most of them must definitely leave by the end of December, if they have not starved to death... they winter successfully in the lower Phoenix area." In fall some C. anna disperse eastward over the deserts; others return to the lowlands where they feed mostly on Nicotiana and Diplacus. All return to the chaparral to breed. The timing, direction and extent of seasonal movements are determined largely by the spatial-temporal distribution of flowers (Stiles, 1970). Miller (1944), "Also there is then (mid-summer) a centrifugal 'scouting' of some individuals, spatially as such out-of-bounds places as Humboldt Bay... localities on the Colorado desert are reached; quite often such vagrants remain in those places nearly or quite through the winter, but by spring they usually disappear." Grinnell (1932), "... is not known to migrate in the common sense of the word." Bent (1940), "During winter season there is only a slight withdrawal from the northern parts of the summer range, as the species has been recorded at this time north in California to Ferndale and Red Bluff. The most southerly record at this season is the Cerros Island, Baja California. During the winter the species also is sometimes common in the southern part of Arizona." Monson and Phillips (1941) reported a collection at Patagonia on 12/3 in Nicotiana. This bird is considered a late fall transient rather than having remained through the winter.

IV HABITAT

A. Biotopic affinities

Miller (1944), "Life-zone, for breeding, restrictedly, and largely affecting individuals throughout the year as well, upper Sonoran. But a post-breeding mid-summer movement of part of population carries individuals far up-mountain, then temporarily amid Transition and Boreal vegetational surroundings." Grinnell (1908), "... was common in the upper Sonoran chaparral belt and lower canons in June and July... seen and adult male secured in lower Bear Creek canon on June 12, 1905... it was common noted on brushy slopes up to about 5000 feet elevation. Both on June 12, 1905 and September 4, 1905."

Calypste anna (con't.)

Stiles (1970), "... is almost entirely restricted in its breeding distribution to the California chaparral, and its annual cycle is very closely tied to that of the chaparral itself."

B. Altitudinal range

Common resident of upper Sonoran zone 6000 feet in mountains; in late summer up to at least 9000 feet (Willetts, 1913).

C. Territory requirements

Perch sites - Hummingbirds do not always choose an exposed roost. C. anna do retire punctually at sunset, also "periodical shifting of perch" (Woods, 1936). October 26 to November 15: night roosting noted on exposed twig at end of drooping branch... was observed to arrive at sunset (when sun went below horizon) and author noted position until 11 pm. at night (Dyer, 1936).

Courtship and mating sites - Miller (1944), "males tend to take territorial stands in the more open situations, as up canyon sides or hill slopes or out on level washes."

Nest sites - Bent (1940), "Nests... have been described or photographed on almost every kind of site to which it would be possible to attach the structure, except on the ground or any extensive horizontal surface. The distance from the ground at which the nests are placed is also extremely variable. Of 52 nests found by W.L. Chambers (1903) between January 1 and February 18, 1903, the heights ranged from 17 inches to 30 feet. Nests in the following locations: on insulated electric line wires under the crossarm of a service pole 30 feet from the ground; on a climbing vine of a granite cliff within a few feet of an occupied golden eagle nest; in citrus trees; in brush removed from any wooded areas; in dense oak groves; in narrow wooded canyons." Christy (1932), "In chaparral, adjacent to trail in an oak on lateral twigs and against a vertical stem, which was 3/16" thick." Dawson (1923), "Nest - of varied construction and position; a dainty cup of mosses and fine plant shreds bound with cobwebs and usually decorated or covered with lichens; lined with plant-downs, chiefly white or yellow, or feathers (sometimes copiously)... trees chiefly those within easy reach of streams, also man's influence: dangling rope ends under porches, electric light fixtures, hanging baskets, harness hooks, coils of wire in outbuildings..." Pitelka (1956a), "Twenty-seven nests of Anna's ranged from 5 to 30 feet; the modal class was 11-15, with 12 nests... 'within a 17 acre area' of oak woodland was utilized." Stiles (1970), "sites of re-nesting were usually within a short distance of earlier nest(s)."

D. Seasonal changes in habitat requirements

Bent (1940), "The changing seasons of the flowers has made expedient for the hummingbirds a somewhat nomadic existence, aside from true migration. Perhaps this instinct for change has become so strong in the non-migratory Anna's that they are unable to remain in one locality permanently... sugar

Calypste anna (con't.)

containers maintained for their use have been visited by a constantly changing succession of individuals, some remaining for a few days, a few for a period of months." Stiles (1970), "The post-breeding season includes the hottest part of the year, and most C. anna desert the chaparral for the high mountains... those that stay are found in cooler shaded spots - gardens or thick oak woodlands." Small (1974), "a northward and up-mountain population movement occurs in mid-summer."

V FOOD

A. Food preferences

Bent (1940) noted food of the hummingbird is divided quite definitely into two classes: Carbohydrates, consisting of the nectar of flowers and more rarely fruit juices and the sap of trees; and Proteins, as furnished by the minute insects and spiders obtained either in conjunction with other food as the product of separate hunting activities. Hummingbirds prefer flowers of tubular form and are comparatively indifferent to composites and double flowers, i.e. roses. Within certain limits, size seems to be of little moment (importance?). The greatest concentration of hummingbirds is seen about the common "century plant" (Agave americana), abundantly found in California; although the numerous blossoms are dull-colored, they offer a rich store of nectar. Various species of eucalyptus, some winter-blooming also attract large numbers of hummingbirds. When flowers are plentiful and hummingbirds not too numerous they pay less attention to artificial food. During the latter half of the year hummingbirds use artificial (sugar water) food to compensate for the comparative scarcity of flowers, though this habit may be continued through spring. Anna's may be seen sipping juice of persimmon that has been picked by other birds and has softened on the tree, or the juice of a partially eaten prickly pear (Opuntia). Females in nesting season require some additional mineral constituents in their diet - particles of mortar, loose sandy soil. In Bent, Mr. Arnold, 1930, tells of seeing Anna's alight on patches of ground where sand and plaster were shrewn and seem to be picking up something, which he did not identify. In Bent, Junius Henderson, 1927, lists the identified contents of a large number of stomachs as reported by Beal and McAtee, 1912. Stomach contents: (the proportion of liquid food cannot be discerned) - of 111 stomachs examined: vegetable matter; only a trace of fruit pulp; Diptera 45.23%, (gnats and small flies, largely neutral); Hymenoptera 35.03%, mostly useful; Hemiptera 17.3%; and spiders 2%. Dawson (1923), "Anna's hummingbird is fond of the sap of common willows (Salix lavigata and S. lasiolepis). It will also follow the red-breasted sapsucker into orchards and glean eagerly from its deserted borings. Ann's favorite flowers... would be probably Ribes speciosum, gooseberry... it is upon the abundance of this flower that Anna's relies for her early nesting." Stiles (1976) reported the hierarchy of factors influencing preferences as: 1. energetic parameters: nectar flow; 2. taste parameters: sugar composition; and 3. color of flower: (excellent detailed work).

Calypste anna (con't.)

B. Foraging strategies

Dawson (1923), "in watching females feed on a gooseberry bush, because of the density of the foliage the bird felt obliged to alight, and did so whenever favorable opportunity offered. At times it would discontinue its wing motion altogether, at other times the wing stroke was retarded to such a degree as to become noiseless but still too fast for eye to see. Anna's forages on insects by sallying and gleaning from spider webs." Stiles (1970) reported two patterns of food distribution: 1. obtaining food within their territory and 2. obtaining food by commuting outside their territory besides the food within their territory. Juvenile C. anna show precocious territorial behavior, and one advantage of winter breeding in C. anna is that it may enable some juveniles to become established at good nectar sources before many spring migrant hummingbirds arrive. Gander (1927), "In Balboa Park in San Diego, the hummingbirds would hang on rapidly vibrating wings for a second and then dart a short distance... on the rare occasions when they did miss, they relentlessly pursued their chosen prey until it was captured." Bassett (1920) noted on August 23, 1918 at 5 pm. perched on wire sallying for insects including a "small white moth". Activity noted from late August to late October. Bowles (1910) reported food supply, mostly of tiny insects secured from flowers. Anna's also delights in robbing webs of larger spiders of their prey... and also has developed the art of flycatching in mid-air. Pitelka (1942), "sally for swarms of gnats." Bent (1940), "In late afternoon or on a cloudy day a hummingbird may sally for flying insects too small to be discerned at any distance."

C. Energy requirements

Stiles (1971), "male C. anna accomodates seasonal changes in energy demands by varying its allocation time and energy among different activites; total energy expenditures change relatively little. Augmented territory defense during the breeding season is made possible by increased feeding efficiency due to the availability of nectar rich flowers." Pearson (1950), "By measuring oxygen consumption I have been able to calculate their rate of metabolism at rest and in flight and their energy needs over a 24-hour period. The rate of oxygen consumption of (Allen's) and Anna's hummingbirds resting in daytime is higher than that of any other animal measured under comparable conditions. This higher rate is in part balanced in both species by a period of torpidity at night during which body temperature falls and metabolism at 24° C. environmental temperature drops as low as 0.84 cc/g/hr. In captivity recovery from torpidity occurred spontaneously before daybreak. This torpidity did not occur in young Anna's. The rate of metabolism of hovering Anna's averaged about 5½ times the resting levels." Pearson (1954), "Hummingbirds... spend almost their entire active day at only two metabolic levels, hovering and perching. A male Anna's watched between September 3 and 8 flew on the average 18.7% of the time. Energy exchange for 24 hours of normal life in the wild: 7.55 Calories (assuming torpidity at night) and 10.32 Calories (assuming sleep at night). During 12 hour 52 minute active day: 3.81 Calories 56% perching; 2.46 Calories 36% nectar flights; 0.09 Calories 1.3% insect-catching flights; 0.30 Calories 4.5% defense of

Calypste anna (con't.)

territory. The nectar of ca. 1022 Fuschia blossoms can supply this daily need." Hummingbirds are among the smallest known homeotherms. Wing beat frequency is as high as 80/sec. (Lasiewski, Galey, and Vasquez, 1965). Nice (1954), "torpidity at night has been recorded for both male and female adult." Torpidity does not occur every night and "should be thought of as an emergency measure utilized if the energetic reserves of the bird are low. The energy cost of small size in hummingbirds is less than previously reported, i.e. rates of metabolism of torpid, resting, and flying birds." Tables on levels of metabolism in zone of thermal neutrality; insulation values of smaller birds; metabolism at low body temperatures; flight metabolism (Lasiewski, 1963). Barthalomew, Howell, and Cade (1957), "C. anna became torpid at 2° to 23° C. (environmental temp.); also at body temperature as low as 8.8° C, metabolic rate during torpor was as low as 0.3 cc O₂/gm., arousal of metabolic rate could be very rapid, i.e. 1 to 1.5° C/min. at 23° C. ambient temperature." Comparison of 4 species of hummingbirds and their use and demands of times and energy is given in Calder (1975) along with an excellent table on energy budgets for C. anna; 7 days spent in logging various activities of C. anna, i.e. perching, flying, sleeping (torpid/non-torpid). The weight (0.0048 kg.) and the metabolic rate (2.2 kcal/24 hour) was noted in Lasiewski and Dawson (1967).

D. Feeding phenology

In the fall Anna's feed on N. glauca; when these blooms decline (early November) they move into cultivated areas and gardens until Eucalyptus globulus begin to bloom in the Santa Monica Mountains (Stiles, 1970). Maximum feeding activity seemed to be 5-10 minutes after sunset (judging by frequency of visits to a sugar syrup supply) (Woods, 1936). Miller (1944), "When foraging, or at non-breeding seasons, absence or presence controlled by kind and abundance of preferred flowers. Earliest in the year, perhaps, of native flowering plants attractive to the hummingbirds are the upper Sonoran kinds of manzanita and gooseberry of the mountain sides; then the currants, and later successional host of 'orthophilous' plants, leading to the sticky monkey-flower (Diplacus) at the lower altitudes in August."

E. Miscellaneous territorial behavior

During the non-breeding season, male C. anna hold feeding territories at rich nectar sources, but females are not territorial. These territories consist of a few plants plus a perch or two in or near them for the male. Territory size is determined mostly by distribution of food and level of competition for it. A male will attempt to defend at least enough of a nectar source to support him for the entire day. The richer/more localized the food source the smaller... the size. The maximum amount of food that a male can defend reflects the amount of competition: if a large enough number of birds compete for a sufficiently small or localized food source, this maximum may fall below the minimum amount of food needed by a male to maintain himself. Under these circumstances, territoriality will no longer be economically feasible according to Brown, 1964.

Calypte anna (con't.)

In feeding territories males sing less and use inconspicuous perches, often within the food plant itself. Chases are short and occur usually only when one of the defended plants is being fed on by the intruder. In February, with the change of blooming species, i.e. R. malvaceum to R. speciosum, there were local shifts of territory corresponding to changes in distribution of food supply. Both adult and first-year males hold feeding territories at Nicotiana, Eucalyptus, or other rich, localized food sources during the prebreeding season. Juveniles appear to be subordinate to older males; older males tend to show more experience in finding and maintaining food territories. Females are also subordinate to males and do not hold food territories in prebreeding season. Several female C. anna appeared to spend most of their time foraging for insects in tops of oak and alder trees. Observations suggest that competition is more intense at those territories containing a food supply. Females forage for insects during breeding season more than males (possibly for their forthcoming protein needs in laying) (Stiles, 1970).

VI REPRODUCTION

A. Territorial behavior

Pitelka (1942), "permanent territories are defended through 'song' and chasing, but migratory species may adopt and defend feeding territories during migration and in winter residences." Bent (1940), "When a male preempts a certain territory he chooses one or more elevated exposed perches from which he can survey his domain and quickly detect trespassers. Sometimes he will use the same perch through a whole season, seeking shelter only in very hot or windy weather; other individuals will alternate between two or more favorite perches, or select new ones at intervals. The males seem to spend a large proportion of daylight hours on these perches." Williamson (1956), "The winter and spring months, December to June, form the period in which the males are in reproductive condition and are occupying breeding territories. In May and June the behavior of the males undergoes changes: display flights become infrequent and eventually stop. Most males assume the most belligerent and hostile attitudes, defending a large area by means of short chases in and about the core area which itself declines in size at localities where large numbers of birds feed." A male on a breeding territory is characterized by persistent singing from exposed perches, and by frequent and long chases, also dive displays whose function is that of intimidation, besides of course the dives use in courtship display. Advertising flights in which the males fly in wide circles singing high over their territory are also observed. A breeding male will attack any hummingbird flying over its territory, even at heights of 100 feet or more. During initial phases of setting up breeding territories, boundary disputes are frequent. Advertising flights are frequent until territorial boundaries are defined, then these displays become very infrequent. Neighboring males are continually aware of one another and periodically test and challenge one another's defenses. A female manifests intolerance of other hummingbirds at these perches but rarely actually defends them (Stiles, 1970).

Calypte anna (con't.)

B. Courtship and mating behavior

Bent (1940), "... nuptial flights... of Anna's hummingbird, on which the bird mounts upward until almost lost to sight then shoots vertically downward at tremendous speed, finally altering his course to describe an arc of a vertical circle, which carries him as closely as possible past the object of his attention as she sits quietly in some bush or tree. At the lowest point of the circuit he gives utterance to a loud, explosive chirp,... he continues along the arc until he arrives at a point directly above his mate, where he hovers for a few seconds with body horizontal and bill directed downward, rendering his squeaky song. Then, without change of attitude he begins to rise rapidly and vertically, repeating the entire maneuver until he tires or the other bird departs, with himself in hot pursuit. When first observed, the birds were playfully chasing each other about and suddenly swooped down to within about eighteen inches of the ground where the leading bird, which proved to be the female, stopped and faced about. The male approached and the mating was consummated in the air, the birds breast to breast and with the male somewhat under the female. The male then settled down to the ground fanning out his tail and pointing beak upward, while the female flew to a nearby perch. After a short rest, the mating again took place as before." In Bent (1940), James B. Dixon, of Escondido, California (MS), concerning nests and their sites: "The female seems to select the nesting site... and did all the nest building." Pitelka (1942) noted the Anna's hummingbird practices two types of courting behavior, the "singing" more frequently than the "displaying". In Pitelka (1942), "Further, on one occasion, I noted a male Anna's hummingbird 'sing' and then display near its post while another male sang some twenty yards away. Thus, territorial competition may stimulate display (Skutch, 1940)." Female completes nest, incubates eggs, rears young, without assistance from male (Miller and Loye, 1919). Unusual situation of adult male feeding nestling. Never before noted in literature (Clyde, 1972). Miller and Loye (1940) reported source of the climax sound produced by male during nuptial diving performance is thought to be a feather vibration. In young males the sound may not be the same tone due to plumage. Rodgers (1944), "note at bottom of the dive of the adult male is produced by vibration of outer tail feathers."

C. Nesting phenology

Bent (1940), "nesting season begins before the arrival of any of the migrants, sets of eggs, having been found by various persons as early as December. Nesting probably continues normally through late winter and spring and sporadically throughout summer, with some evidence of its extending even into the fall. With the breeding season so greatly prolonged, it is of course difficult to determine exactly how many broods are raised each year, but it may be inferred that two is the usual number, as in the black-chinned and Allen's hummingbirds. The first incubation period began in late January, the second just two months later... it is hard to explain satisfactorily why these species, which... raise two broods yearly, do not gain, in numbers relatively to the Costa's, rufous, and calliope hummingbirds, which do not remain on their breeding

Calypste anna (con't.)

grounds long enough to permit more than one. Egg dates in California: 86 records, December 21 to August 17; 43 records, February 22 to May 18 - indicating the height of the season." Williamson (1956), "By late August and early September, chases become longer and more frequent. By late September and early October many birds have finished molting and development of testes has commenced, but the tempo of territorial activity shows little change until late November and early December. At this time both adult and juvenile males, have completed molt and testes are coming into breeding condition. In this area winter rains commence and, in local areas where suitable food in the rainy season attracts hummingbirds in numbers, females become increasingly more conspicuous in the dense population of males. Display flights increase abruptly, typically after a major spell of rainy weather, and movement to a suitable breeding habitat begins. By mid-December all males are in full breeding condition. By January all the males are well established on breeding territories. The achievement of breeding condition seems more closely related to the onset of winter rains than any other climatic factor. The number of consecutive days of rainfall appears to be of greater significance than the actual amount of rain received. Until further evidence is available it seems reasonable to assume that an inherent rhythm is operative in controlling the testis cycle, and that this rhythm is modifiable by rainfall and other factors, such as the presence of females, with the ensuing breeding season occurring in the period when food plants are numerous. Territory size and defense vary according to the season of the year and the physiological condition of the males. During the dry season when the birds are molting, small areas are weakly defended. With an increase in testis volume, and a probable corresponding rise in hormone level, activity increases. When the breeding condition is attained, most of the males are established on large, actively defended territories." The permanently resident Anna's hummingbird has the longest breeding period, from late December to mid-June, and two broods (occasionally three?) are raised per season. Near Santa Barbara, this species begins to breed a full month to six weeks ahead of Allen's hummingbird, this difference also occurs between the two species in the San Francisco Bay area. Fifty-one records from Santa Monica also support this for the years 1901 and 1902 (Pitelka, 1951). In Abbott (1927), John von Bloeker, Jr. found a nest with well grown young present on 2/16/26. Stiles (1970) gives a table of timing and major events of the annual cycles of C. anna. The data is over a four-year period. Reports such important and intricate data as first breeding territories, maximum number of territories occupied, first nesting activity seen, egg dates, first juvenal seen, most C. anna abandoning breeding territories, etc. "Breeding season begins in November or December with movement of male Anna's onto breeding territories, followed within a few weeks by the beginning of nest building by the female. It ends with the males abandoning their breeding territories in April and May and the females ceasing nesting activities between May and July. Timing and duration of these seasons vary from year to year." Winter rains are followed by rapid testicular maturation and the appearances of some breeding behavior in C. anna males, but breeding territories in the chaparral are occupied only as Ribes malvaceum comes into bloom there. Full breeding behavior is attained at about the same time each year despite

Calypte anna (con't.)

the variability in timing of rainfall or acquisitions of a territory; a response to daylength is suggested. During the cold winter months C. anna is the only breeding bird and Ribes speciosum practically the only blooming plant in the chaparral. Winter reproduction in either species would be impossible without the other, and a coevolutionary relationship is suggested. Females foraging for insects more than males may be due to male control of best floral sources and also females must catch insects to obtain protein for egg production and to feed the young. A ready source of flower nectar is important also, since when incubating eggs or brooding young, she does not enter torpor at night, thus being deprived of an important energy conserving mechanism, location of suitable flowers seems to be important factor in a females nest site. "Before beginning to build her nest, a female will restrict her activities to the vicinity of a good food source. She may defend it not unlike a male on a feeding territory, although usually less vigorously. I believe that a nest site is usually chosen after the female has found a nectar source." Nesting commences following the appearance of the male breeding territoriality and the blooming of suitable flowers in the nesting areas. Nesting continues until males in breeding condition are no longer available. Young from very late broods may not reproduce the following season. "I know of no female that successfully raised three broods. A female that successfully raised two broods laid her eggs about 1-5 February and 25-30 March; the young fledged approximately 15 March and 10 May respectively."

D. Length of incubation period

Bowles (1910) reported 17 days incubation in Santa Barbara. This is longer than most other small birds, may be attributed in part to the consistency of the albumen, "which is thick and almost gummy" when compared to other local hummingbirds' albumen. Anthony (1897) noted 18 days incubation.

E. Length of nestling period

Bowles (1910), "it was not until thirteen days that his eyes opened. On February 13, when he was just 3 weeks old, the young bird left the nest, but remained in the home tree for the greater part of the day."

F. Growth rates

Howell and Dawson (1954), "First few days after hatching, the nestlings exhibited no apparent capacity for homeothermy, their temperatures rose when they were brooded and dropped when parent left the nest. By the 13th day the nestlings could maintain their temperatures well above that of the environment." Dickey (1915), "young hatched into black, grubby caterpillars, with smokey fuzz in two lines down the back, and squat yellowish mouths that give no hint of the future awl-like bills. On the fifth day the eyes opened. On the seventh day pin feathers were apparent."

G. Post-breeding behavior

Williamson (1956), "Coincident with the decline of territorial behavior in adults and the inception of molt on both age groups there is extensive movement, from the dry brushy hillsides, to areas of favorable food supply such as gardens and places where suitable plants such as Nicotiana glauca and Fuschia can be found. In these areas small territories are defended for varying periods of time by both adult and juvenal males, the former being more successful. In such places the density may be great. By mid-August, defense of these small territories constitutes only a fraction of the activity seen in the breeding season. Display flights are virtually absent. Two males may be seen feeding within a few feet of one another with no overt signs of hostility." Law (1919) noted is pugnaciously solitary between nesting periods.

VII POPULATION PARAMETERS

A. Clutch size

Bent (1940), "The usual two eggs are indistinguishable from other hummingbird eggs of similar size. The measurements of 50 eggs average 13.31 by 8.65 mm; eggs showing extremes are 14.3 by 9.0, 12.7 by 9.4 and 11.3 by 7.7 mm." Bowles (1910), "eggs are invariably 2 in a complete set, pure milky white, and elliptical ovate in shape. An average specimen measures 0.53 x 0.32 inches." On 4/15/43: 2 newly hatched and one infertile egg (Peyton, 1943).

B. Nesting success

Bent (1940), "Dependence upon one parent alone would theoretically increase the chances of failure. It would seem that the number of young fledged could not represent a very large proportion of the eggs laid. Once the young bird is able to fly, however, the situation is wholly changed, and the fledgling may look forward to the expectancy of a long life. In some cases, one of the eggs will fail to hatch, even though not disturbed." Nesting success was about 45% of all nests in which eggs were laid (Stiles, 1970). Nestling success = 30% (Pitelka and Legg, 1956).

C. Seasonal abundance

Peterson (1969), "The only hummingbird commonly found in California in mid-winter."

D. Habitat density figures

Breeding distribution: 31 nests/17 acres of mature live-oak (Pitelka, 1951a). Density 10-11 males per 125 acres. Females less numerous (they breed in other habitats). Distance between active nests: C. anna + C. anna (20 nests) = 20-50 feet; C. anna + S. sasin (6 nests) = 18-40 feet; C. anna + A. alexandri (3 nests) = 20-42 feet (Pitelka, 1951b). Pitelka and Legg, 1956), "nests of C. anna simultaneously active were spaced about

Calypte anna (con't.)

200 feet apart." April 1, 1955 breeding population of 5 females in 6 acres near Santa Cruz.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1940), "The adult hummingbird seems to have no enemies of importance." Most cases cited are accidental, i.e., caught in the web of a giant black spider. Anthony (1923) noted young eaten by "Argentine ants" in Balboa Park, San Diego. Edwards (1919) reported 4 nests destroyed by jays.

B. Competition

In areas of overlap C. anna and S. sasin (usually areas of willows) a mutual but unbalanced suppression of population levels of males occurred. Nearly always C. anna would be favored over S. sasin (Pitelka, 1951). Ecologic overlap of C. anna and Selasphorus sasin. Concludes that there may be little margin of success favoring either species in areas of overlap and competition (Pitelka and Legg, 1956). Pitelka (1951a), "In the Santa Barbara area, three species (anna, sasin, and alexandri) overlap in habitat distribution of nesting females. Competition for space or food or both may be expected to occur... other pertinent information... can relieve or intensify competition... within a general habitat type such as oak woods along a canyon stream, the three species may breed in fair numbers. This applies specifically to the females and their nesting activity." Dixon (1954), "chickadees being pursued by C. anna." Male adult was chased by male adult C. costae (Woods, 1934). Jencks (1930) reported on 11/30/29: advanced repeatedly to within one yard of saw-whet; also buzzed directly in the owl's face. Yeaton and Laughrin (1976) noted there is only one abundant food source (on Santa Cruz Island in fall), Zauschneria sp. for nectar. C. anna shares it with Allen's but uses different strategy. C. anna uses a larger feeding territory with low density of food plants, Allen's is the converse, small territory with high density of food plants.

IX STATUS

A. Past population trends

Woods (1927), "Anna's is apt to be seen in any season, except possibly in mid-summer, but never in abundance."

B. Present population status

Miller (1944), "Resident. Common, but not in as great concentrations as other hummingbirds. Because of human settlement and clearing of woodlands, extensive gardening and the planting of flowering non-native trees, the numbers of Anna's no doubt exceed the original aggregate population. An important factor is the presence now of plants which flower

Calypste anna (con't.)

abundantly all through the quiescent period for most native kinds of shrubs, roughly October-January... the rigors of a 'minimum food period: in the annual cycle have been abated; a much larger population of wintering hummingbirds can carry over'. Habitat conditions favorable to Anna's hummingbird have vastly improved and spread in the last 50 years." California must now be capable of supporting a much larger population of these birds than would have been possible under primitive conditions (Bent, 1940). Anna is the only year round resident (in California, ed.) of the family Trochilidae (Pitelka, 1956a).

C. Environmental quality: adverse impacts

Man has affected, in varying degrees, the ecology and distribution of every C. anna hummingbird species. The introduction of fall blooming flowers has doubtless increased the total C. anna population. Man has affected the occurrence of breeding and seasonal movements in space but not time; nesting success of C. anna in natural and man-made habitats is similar (Stiles, 1970).

Calypste anna (con't.)

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COMMON FLICKER

Colaptes Auratus

I TAXONOMY

A. Type description of desert subspecies

Colaptes auratus borealis, boreal flicker (yellow-shafted): Colaptes auratus borealis Ridgeway, 1911, Proc. Biol. Soc. Wash. 24:31 - Nulato, Lower Yukon River, Alaska (Peters 1948).

Synonomies - Colaptes auratus luteus; northern flicker, yellow-shafted flicker, boreal yellow-shafted flicker (Grinnell and Miller 1944).

Colaptes auratus collaris, Monterey flicker (red-shafted): Colaptes collaris Vigots, 1829, Zool. Journ. 4:324 - Monterey, California (Peters 1948)

Synonomies - Colaptes collaris, Colaptes cafer canescens, Colaptes cafer chihuahuae (Peters 1948), Colaptes mexicanus, Colaptes mexicanoides, Colaptes ayresii, Picus mexicanus, Colaptes auratus mexicanus, Colaptes auratus hybridus, Colaptes cafer collaris (Grinnell and Miller 1944); red-shafted flicker, red-shafted woodpecker, orange-shafted woodpecker, red-moustached woodpecker, red-quilled flicker, Mexican flicker, hybrid flicker, California flicker, Monterey red-shafted flicker (Grinnell and Miller 1944).

Colaptes auratus mearnsi, Mearns flicker (gilded) Colaptes chrysoides mearnsi Ridgeway, 1911, Proc. Biol. Soc. Wash. 24:32 - Quitoraquito, Arizona (Peters 1948).

Synonomies - Picus chrysoides, Colaptes chrysoides chrysoides, Colaptes chrysoides mearnsi; malherbe flicker, gilded flicker, mearns gilded flicker (Grinnell and Miller 1944).

B. Current systematic treatment

Order Piciformes, family Picidae, subfamily Picinae, genus Colaptes vigors, 1826, Trans. Linn. Soc. Lond. 14(2):457 (Peters 1948).

Colaptes auratus is composed of 17 recognized subspecies: eight are associated with the former Colaptes cafer, five with the former Colaptes auratus, and four with the former Colaptes chrysoides (Peters 1948). Of these subspecies, three "cafer" subspecies occur in the United States (cafer, collaris, sedentarius), as do three "auratus" subspecies (borealis, luteus, auratus) and one "chrysoides" subspecies (mearnsi).

C. Recent taxonomic revisions

The Supplement to the AOU Check-list of North American Birds (1973) considers that Colaptes cafer and Colaptes chrysoides are conspecific

Colaptes auratus (Cont'd)

with Colaptes auratus. The English name for the enlarged Colaptes auratus becomes common flicker, with yellow-shafted flicker, red-shafted flicker, and gilded flicker remaining available, respectively, for the auratus, cafer, and chrysoides subspecies groups (see also Short 1965).

II DESCRIPTION

A. External morphology of the adults

The flicker is "a large (130-160 gram) woodpecker... upper surface gray-brown, lightly barred on back, the rump white; ... breast with black crescent; posterior underparts light gray and white with black spotting" (Miller and Stebbins 1964; see also Bent 1939).

B. External morphology of subadult age classes

Juvenile male plumage is similar to that of the adult male, but duller, more brownish, black areas less sharply defined (Bent 1939). Juvenile female similar to juvenile male, but malar region is grayish brown and not colored (Bent 1939).

C. Distinguishing characteristics

Interspecific - The white rump is the most conspicuous field mark and distinguishes this woodpecker from all others (Bent 1939).

Intraspecific - The color pattern of collaris is similar to borealis, but it shows reddish color under the wings in collaris and yellow in borealis (Bent 1939). The male collaris has a red malar stripe, whereas the male borealis has a black malar stripe. The throat and foreneck is gray in collaris and the head and hind neck are brown. The colors are reversed in borealis.

The subspecies mearnsi has yellow quills but a red malar patch, and it has no red crescent on the nape of either sex, as is found in borealis (Bent 1939).

D. Special morphological features

Woodpeckers are "chisel-billed wood-boring birds with powerful zygodactyl feet..., remarkably long tongues and stiff, spiny tails which act as props when climbing" (Peterson 1961).

III DESCRIPTION

A. Overall distribution of the species

Flickers occur from the tree limit in Canada and Alaska south to the highlands of El Salvador, Honduras and Nicaragua; only the northernmost

Colaptes auratus (Cont'd)

species migrate (Peters 1948). The distributions of the non-desert subspecies are as follows: cafer (northwest coast of North America), sedentarius (Santa Cruz Island, California), luteus (from U.S.-Canadian border southeast of Rockies to southern U.S.; winters to Gulf Coast and southern Texas), auratus (southern U.S. below luteus).

Colaptes auratus borealis breeds "from limit of trees in Alaska, Mackenzie, northern Manitoba, Labrador (lat. 55°N) southward (east of Rockies) to eastern Montana, northern Ontario, Anticosti Island" (Peters 1948).

Colaptes auratus collaris breeds from "Southeastern British Columbia, southern Alberta, southwestern Saskatchewan south to southern California, Sonora, Chihuahua, Durango and Zacatecas" (Peters 1948).

Colaptes auratus mearnsi breeds from "southeastern California and southwestern Arizona to northwestern Baja California and northern Sonora; Tiburon Island" (Peters 1948).

B. California distribution of the species

C.a. borealis is found scatteringly throughout the entire state (Grinnell and Miller 1944).

C.a. collaris breeds west and north of the Mohave and Colorado Deserts and south and east of the northern humid-coast belt (Grinnell and Miller 1944).

C.a. mearnsi breeds in the Colorado River Valley, south from Needles (San Bernardino County) to the Mexican line below Yuma (Imperial County; Grinnell and Miller 1944).

C. California desert distribution

See information under California distribution. Colaptes auratus is also present in the winter in the Colorado River Valley (Grinnell 1914), in Death Valley (Wauer 1962) and in Joshua Tree National Monument (Miller and Stebbins 1964).

D. Seasonal variations in distribution

C.a. borealis is present in southern California primarily during the winter (Grinnell and Miller 1944, Peters 1948).

C.a. collaris migrates vertically rather than laterally, primarily from the Rocky Mountains onto the Great Plains (Bent 1939). The northern populations also tend to migrate south (Peters 1948). This subspecies spends the winter in southern Arizona, arriving in early September and

Colaptes auratus (Cont'd)

and leaving in early April (Gilman 1915) and is also a common winter visitor to the lower Colorado River Valley (Grinnell 1914) and Death Valley (Wauer 1962).

C.a. mearnsi is a year-round resident (Grinnell and Miller 1944, Peters 1948).

IV HABITAT

A. Biotopic affinities

C.a. borealis is found in the Transition and Canadian Life Zones, where there is marginal forest or woodland (with some dead trees) adjacent to grassland (Grinnell and Miller 1944).

C.a. collaris is found in the Upper Sonoran and Transition life zones and occasionally in the Canadian and Lower Sonoran life zones where the terrain is semi-open and where trees stand near grasslands (Grinnell and Miller 1944). This subspecies is not usually found on treeless plains or deserts at least not for breeding (Bent 1939).

C.a. mearnsi is restricted to the Lower Sonoran life zone and inhabits the saguaro cactus belt in particular (Grinnell and Miller 1944). It is found "in cottonwood and willow groves, as well as wherever the giant cactus grows," since the saguaro supplies them with home, shelter, food, and possibly drink (Gilman 1915).

B. Altitudinal range

Grinnell and Miller (1944) reported that collaris occurs up to 9200 feet. This subspecies moves southward and downward in winter, staying below snowline. C.a. collaris has been seen nesting as high as 10,500 feet in the bristlecone pine association of the Panamint Mountains (Wauer 1964).

C. Home range size

No information located for desert areas.

D. Territory requirements

Roost site - "Flickers will roost in any open cavity in a tree, or even in a partially sheltered spot on the open trunk" (Bent 1939).

Courtship and mating sites - Courtship takes place on or in dead trees which are potential nest sites (Bent 1939).

Nest sites - Colaptes auratus borealis and collaris nest in old rotten stumps or trees, such as cottonwoods, willows, sycamores, junipers,

Colaptes auratus (Cont'd)

oaks, pines, and holes in banks (Bent 1939, Grinnell and Miller 1944). The nests are located from ground level to 100 feet, but most are found between eight and 25 feet (Bent 1939).

Colaptes auratus mearnsi nests primarily in saguaro, 12 to 20 feet from the ground (Bent 1939). Gilman (1915) found 21/27 nests in saguaro, 4/27 in willows and 1/27 in cottonwoods.

E. Special habitat requirements

C.a. mearnsi is restricted to the saguaro belt of the Lower Sonoran life zone (Grinnell and Miller 1944).

F. Seasonal changes in habitat requirements

C.a. collaris arrives in the southern California desert areas in late September or early October, remaining until late March or April (Wauer 1962, Miller and Stebbins 1964). It frequents the willow association next to the Colorado River (Grinnell 1914) and the pinon and yucca belts of Joshua Tree National Monument (Miller and Stebbins 1964). This species avoids the open lower desert basins (Miller and Stebbins 1964).

G. Physiological ecology

Early collaris arrivals in Death Valley in the fall frequently die of heat and dehydration if they do not make the adjustment from the cooler breeding environment to the desert environment (Wauer 1962).

V FOOD

A. Food preferences

Beal (1910) reported that California Colaptes auratus consumed 54% animal matter and 46% vegetable matter on a yearly basis. The animal diet consisted mostly of Hymenoptera (46% of the total annual food consumption, 45% of the total being ants). Coleoptera accounted for 3% and other arthropods for 5% of the diet. The vegetable material had the following composition: mast (19%), grain (4%), fruit (15%) and other plants (17%). C.a. borealis in particular consumed less vegetable matter than unspecified Colaptes auratus subspecies (39.1% for borealis vs 46% for California subspecies; Beal 1911).

C.a. mearnsi consumes corn around storage areas, saguaro fruit and pulp, and ants (Gilman 1915).

B. Foraging area

The flicker gains most of its animal diet by foraging in decaying logs and stumps (Beal 1910), hence the high proportion of ants found in the flicker stomachs. It forages both in forests and on fields and open hillsides (Grinnell and Miller 1944).

C. Foraging strategies

The flicker forages for vegetable and animal matter on branches and trunks of trees, on the ground beneath trees, and on fields and open hillsides (Grinnell and Miller 1944).

D. Feeding phenology

Ants provided up to 80% of the diet in June and July and fell to 7% in November (Beal 1910). Plant material was most heavily consumed in the fall and winter. Grain was taken from August, through November only. Fruits contributed 48% of the diet in September and Rhus seeds provided 40% of the food intake in October. Mast was an important food source in winter, reaching 40% of the diet in December (Beal 1910).

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

There is very little information on territorial behavior in the flicker. One description in Bent (1939) indicates that the mock warfare is very mild. Two males associated together for some time, alternately posturing and tilting three times before separating. The posturing consisted of head weaving and tail fanning on the trunk of a tree, and the tilting was only momentary.

C. Courtship and mating behavior

Flicker males use a "wick-up" vocalization throughout the breeding season and this call could function both to attract females and advertise territories to other males (Bent 1939). The males also drum on resonant limbs or inside nesting cavities as part of courtship activities, but it occurs at other times as well.

Colaptes auratus (Cont'd)

The male helps incubate the eggs and feed the young. He also frequently stays all night with the young (Bent 1939).

D. Nesting phenology

April is the peak of the breeding season. Gilman (1915) found 19 of 27 nests during this season, 11 nests with eggs and eight with young. Bent (1939) reported the following egg dates for California: 75 records, April 9 to July 2, 38 records, May 3 to 28, indicating the height of the breeding season.

E. Length of incubation period

Bent (1939) reported an incubation period of 14 to 16 days, although Sherman (1910) stated that incubation lasted nine to 12 days.

F. Length of nestling period

Bent (1939) reported a nestling period of 25 to 28 days, as did Sherman (1910).

G. Growth rates

Sherman (1910) observed behavioral changes during nestling development. Until 11 days, the nestlings lie in circle. At 10 days, their eyes open. By 17 to 18 days the young begin to cling to the wall. By 21 days, the nestlings can climb to the hole for feeding. The nestlings are fed 1/10 to 1/16th of their weight at a single feeding, the average feeding load being 100 grains. The young weigh 83 to 85 grains at hatching and gain an average of 100 grains per day for the next 11 days. After this time, the average weight gain is 25 to 40 grains per day. After about 18 days, the weight curve flattens out and the nestlings may even lose weight. Peak weights for three broods were reached on days 22 (1751 grains and 1981 grains) or 23 (1635 grains). Fledging weights were 1572 grains (day 27), 1896 grains (day 25), and 1615 grains (day 25), respectively (Sherman 1910).

H. Post-breeding behavior

The young are fed for at least 2 weeks after fledging while they learn to forage (Bent 1939). The adults hide food in cracks in sight of the young, who must retrieve it, thus developing skill at foraging.

Pairs may last year round or begin forming in winter. Balda et al (1972) observed flickers foraging in pairs in Arizona.

VII POPULATION PARAMETERS

A. Clutch size

Burns (1900) has carried out an extensive survey of clutch size involving 169 nests. He found the following distribution of clutch sizes: 4 eggs (11 nests), 5 eggs (16), 6 eggs (35), 7 eggs (34), 8 eggs (38), 9 eggs (17), 10 eggs (13), 12 eggs (3), 13 eggs (1), 14 eggs (1). This results in a mean clutch size of 7.2 eggs, although the larger clutches may be the result of laying by more than two females. Burns also found that flickers could lay repeated replacement clutches, one laying seven successive clutches.

Gilman (1915) observed a much lower clutch size: 4.1 eggs, range 3 to 5 eggs, n = 25 nests. He also found a large number of infertile eggs.

B. Nesting success

No information located.

C. Mortality rates per age class

No information located.

D. Longevity

Sherman (1910) observed the reproductive efforts of a single male for four consecutive years making this bird at least four years old during the final season.

E. Seasonal abundance

The northern subspecies migrate south from the more northern breeding areas, depleting the population there and adding more birds to the southern California desert areas (Wauer 1962, Miller and Stebbins 1964).

F. Habitat density figures

Cody (1974) observed densities in breeding and winter seasons, recording them as the proportion of the study area occupied. The data are presented in the following table.

	Proportion study area occupied	
	Breeding	Winter
Oak-woodland	61%	63%
North slope chaparral	71%	50%
South slope chaparral		70%

Another study area yielded a density figure of 0.7 pairs per acre (Cody 1974).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1939) reported that the following hawks preyed on flickers: duck hawk, sharp-shinned hawk, broad-winged hawk, marsh hawk, Cooper's hawk, red-shouldered hawk. DeWeese and Pillmore (1972) observed a black bear destroy a flicker cavity to prey on the young.

B. Competition

Starlings compete with flickers by eating some of the same foods and stealing nest sites (Bent 1939, Kessel 1957).

During the winter season, flickers forage in association with pinon jays and are rarely found alone (Balda et al, 1972). The two species forage on the ground and aggressive encounters are not uncommon, especially when flickers forage in jay cache sites in decaying logs. Jays supplant flickers about 54% of the time.

C. Parasitism

No information located.

IX STATUS

A. Past population trends

No information located.

B. Present population status

The Seventy-seventh Audubon Christmas bird count (1977) reported flickers in 22 out of 28 desert and near desert areas censused. The areas censused (and the number of flickers sighted) are as follows: Bakersfield (39 collaris), Big Bear Lake (48 collaris), Butterfield Spring (10 collaris), Carrizo Plains (6 collaris), China Lake (10 collaris), Claremont (80 collaris), Death Valley (20 borealis), Granite-Woody-Glennville (43 borealis), Idylwild (43 borealis), Joshua Tree National Monument (1 borealis), Orange County NE (160 borealis), Pasadena (113 borealis), Redlands (54 borealis), Salton Sea N (4 borealis), Salton Sea S (64 borealis), San Bernardino Valley (171 borealis), San Fernando Valley (40 borealis), Sespe Wildlife Area (56 borealis), Springville (160 borealis), Thousand Oaks (100 borealis), Parker, ARizona-Colorado River (93 collaris, 3 mearnsi), Yuma, Arizona (23 borealis, 36 collaris, 3 mearnsi).

C. Population limiting factors

No information located.

Colaptes auratus (Cont'd)

D. Environmental quality: adverse impact

No information located.

E. Potential for endangered status

No information located.

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Colaptes auratus (Cont'd)

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GILA WOODPECKER

Melanerpes uropygialis

I TAXONOMY

A. Type description

Melanerpes uropygialis albescens, Colorado River gila woodpecker:

Centurus uropygialis albescens van Rossem, 1942, Condor 44:22 - Laguna Dam, lower Colorado River, Imperial County, California (Peters 1948).

Synonomies - Melanerpes hypopolius albescens (Peters 1948), Centurus uropygialis uropygialis; gila woodpecker (Grinnell and Miller 1944).

B. Current systematic treatments

Order Piciformes, family Picidae, subfamily Picinae, genus Melanerpes Swainson, 1831, Fauna Bor. Am. 2:316 (Peters 1948).

Peters (1948) recognized eight subspecies, two of which occur in the U.S.: uropygialis, albescens, cardonensis, brewsteri, fuscescens, tiburonensis, sulfiventes, hypopolius.

C. Recent taxonomic revisions

The supplement to the AOU Checklist of North American Birds (1973, Auk 90:411-419) indicates that there have been no changes in gila woodpecker taxonomy since the 5th edition of the Checklist (1957).

II DESCRIPTION

A. External morphology of adults

The gila woodpecker is a "middle-sized (58 - 72 gram), stoutly built woodpecker. Head and breast gray, except for a dark red spot on the crown in males; posterior belly yellow; back, wings and central and lateral areas of tail conspicuously and finely cross-barred, black and white" (Miller and Stebbins 1964); see also Bent 1939, van Rossem 1942). The gila woodpecker shows a white wing patch in flight (Peterson 1961).

B. External morphology of subadult age classes

The juveniles are similar to the adults, but paler and grayer with barring less distinct and white bars suffused with brownish buff (Bent 1939). The red patch on the crown of the male is smaller in the juveniles. The young birds assume adult plumage with the post-juvenal molt.

C. Distinguishing characteristics

Interspecific - Flickers are generally brown, not gray and the ladderbacked woodpecker has a striped face; neither shows a white wing patch in flight (Peterson 1961).

Melanerpes uropygialis (Cont'd)

Intraspecific - M.u. albescens is the palest of the races ...rump and upper tail coverts with barring or spotting at a minimum for the species; head, neck, and underparts, as compared with uropygialis, paler and more grayish (less brownish) drab, yellow abdominal patch paler yellow, and crown patch in males more orange (less scarlet) red. Size slightly smaller than uropygialis" (van Rossem 1942).

D. Special morphological features

Woodpeckers are "chisel-billed, wood-boring birds with powerful zygodactyl feet..., remarkably long tongues, and stiff, spiny tails which act as props when climbing" (Peterson 1961).

III DISTRIBUTION

A. Overall distribution of the species

The gila woodpecker is generally found in southwestern United States and north and central Mexico. The seven non-California species are distributed as follows: uropygialis (southwestern New Mexico, southern Arizona to northern and central Sonora), cardonensis (central Baja California), brewsteri (southern Baja California), juscenscens (southwest Sonora to northern Sinaloa and southwest Chihuahua), tiburonensis (Tiburon Island), sulfiventer (western Mexico), hypopolius (central Mexico) (Peters 1948).

M.u. albescens is found in the Imperial Valley in California and the Colorado Valley from southern Nevada to northwestern Sonora (Peters 1948).

B. California distribution of the species

The Colorado River gila woodpecker is found in the "riparian associations... of a narrow strip along the lower Colorado River from extreme southern Nevada, Fort Mohave, Arizona, and Needles, California, south to extreme northwestern Sonora and extreme northeastern Lower California" (van Rossem 1942). This range includes the Imperial Valley (Grinnell and Miller 1944). This subspecies is rare in Joshua Tree National Monument due to the absence of suitable tree growth although it occurs here as an occasional vagrant (Miller and Stebbins 1964).

C. California desert distribution

See California distribution above.

D. Seasonal variation in distribution.

The gila woodpecker is a year-round resident (Grinnell and Miller 1944, Peters 1948).

IV HABITAT

A. Biotopic affinities

The gila woodpecker is a resident of the Lower Sonoran life zone in riparian areas supporting old growth cottonwood and willow (van Rossem 1942, Grinnell and Miller 1944). It is also found up desert washes where ironwood and palo verde are large and in the saguaro belt on desert mesas (Grinnell and Miller 1944, Emlen 1974).

Bent (1939) describes the gila woodpecker habitat as follows. Its center of abundance is on desert mesas "scantily covered with a scattered growth of creosote bushes, low mesquites, an occasional cholla or barrel cactus and dotted with ...saguaro. But it is also common in the river bottoms, covered with a heavier growth of mesquite, and in the canyons of the foothills among the cottonwoods, willows, and sycamores."

B. Altitudinal range

The Colorado River gila woodpecker is usually found below 500 feet in riparian growth (Grinnell and Miller 1944) but other subspecies occurs from 2500 on the mesas up to 4000 feet or even 4500 feet in the canyons and foothills (Bent 1959).

C. Home range size

Emlen (1974) indicated that gila woodpeckers held a large territory with a foraging area included. Hensley (1954) found the following territorial values for different habitats: 24.4 acres for 2 open desert areas, 11.5 acres for 2 desert washes, and 11.0 for a third desert wash.

D. Territory requirements

Perchsite - No information located.

Courtship and mating sites - No information located.

Nest site - The gila woodpecker nests primarily in saguaro and secondarily in cottonwoods, willows, and mesquites (Gilman 1915, Bent 1939). The height of the nests varies from 5 feet to 35 feet and the nest cavity is usually 15 to 20" deep. The nest height in cottonwood and willow is determined by the location of decaying wood (Gilman 1915). Nest height in saguaro is generally higher than that of the gilded flicker (Gilman 1915).

E. Special habitat requirements

Grinnell (1914) commented that the availability of nest sites as in saguaro seemed "to be the prime factor in governing the local distribution of this species" in desert areas.

Melanerpes uropygialis (Cont'd)

F. Seasonal changes in habitat requirements

The gila woodpecker is a year-round resident (Grinnell and Miller 1944, Peters 1948).

G. Physiological ecology

No information located.

V FOOD

A. Food preferences

Gilman (1915) reported that gila woodpeckers eat corn around storage areas and on fields, insects around live and dead trees, saguaro fruit and pulp, Lycium berries, garbage, pears, peaches, pomegranate, and grapes. This woodpecker also eats mistletoe berries (Bent 1939, Grinnell and Miller 1944). They eat such insects as ants, beetles, grasshoppers, and larvae (Bent 1939) including the insect eggs and larvae contained inside the galls on hackberry trees (Anderson 1934) and cottonwood leaves (Speich and Radke 1975).

Insects are prominent food items brought to the young as are Lycium berries (Gilman 1915).

B. Foraging areas

No information located.

C. Foraging strategies

No information located.

D. Feeding phenology

No information located.

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

The gila woodpecker is a quarrelsome and intolerant bird. The male fights all the species it can although it frequently backs out if challenged by birds such as thrashers (Gilman 1915). It defends the nest vigorously with pecking and harrassment of intruders (Bent 1939).

Melanerpes uropygialis (Cont'd)

C. Courtship and mating behavior

No information located.

D. Nesting phenology

Gilman (1915) indicated that the height of the nesting season is mid-April to mid-May. May 10th was the latest egg date observed. The presence of young on July 10 may indicate that a second brood is sometimes raised.

Bent (1939) reported the following egg dates for Arizona: 26 records, April 7 to May 30; 13 records, May 5 to 25, indicating the height of the season.

E. Length of incubation period

Incubation lasts 14 days and is probably shared by both adults (Bent 1939).

F. Length of nestling period

No information located.

G. Growth rates

No information located.

H. Post-breeding behavior

The young are fed (by both parents) for a long time after leaving the nest (Gilman 1915).

VII POPULATION PARAMETERS

A. Clutch size

The clutch size is usually 3 to 5 eggs (Gilman 1915, Bent 1939). Gilman found 7 nests with 3 eggs, 2 nests with 4 eggs, 3 nests with 5 eggs and 1 nest with 1 egg. These data yield a mean clutch size of 3.7 eggs if one ignores the 1 egg clutch. A second clutch may be laid (Gilman 1915).

B. Nesting success

No information located.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

Melanerpes uropygialis (Cont'd)

E. Seasonal abundance

Gila woodpeckers are year round residents and populations will not fluctuate due to migration.

F. Habitat density figures

Hensley (1954) found 2 pairs per 100 acres in open desert and 3 and 5 pairs per 100 acres in two desert washes. Emlen (1974) observed 0.3 birds per 100 acres in desert areas near Tucson, Arizona and 14 birds per 100 acres in residential areas of Tucson itself.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

No information located.

B. Competition

Gilman (1915) reported that gila woodpecker holes are taken over and/or used by elf owls, ferruginous pigmy owls, ash-throated flycatchers, Arizona crested flycatchers, and occasionally cactus wrens. Gila woodpeckers may kill starling nestlings in attempts to expropriate starling nest holes for woodpecker use (Royall 1966).

C. Parasitism

No information located.

IX STATUS

A. Past population trends

No information located.

B. Present population status

Gila woodpeckers were observed in 3 out of 22 desert or near desert areas censused in California by the seventy-seventh Audubon Christmas bird count (1977). The areas (and numbers of woodpeckers observed) were as follows: Salton Sea S (2), Parker, Arizona-Colorado River (23), Yuma, Arizona (20).

C. Population limiting factors

"The availability of satisfactory nest sites would... seem to be the prime factor in governing the local distribution of this species" (Grinnell 1914).

D. Environmental quality: adverse impacts

No information located

E. Potential for endangered status

No information located.

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CASSIN'S KINGBIRD
Tyrannus vociferans

I TAXONOMY

A. Type description

Tyrannus vociferans - AOU (1957) Swainson, Quart. J. Sci. Lit. Arts Roy. Inst., 20, no. 40, January 1826. Temascaltepec, Mexico; Family: Tyrannidae.

B. Synonymies

Grinnell and Miller (1944) - Tyrannus vociferans. Noisy kingbird; Cassin flycatcher; northern Cassin kingbird; Cassin kingbird.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "Tail is narrowly tipped with gray or white and lacks white outer tail feathers." Ridgway (1907) gives detailed description of plumages and measurements.

B. External morphology of subadult age classes

Ridgway (1907), "Young - Essentially like adults, but crown without any orange-red, coloration of upper parts duller, paler wing-markings buffy, and yellow of under parts paler."

C. Distinguishing characteristics

Peterson (1961), "Like western kingbird but darker, with a dark olive-gray rather than a gray back, and no distinct white sides on black tail. Cassin's appears to have whiter chin than the 2 similar kingbirds, owing to darker chest." Miller and Stebbins (1964), "Description: a large (40-52 gram) flycatcher, in appearance very similar to the western kingbird, but tail without definite white edging." - Interspecific.

Ridgway (1907), "Adult female - Similar to the male and not always distinguishable as to coloration." - Intraspecific.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Cory and Hellmayr (1927), "Range: western North America, breeding from central California and southern Wyoming south to Michoacan and Jalisco, Mexico, and western Texas, wintering from southern California and northern Mexico to Guatemala; casual in Oregon." Peterson (1961), "West: breeds from Utah, southeastern Montana south through Rocky Mountain states to southern Mexico, Guatemala. Also southern California west of San Joaquin Valley and the deserts. Casual, Oregon, Nevada, western South Dakota, and northwestern Nebraska." Preble (1921) noted first Montana record

Tyrannus vociferans (con't.)

(August); a family group noted in ponderosa pine.

Tyrannus vociferans vociferans - AOU (1957), "Breeds from central California (northern San Joaquin Valley; San Benito County), northern Arizona, southern Utah (Zion National Park), Colorado, eastern Wyoming, southeastern Montana, east to southwestern Kansas, western Oklahoma, and western Texas; south to northwestern Baja California, central and southeastern Sonora, Durango, Jalisco, Colima, Michoacan, Puebla, and central Tamaulipas."

Tyrannus vociferans - AOU (1957), "Central California and southern Montana south to Guerrero; in winter south to Guatemala."

B. California distribution of the species

Small (1974), "range in California - primarily confined to the southwestern coastal region north to about Santa Cruz County on the coast and Alameda County interiorly; also as summer visitor to Providence Mountains in eastern San Bernardino County." Willett (1933), "Fairly common summer resident, locally, in lower Sonoran zone. Winters in small numbers north to Santa Barbara." Grinnell and Miller (1944), "Geographic range - In general, southern coastal area, west of San Joaquin Valley and the deserts, southeast from Monterey Bay to San Diego County at Mexican line; and also, in summer, Providence Mountains, on Mohave desert, eastern San Bernardino County. Formerly fairly numerous in San Diegan district; but center of abundance now (possibly always) seems to lie in inner coast-range valleys of San Benito, San Luis Obispo, Santa Barbara and Ventura Counties." Bent (1942), "In California, its distribution is more or less irregular, where it seems to be less of a mountain species than in other places; barely exceeds the upper limit of the lower Sonoran faunal zone" (rare also on the San Jacinto and San Bernardino Mountains). Dawson (1923), "Distribution in California - Summer resident of very local distribution in southern California, and west of the Sierran divide north to about latitude 37°. Winters sparingly in southern California and casually west to Santa Barbara." Miller (1937), "A slight northward extension of the known summer range... in California is involved in the occurrence of a pair... in... San Joaquin County" (15 July 1937). De Benedictis and McCaskie (1967) reported Cassin's kingbirds noted breeding near Deep Springs, Inyo County, and at Oasis, Mono County, California; these sites are north of their previously reported ranges.

C. Desert distribution

Miller and Stebbins (1964), "Apparently a scarce spring migrant and also summer resident locally. Reported from upper (and) lower Covington Flat; Twentynine Palms" (in Joshua Tree National Monument). Bent (1942), "It is apparently of very irregular distribution over the two California deserts, and in the lowlands of the San Diego-Santa Barbara region." Dawson (1923), "of very irregular distribution over the two California deserts." Carter (1937), "Definitely recorded April 2, 11, 12, and May 5, 1934" (at Twentynine Palms, California). Wauer (1962)

Tyrannus vociferans (con't.)

reported Cassin's kingbird noted at Furnace Creek Ranch golf course on 12 September 1960; few records (Death Valley). Van Rossem (1911) noted Cassin's kingbird noted during December and January at Brawley and Mecca, near the Salton Sea, California.

Short (1974) reported called common in Sonoran desert in Sonora, Mexico; however, breeding status is uncertain and needs clarification.

Hespenheide (1964), "The smallest numbers were in the desert and these were often associated with man's activity" (Arizona).

D. Seasonal variations in distribution

Peterson (1961), "Winters in Mexico, Guatemala; some in southern California." AOU (1957), "Winters from central California (casually) and south-central Tamaulipas (Victoria) south to southern Baja California (La Paz) and south-central Guatemala (Salama, Duenas). Casual on migration to Oregon, northwestern Nebraska, and central and southern Texas. Accidental in Ontario." Grinnell (1898), "Common in winter in the lower parts of the county. I have noted it in the vicinity of Pasadena from September 16 until May 1. A few remain... and probably breed." Arnold (1937), "Earliest record, March 7, latest, December 8. None was noted during September or October" (Fresno County, California). Mowbray (1947), "Cassin kingbird. Common summer resident. Earliest arrival date noted was March 23" (Monterey and San Luis Obispo Counties, California).

IV HABITAT

A. Biotopic affinities

Small (1974), "habitat - dry open savannah country as found in interior valleys west of the deserts." Grinnell and Miller (1944), "Habitat: dry, open, interior valleys, with widely scattered trees of valley oak and old cottonwood. In Providence Mountains, different only in that look-out and nesting sites are afforded in tall tree-yuccas and pinon pines." Phillips, Marshall, and Monson (1964), "Like all kingbirds, it prefers tall trees by open spaces; but it nests at altitudes from Transition zone down to the highest lower Sonoran zone - the upper limit for other kingbirds." Robbins, Bruun, and Zim (1966), "prefers higher land near brushy or wooded areas." Wetmore (1921) reported pairs noted in scattered yellow pines near Williams, Arizona. De Benedictis and McCaskie (1967) noted in Mono and Inyo Counties, Cassin's kingbirds breeding in Artemesia flats and cottonwoods growing along irrigation ditches. Wetmore (1920), "They frequented rocky hillsides where scattered yellow pines rising above the low underbrush made convenient perches" (New Mexico). Marshall (1957), "inhabits river bottoms, fields, meadows, and clearings from desert to white pine forest" (Arizona). Peterson (1961), "Habitat: semi-open high country, scattered trees, pine-oak mountains, ranch groves."

Tyrannus vociferans (con't.)

B. Altitudinal range

Grinnell and Miller (1944), "Altitudes of breeding extend from near sea level, as at San Diego, up to 5200 feet, in Providence Mountains." Bent (1942) reported birds seen as high as 7500-9000 feet in southern Arizona mountains, although most common breeding range was given as 5000 and 6000 feet. Jensen (1923), "Nesting up to 7500 feet" (New Mexico).

C. Territory requirements

Perch sites - Marshall (1957), "Tall lookout trees are necessary in addition to the openings over which insects are caught in flight from the perch. Insect captures follow flights also from fences, low weeds, and the ground."

Nest sites - Bent (1942), "The trees generally selected by this species for nesting sites are pines, oaks, cottonwood, walnut, hackberry, and sycamores, and the nests are... placed near the end of a horizontal limb, usually 20 to 40 feet from the ground." Robertson (1931), "Cassin kingbirds select open crotches near the tree tops, where they may have a wide view" (in eucalyptus trees in southern California). Tatschl (1967), "nests... usually in Juniperus monosperma, once in a cottonwood, from 6 to 10 feet above ground; scattered Juniperus sp. and Pinus edulis always near nest." Hespenheide (1964), "the greatest proportion of the Cassin's kingbirds' nests was located in the Transition zone, despite the limited amount of this type of area present. Canyon and desert localities both had nesting Cassin's kingbirds, but these areas were clearly less preferred" (Arizona). "It is apparent that the Cassin's kingbird will nest in any broad habitat zone in which there are tall trees." Ohlendorf (1974), "The mean elevation of vociferans nests was 4735 ± 229 feet" (Texas). He also reported 11.9% of Cassin's kingbird nests were on man-made structures (cross-arms of utility poles), while 78.6% were in trees, primarily cottonwoods. Nest height averaged 29.3 ± 4.2 feet. Jensen (1923), "It usually makes its home from ten to fifty feet up in some shade tree, but the nests may also be found in pinon pines" (New Mexico). Colvin (1939) noted Cassin's kingbirds nesting in cottonwoods in Colorado and Oklahoma; nests typically on a horizontal branch roughly seven feet up.

V FOOD

A. Food preferences

Bent (1942), "diet was found to be composed of 78.57% animal matter to 21.43% of vegetable. Of the animal food, beetles of all kinds amount to 14.91%. Hymenoptera amount to 21.61%. Lepidoptera amount to 18.21%. Orthoptera averaged 14.67% for the year. Small percentages of Hemiptera, Diptera, a few dragonflies, and some spiders make up the balance of the animal food, 9.17%." Grapes, elderberries, and blueberries were also taken. Grant (1945), "Mr. Ed N. Harrison... informs me that from his personal observation... the Cassin kingbird... eats bees." Ohlendorf (1974) gives detailed analysis of diet; Coleoptera (about 36%), Hymen-

Tyrannus vociferans (con't.)

optera (about 23%), Hemiptera (about 18%), and Orthoptera (about 14%) were the most frequently captured items (Texas). Cook (1896) noted Cassin's kingbirds fed solely on insects in Claremont, California.

B. Foraging areas

Hespenheide (1964), "fed in a full range of formational types from short grass desert to riparian associations... feeding... on the desert edge of the riparian zone, spent 39% of the time at the nest sycamore, 59% in the desert shrub or high grass, and 4% in the riparian" (near Portal, Arizona).

C. Feeding phenology

Bent (1942), "With the exception of some grapes found in 1 of the March stomachs, all the fruit was eaten in the months from September to January, inclusive."

D. Energy requirements

Ohlendorf (1974), "All insect tissues are similar in terms of calories per ash-free gram. Consequently, differential nutritive values per unit are not a factor... the taxa representing the greatest portion of the volume constitute the most important taxa of the diet."

VI REPRODUCTION

A. Courtship and mating behavior

Wetmore (1920), "males were seen at intervals in crazy zigzag sky dances made to the accompaniment of harsh calls and odd notes."

B. Nesting phenology

Miller and Stebbins (1964), "the general area of Twentynine Palms, mentioning nesting observed from May 21 to June 2." Bent (1942), "In the southern portion of its range, the Cassin's kingbird is said to raise two broods in a season." Egg dates - California: 72 records, April 22 to June 29; 36 records, May 11 to June 2. Dawson (1923), "Season: April-June; one or two broods" (California). Carter (1937), "Nesting observed from May 21 to June 2, 1935" (Twentynine Palms, California). Hanna (1942) reported Cassin's kingbirds feeding young in a eucalyptus tree at Corona del Mar, Orange County, California, on 18 August 1941. Ohlendorf (1974) noted in Texas, the nesting season of Cassin's kingbirds was from 11 May to 6 July. Jensen (1923), "Fresh sets June 1-15" (New Mexico).

C. Length of incubation period

Bent (1942), "incubation lasts from twelve to fourteen days, and is almost always, if not exclusively, performed by the female."

Tyrannus vociferans (con't.)

D. Post-breeding behavior

Preble (1921) noted adults and juveniles together in August (= family group); in Montana.

VII POPULATION PARAMETERS

A. Clutch size

Bent (1942), "Eggs - Three or four eggs are most commonly laid... though quite often sets of five and very rarely as few as two." Ohlendorf (1974), "Means and ranges of clutches were... 3.3 (2 to 4) in 15 vociferans nests. Successful rearing of more than one brood by the same adults was not observed" (Second nests were successful after the first was lost, however).

B. Habitat density figures

Balda (1970) reported population density of Cassin's kingbirds given as 3.0 pairs per 100 acres in a southern Arizona oak woodland; not noted breeding in oak-juniper-pine association. Ohlendorf (1974), "In vociferans, nests were not observed nearer than 675 feet" (Texas riparian habitat).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Ohlendorf (1974) noted Cassin's kingbirds attacked larger birds, including red-tailed hawks, owls, and ravens. "Such aggressive behavior has obvious selective value in protecting eggs and nestlings from predation."

B. Competition

Bent (1942) noted although the general range of the Cassin's and western kingbirds often overlap, little competition is possible due to different habitat selection. De Benedictis and McCaskie (1967) reported competition for nest sites between Cassin's and western kingbirds in California - "suggest that in some areas, perhaps where nest sites are at a premium, these two species may be as interspecifically territorial as they are intraspecifically territorial." Ohlendorf (1976), "the kingbird species (western and Cassin's) occupied different habitat types but exploited the resources in a similar manner and seldom occurred together." However, intense intraspecific aggression did occur when the two species came into contact; one western kingbird nest failed due to this aggression. In 1974 he gave a detailed description of inter- and intraspecific aggression. When not near nests, western and Cassin's kingbirds tolerated each other's presence. Cassin's attacked cactus wrens and house finches, although orioles were tolerated near nests. Zimmerman (1960) noted nesting of thick-billed (T. crassirostris), western (T. verticalis), and Cassin's kingbirds in New Mexico, and the fighting between them.

Tyrannus vociferans (con't.)

C. Parasitism

Friedmann (1963), "I know of only a single instance of this species being used as a host by the brown-headed cowbird" (in Arizona).

IX STATUS

Grinnell and Miller (1944), "Resident, but notably uncertain as to seasonal occurrence, one place or another, within general range. Has been appraised as 'common' in but few localities. Aggregate numbers in recent years evidently smaller than... the 1860's or 1890's." Phillips, Marshall, and Monson (1964), "Like other kingbirds, Cassin's, where present in sufficient numbers, gathers to roost in large companies."

Tyrannus vociferans (con't.)

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Tyrannus vociferans (con't.)

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ASH-THROATED FLYCATCHER
Myiarchus cinerascens

I TAXONOMY

A. Type description

Tyrannula cinerascens - AOU (1957) Lawrence, Ann. Lye. Nat. Hist. New York, 5, 1851 (September). Western Texas; Family: Tyrannidae.

B. Current systematic treatments

Cory and Hellmayr (1927) recognize 2 races of Myiarchus cinerascens; cinerascens breeding in western North America, and pertinax, breeding in southern lower California.

Lanyon (1961) discusses morphological variation among the races of M. cinerascens.

Nelson (1904) recognizes 19 species and races of Myiarchus in North America; discusses distribution, development, and the like.

Synonymies - Grinnell and Miller (1944) reported Tyrannus crinitus; Tyrannula cinerascens; Myiobius crinitus; Myiarchus cinerascens; M. crinitus cinerascens. Great-crested flycatcher; ash-throated flycatcher; ash-colored flycatcher.

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "A medium-sized flycatcher, smaller than a kingbird, with 2 white wing-bars, whitish throat, very pale yellowish belly, and rufous tail. Head slightly bushy. Except in southern Arizona, southwestern New Mexico and Texas this is the only flycatcher breeding in western United States that has a rufous tail." Under similar species: "(1) Some kingbirds have yellow bellies, but their tails are blackish. In southwest see (2) Wied's crested flycatcher, (3) olivaceous flycatcher. (4) East of Rockies see great-crested flycatcher." Robbins, Bruun, and Zim (1966), "Palest of the Myiarchus group, it is decidedly smaller than great-crested and Wied's and more slender billed. The white throat is a good field mark." Ridgway (1907) detailed description of adult and sub-adult plumages and measurements.

B. External morphology of subadult age classes

Ridgway (1907), "Young - Essentially like adults, but pileum cinnamon-brown or wood brown, rectrices cinnamon-rufous with a median streak of grayish brown... and yellow of under parts much paler."

C. Distinguishing characteristics

Interspecific - Ligon (1961), "It is smaller and more streamlined than the kingbirds, and has two white wing bars, white throat, yellowish

Myiarchus cinerascens (con't.)

underparts, and rufous tail. The kingbirds have dark tails."

Intraspecific - Ligon (1961), "Eight to eight and one-half inches long. Color pattern of sexes alike."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Myiarchus cinerascens cinerascens - AOU (1957), "Breeds from southwestern Oregon (Rogue River Valley, Jackson County), eastern Washington (Early Winters), southern Idaho (Cassia County, Pocatello), southwestern Wyoming, Colorado, New Mexico (Rinconada, Montoya), and northern and central Texas (Palo Duro Canyon, San Antonio) south to northern Baja California (San Fernando), Guerrero, and southwestern Tamaulipas. Winters from northern Baja California (San Fernando), southeastern California (Colorado River Valley), central Arizona (Fort Mohave, Phoenix), and southern Tamaulipas (Victoria) south to Guatemala (Sacapulas, Zacapa), and El Salvador (Libertad, Barro de Santiago), casually to Costa Rica; rarely in southwestern California (Pasadena). Casual in British Columbia (Vancouver, Marpole), Montana (Libby), southwestern Kansas (Morton County), western Oklahoma (Kenton), and Louisiana (University, New Roads, Holly Beach). Accidental in Florida (Pensacola Bay)."

Myiarchus cinerascens - AOU (1957), "Southwestern Oregon, eastern Washington, northeastern Utah, western Colorado, northern New Mexico, and northern Texas south to Guerrero; winters from the southwestern United States south to El Salvador, casually to Costa Rica."

B. California distribution of the species

Small (1974), "Range in California - north to Mendocino, Trinity, Siskiyou, and Modoc Counties." Summer resident, early April to mid-September. Grinnell and Miller (1944), "In breeding season, lower, warmer and therefore more southern, parts of state north and northwest, both east and west of mountain divides, from Mexican line to northeastern Mendocino County, to western Trinity County, to Shasta Valley, Siskiyou County, and to eastern Modoc and Lassen Counties."

C. California desert distribution

Miller and Stebbins (1964), "Widespread and common summer resident" (Joshua Tree National Monument). Willett (1951), "Summer resident; rare in winter" (in southern California deserts).

D. Seasonal variations in distribution

Grinnell and Miller (1944) reported summer resident; March, April, or early May... to August or early September. Some may winter in California; most widely spread at low levels in spring, when migrating. Lanyon (1961), "Myiarchus c. cinerascens is migratory throughout most, if not all, of its

Myiarchus cinerascens (con't.)

range. Wintering specimens have been taken throughout most of southern Mexico and southward through Central America to Nicaragua and Costa Rica." Van Rossem (1936), "these birds had come to the mountains in a post-breeding, vertical migration" Nevada.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - brushland or chaparral where relieved by an occasional tree. This is essentially a dry-country inhabiting flycatcher." Small (1974), "Habitat - high desert, pinon-juniper woodlands, desert edge, chaparral, riparian woodland, open oak woodland." Phillips, Marshall, and Monson (1964), "Characteristically a desert bird (Sonoran zone), it also inhabits streamside trees and open oak or juniper woods." Wauer (1964) noted breeding in the low canyons of Death Valley's Panamint Mountains. Lanyon (1961), "is essentially a desert species and its distribution is roughly coincident with that of... mesquite scrub, cactus and acacia desert, creosote and sagebrush desert, and chaparral." Miller and Stebbins (1964), "Ash-throats favor the pinon belt and the Joshua tree 'forests' but will settle also along sparse lines of smoke trees and ironwoods on open alluvial fans and about all oases and canyons" California deserts. Tyler (1913), "They frequent the willows along canals, peach orchards, and occasionally the dry weeds in neglected fields" (Fresno, California). Bent (1942), "Their favorite haunts were the denser mesquite thickets in the creek bottoms, oak groves along hillsides... in or around junipers, willows, or sagebrush." Oberholser (1974), "Haunts and habits: mesquite-acacia-cactus deserts and open juniper-oak woodlands ... thorn scrub and brushy groves on flats, valleys, mesas, canyons, gulches, and slopes of hills." Monson and Phillips (1964), "Common summer resident throughout all but the densely wooded parts of the Sonoran zone" (in Arizona).

B. Altitudinal range

Grinnell and Miller (1944), "Altitudes of breeding extend from near sea level, as in Imperial County, up to 7500 feet, as on Inyo Mountains, Inyo County." Wauer (1964) noted ash-throats range from about 1000 to 4000 feet, and occasionally up to 6500 feet, in the Panamint Mountains, Death Valley, California. Bent (1942), "it is as much at home in... the southern Sierra Nevadas, at an altitude of 9000 feet, as in Death Valley." Oberholser (1974), "Breeding... from near sea level to about 7000 feet." Ligon (1961), "It ranges up to 7500 feet in the more mountainous sections" (New Mexico).

C. Territorial requirements

Nest sites - Grinnell and Miller (1944), "... there must be present... a hole or hollow for nesting purposes; this cavity may be the result of a split or decay, or it may be woodpecker-excavated. Some trees used are: live oak, blue oak, valley oak, sycamore, cottonwood, elderberry; in

Myiarchus cinerascens (con't.)

Great Basin country, juniper; on the deserts, tree-yucca, sahuaro, ironwood, mesquite." Dawson (1923), "Nest: a natural cavity or deserted flicker hole, copiously lined (with) soft materials." Miller and Stebbins (1964), "requires cavities for nesting." Bryant and Bryant (1916) notes ash-throats nesting inside a 3-foot section of drain pipe (horizontal) on a roof of a house near Pasadena, California. Carter (1937) reported nest site at Twentynine Palms, San Bernardino County: within a gate post, 14 inches below the top. Bolander (1929) notes nesting of ash-throat in an insulation box of a power pole in Moraga Valley, Contra Costa County, California. Hanna (1931) notes ash-throat nesting for 2 years in the boom of a steam shovel in Colton, California (in a clay quarry). Bent (1942), "The nests are usually placed in knot holes of mesquite, ash, oak, sycamore, juniper, and cottonwood trees, as well as in cavities of old stumps, in woodpecker's holes" (usually under 20 feet in height). Ligon (1961), "Nest: In woodpecker holes, cavities in trees, or ends of exposed pipes, or in nesting boxes."

V FOOD

A. Food preferences

Bent (1942), "Animal food amounts to 92% and vegetable to 8%." Bees, wasps, and a few ants (Hymenoptera) amount to 27%; bugs (Hemiptera)... about 20%; flies (Diptera) amount to about 14%; caterpillars... amount to 19%; grasshoppers formed about 5%; various spiders and other insects amount to a little more than 3%. Stone (1941) notes ash-throats feeding on elderberries in Lake County, California (June).

B. Foraging strategies

Miller and Stebbins (1964), "favors working through open foliage of trees and bushes to capture flying insects at fairly low level."

C. Energy requirements

Bent (1942) reported young were fed about 14 times per hour; "each of the young birds must have been fed about 49 times every day, or 196 insects in all." Smyth and Coulombe (1971) noted ash-throats were not seen drinking at desert springs in Riverside County.

VI REPRODUCTION

A. Courtship and mating behavior

Oberholser (1974), "All vocalizations are heard mainly between early April and mid-July."

B. Nesting phenology

Bent (1942), "Egg dates - Arizona: 22 records, May 6 to June 26; 12 records, May 21 to June 23, indicating the height of the season."

Myiarchus cinerascens (con't.)

California: 79 records, April 12 to July 5; 41 records, May 25 to June 11." Dawson (1923), "Season: May 15-June 15; one brood."

C. Length of incubation period

Bent (1942), "The female, I think, attends to the duties of incubation exclusively, which lasts about fifteen days." Dawson (1923) noted incubation period is 15 days, with female doing most, if not all, of the incubation.

D. Length of nestling period

Bent (1942) reported nestling period given as about 16 days.

E. Post-breeding behavior

Wauer (1964), "Post-nesting birds can be expected well into the lower limits of the timber pine association, and they move out of the study area by mid-September" (in Death Valley, Panamint Mountains).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1942), "The number of eggs laid... varies from three to seven; the usual set consists of four or five." Dawson (1923), "Eggs: 3 to 6, usually 4." Oberholser (1974), "Eggs: 3-7, usually 4."

B. Nest mortality

Carter (1937) reported eggs in a nest at Twentynine Palms (San Bernardino County) were "cooked" by the summer heat, and thus failed.

C. Habitat density figures

Balda (1969) noted ash-throated density in oak-juniper woodland (breeding in Arizona) given as 12 pair per 100 acres. Balda (1970) reported ash-throated breeding density: 1) oak woodland = 18 pairs per 100 acres and 2) oak-juniper-pine = 12 pairs per 100 acres. Emlen (1974) noted density of ash-throated flycatcher in the desert as 0.8 per 100 acres and in urban areas as 2.0 per 100 acres. Gifford and Scott (1974) noted in desert shrub, Washington County, Utah - ash-throated flycatcher = 1 territorial male per 100 acres. Smice (1974) reported in coastal sage shrub, Los Angeles County: ash-throated flycatcher = 2 territorial males per 100 acres.

VIII STATUS

Pruitt (1949) notes movements of ash-throats into Lane County, Oregon. Hughes (1954) notes first record of the ash-throat in Canada.

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BLACK PHOEBE
Sayornis nigricans

I TAXONOMY

A. Type description

Muscicapa semiatra - AOU (1957) Vigors, Zool. Beechey's Voy. Blossom, 1839. No locality given = Monterey, California. Order Passeriformes: Family Tyrannidae: Genus Sayornis.

B. Current systematic treatments

Ridgway (1907) lists S. nigricans semiatra as a synonym of S. n. nigricans; does not separate these races. Provides detailed description of plumages and measurements of S. n. nigricans.

Cory and Hellmayr (1927) recognize 4 races of Sayornis nigricans, but lists S. n. semiatra as a synonym of S. n. nigricans.

Synonymies - Grinnell and Miller (1944), Muscicapa semiatra; M. nigricans; Tyrannus nigricans; Myiobius nigricans; Tyrannula nigricans. Rocky Mountain flycatcher; black pewee; black flycatcher.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "This is our only black-breasted flycatcher, and also the only flycatcher with a sharp color break between breast and belly. Its color pattern suggests a junco, but the erect posture, tail-wagging, and fly-catching habits do not. As in the other phoebes, the head is darker than the body." Peterson (1961), "The only black-breasted flycatcher in the United States. Upper parts, head and breast black; belly white, in sharp contrast to black of sides and breast. Has phoebe tail-wagging habit."

B. Distinguishing characteristics

Intraspecific - Bent (1942), "The sexes are alike in all plumages. Young birds in juvenal plumage, in June and July, are much like the adults... but the darker parts are sootier." Ligon (1961), "Six and one-half to seven inches long. Color pattern of sexes alike."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Sayornis nigricans semiatra - AOU (1957), "Resident from California, southern Nevada, southwestern Utah (St. George), central Arizona (Grand Canyon, Springerville), southwestern New Mexico (Cooney, Mesilla), and western and central Texas (San Antonio) south to southern Baja California (San Jose del Cabo, Miraflores), central Chihuahua (Jesus Maria, Chihuahua), and Colima. Casual in Oregon (Mercer, Cascadia) and British Columbia (Vancouver)."

Sayornis nigricans (con't.)

Sayornis nigricans - AOU (1957), "California, southern Nevada, southwestern Utah, central Arizona, southern New Mexico, and central Texas south through Mexico (except the Yucatan Peninsula) and the mountains of Central America and South America to northern Argentina."

B. California distribution of the species

Small (1974), "Range in California - at lower elevations length of state west of Sierra Nevada north to head of Sacramento Valley and to Del Norte County" (common resident). Grinnell and Miller (1944), "As breeding, chiefly westward drainage slope of state below middle altitudes; northwest from Mexican line in San Diego County through central region west of Sierran divides... to Humboldt County."

C. California desert distribution

Lamb (1912) noted only around water holes in the desert near Doggett and Yermo. Cardiff (1950) notes fairly common nesting of black phoebes in Imperial Valley; updates data given in Grinnell and Miller, 1944. Miller and Stebbins (1964), "Vagrant; also occasionally nests" (in Joshua Tree National Monument).

D. Seasonal variations in distribution

Monson and Phillips (1964), "Winters at water throughout lower Sonoran zone valleys... On migration apt to occur at any water hole" (Arizona). Oberholser (1974), "The black phoebe... are essentially nonmigratory throughout most of their range." Bent (1942), "This species... may be considered substantially nonmigratory throughout most of their ranges. Their seasonal movements appear to be more in response to local conditions... In many parts of southwestern California... is... resident." Grinnell and Miller (1944), "in late summer, wandering individuals go up even to 9000 feet altitude; and in winter there is an invasion of the southeastern desert areas, notably the Colorado River and Imperial Valleys."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - Typically, close vicinity of running water where more or less shaded by riparian trees. A tolerated or second-choice habitat is that provided by any kind of open water, such as irrigation, reservoirs" (etc.). Small (1974), "Habitat - almost always found close to fresh water lakes, streams, rivers, ponds, irrigation canals." Sharp (1907), "nesting around buildings, bridges, rocks, etc., generally not far from water, often over it" (Escondido, San Diego County, California). Bent (1942), "is so partial to the vicinity of water... The black phoebe is only sparingly distributed over the interior or more arid portion of its territory, because of the scarcity of its preferred types of habitat." Oberholser (1974), "black phoebe is

Sayornis nigricans (con't.)

attracted to water and light shade in dry country... typically seeks cottonwoods, willows, and sycamores" (Arizona). Monson and Phillips (1964), "Breeds commonly along permanent streams and canals... and even up into the Transition zone" (in Arizona).

B. Altitudinal range

Grinnell and Miller (1944), "Nesting altitudes extend from within a few feet of sea level, as at Point Lobos, Monterey County, up to an extreme of 6000 feet, in San Jacinto Mountains, Riverside County." Bent (1942), "Although the black phoebe is for the most part a bird of the lower altitudes in California, it is reported... to nest occasionally at elevations of 4000 to 6000 feet." Oberholser (1974), "Breeding ... from about 1000 to 7000 feet."

C. Territory requirements

Perch sites - Bent (1942), "Rarely seeking the treetops, the black phoebe usually perches instead on the shaded lower branches, on fences, stones, or other low objects, but seldom on the ground itself." Verbeek (1975) gives seasonal differences in use of various perches; trees, fences, buildings, utility wires, and on occasion, the ground, are utilized.

Nest sites - Grinnell and Miller (1944) reported nest sites: protected rock faces, bridges, cement culverts, wells, and buildings. Dawson (1923), "Nest: cemented to wall or resting on ledge of other projection of bridge, culvert or outbuilding, or else... along cliffs... overlooking streams." Quigley (1954), "The occupied mud nest was circular and was fastened onto a length of bailing wire dangling from an overhead support" (under a bridge). Robertson (1933) notes black phoebe nest in dead tree branch near Artesia, California; normally nest on horizontal structures under bridges and buildings, cliffs. Tyler (1913), "Nests of these birds are sometimes fastened to the walls of deserted cabins... will build in an old well if they can gain entrance... from six to fifteen feet below the surface." Bent (1942), "They must have sheltered faces of rocks or wooden walls against which to place their nests." Ohlendorf (1976) reported 13.9% of nest sites were in "natural" locations, while 86.1% were in bridges, culverts, buildings and wells. Ligon (1961), "nests are placed in protected locations, as in pockets under ledges, entrances to caves, or under bridges."

D. Special habitat requirements

Grinnell and Miller (1944), "For nesting, mud must be available." Phillips, Marshall, and Monson (1964) discusses dependence upon water of this species, which limits its distribution, especially in desert areas. Bent (1942), "These (nest) sites must be within carrying distance of some source of the mud used in nest construction."

V FOOD

A. Food preferences

Ross (1933) reported Hymenoptera account for a substantial portion of black phoebes diet; the number of honey-bees consumed is open to question. Gander (1929) noted eating Jerusalem crickets and lepidopterous larvae in San Diego, California. Bent (1942), "Ninety-nine and thirty-nine hundredths percent of animal matter to 0.61% of vegetable." Beetles ... made up 12.82%; Hymenoptera, principally wild bees and wasps, contributed 35%; Hemiptera... formed 7%; Diptera (flies)... averaged 28%; grasshoppers... only about 2.5%; moths and caterpillars 8%; dragonflies and spiders... 6%. Ohlendorf (1976) reported major prey items of black phoebes in Texas were Isoptera, Hemiptera, Coleoptera, and Hymenoptera.

B. Foraging areas

Gander (1929) noted black phoebes pulling larvae from the ground in high grass (San Diego, California). Oberlander (1939) reported normally feed near water, staying out of thickets: Grassy fields are preferred over roadways and parking areas; perch sites (posts and wires) are necessary before an area will be used (= will limit distribution).

C. Foraging strategies

Oberlander (1939) gives detailed description of feeding methods; majority of prey is taken in the air from a perch, which the bird returns to; often hovers while hunting. Bent (1942), "hunting is done by skimming low over lawns." Verbeek (1975), "Hawking" is used as the feeding method of black phoebes between 82.3 and 96.7% of the time, while "gleaning" is used between 3.4 and 17.8% of the time (highest in June) (California). Hawking over grass (24.1%) and in open air (49.6%) was the most common foraging method (Total hawking = 76.8%; gleaning = 23.3%).

D. Feeding phenology

Oberlander (1939), "In late spring and summer the adult phoebes were observed to pass up dozens of checkered fritillary butterflies (Argynnis); normally take most available prey" (Berkeley, California). Bent (1942), "Hymenoptera... contributed 35% (of the diet), rising to 60% in the month of August. Flies (Diptera) ranged from 3% in August to 64% in April." Verbeek (1975), "The number of feeding sorties per minute was highest in February and lowest in August."

VI REPRODUCTION

A. Territorial behavior

Oberlander (1939) noted phoebes wander widely during the pre-nesting period (searching for food). "After pairing and with the approach of

Sayornis nigricans (con't.)

spring the birds gradually become more localized until finally the territory becomes restricted... (to) the nest site." Verbeek (1975), "Providing the winter was not too cold or too wet, the... birds stayed on their territories until next year. They were joined by a mate in February."

B. Courtship and mating behavior

Oberlander (1939) notes courtship behavior; birds keep in contact by calling; pairing occurred at least 5 weeks before nest building began. The nest is apparently built by the female (Berkeley, California). Bent (1942), "in the mating season the male often makes a song flight, fluttering about in the air, repeating ti - ti - ti for a few seconds and then slowly descending."

C. Nesting phenology

Dawson (1923), "Season: March - June; two broods." Sharp (1907), "April 16 (far advanced) to June 16. Two broods, probably three, are raised" (Escondido, San Diego County, California). Fraser (1931) notes pair of black phoebes feeding young (in nest) on 28 September 1930 in Humboldt County, California. Kinsey (1935), "Middle June is the normal time for fresh eggs of Sayornis" (Marin County, California). Tyler (1913), the nesting period... from March 1 to July 1, with probably two broods reared in a season" (Fresno, California). Bent (1942), "Egg dates - California: 126 records, March 17 to August 15; 64 records, April 15 to May 16, indicating the height of the season."

D. Length of incubation period

Oberlander (1939) reported incubation = 15 days (Berkeley, California). Bent (1942) noted incubation begins with the laying of the last egg, and lasts from 15 to 17 days.

E. Length of nestling period

Oberlander (1939) reported nestling period given as 21 to 22 days from hatching (Berkeley, California). Parental feeding of young continues for at least 3 weeks after leaving nest. Bent (1942) noted nestling period varies widely, normally from 2 to 3 weeks.

F. Post-breeding behavior

Verbeek (1975), "Shortly after the independence of the second brood... adults become intolerant of each other and one bird of each pair was chased off the territory."

VII POPULATION PARAMETERS

A. Clutch size

Ohlendorf (1976), "Clutch size ranged from 1 to 4 (mean = 3.42 ± 0.30) for 26 clutches." Dawson (1923), "Eggs: 4 or 5." Oberholser (1974), "Eggs: 3-6, usually 4-5."

Sayornis nigricans (con't.)

B. Nesting success

Ohlendorf (1976) reported young fledged/nest = 2.52; young fledged of eggs laid = 70.7%; young fledged of eggs hatched = 76.8%. Successful nestings = 71.4% (at least one young fledged) (Texas).

C. Mortality rates

Ohlendorf (1976), "I attributed almost half of the egg loss before hatching to human destruction of nests located under culverts and bridges."

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Holland (1923) notes house finch laying eggs in black phoebe nest (San Diego County); nest was abandoned by both species. Verbeek (1975), "When the two phoebe species (black and Say's) occasionally interacted, the larger Say's phoebe was always dominant."

B. Parasitism

Friedmann (1963) notes single instance of this flycatcher as a host for cowbirds. Stoner (1938) notes eggs of the brown-headed cowbird, western flycatcher, and black phoebe in same nest; western flycatcher was incubating (Solano County, California).

IX STATUS

Grinnell and Miller (1944), "in a dry or semi-arid country like California, the local distribution is decidedly spotty and the aggregate population is not large."

A. Past population trends

Bent (1942), "this is one species that have thrived and increased with the settlement of the southwest."

B. Population limiting factors

Miller and Stebbins (1964), "This phoebe, which is dependent on mud for nest building and favors moist areas over which to (forage), finds few suitable localities (in Joshua Tree National Monument)." Tyler (1913), "they have no preference as to the type of country they frequent, the chief requisite being the proximity of water." Ohlendorf (1976), "I did not find (black phoebe) nests more than 15 m from mud." Distribution of this species is thus limited by absence of water (mud). Ligon (1961), "The range of the black phoebe is confined largely to watercourses and water projects."

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SAY'S PHOEBE
Sayornis saya

I TAXONOMY

A. Type description

AOU (1957) - Order Passeriformes: Family Tyrannidae: Genus Sayornis.

S. s. saya - AOU (1957) Muscicapa saya Bonaparte, Amer. Orn., vol. 1, 1825. Arkansaw River, about twenty miles from the Rocky Mountains = near Pueblo, Colorado.

S. s. quiescens - AOU (1957) Sayornis sayus quiescens Grinnell, Condor, 28, no. 4, July 15, 1926. San Jose, 2500 feet altitude, latitude close to 31°, about 45 miles northeast of San Quintin, lower California, Mexico.

B. Current systematic treatments

S. saya - Ridgway (1907) does not list S. s. saya nor S. s. quiescens as races; gives detailed description of plumages and measurements of Sayornis saya, in general. Miller and Stebbins (1964) states that both Sayornis saya and S. s. quiescens may nest in Joshua Tree National Monument; S. s. saya is from the northern Mojave desert, while S. s. quiescens is more common in Baja California, Mexico.

S. s. saya - Cory and Hellmayr (1927) recognize 3 races of Sayornis saya; range of S. s. saya given as: "Western North America. Breeds from northeastern Alberta, southeastern Saskatchewan, and North Dakota south to California, Arizona, New Mexico, western Iowa, and western Kansas; winters from central California, southern Arizona, southern New Mexico, and central Texas south to Mexico."

S. s. quiescens - Cory and Hellmayr (1927) recognize 3 races of Sayornis saya, including quiescens, whose range is given as: "Northwestern lower California, on the Pacific drainage from the Sierra San Pedro Martir west to the sea coast."

C. Recent taxonomic revisions

Browning (1976) considers the race yukonensis a synonym of nominate saya.

D. Synonymies

S. s. saya - Grinnell and Miller (1944), Tyrannula saya; Myiobius saya; Sayornis pallida; Sayornis sayi (saya or sayus); Sayornis sayus yukonensis. Black-tailed flycatcher; black-tailed phoebe; Say flycatcher; Say pewee.

S. s. quiescens - Grinnell and Miller (1944), lower California Say phoebe.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "From the front it is recognized by the rusty belly and undertail coverts, from behind by the contrast between the pale back and the black tail, which it frequently wags. The female vermilion flycatcher is much the same color, but is decidedly smaller, with a white throat and finely streaked sides." Peterson (1961), "A large, pale phoebe with a pale rusty belly and undertail coverts. Black tail and rusty underparts give it the look of a small robin, but it has flycatcher habits." Under similar species: "(1) See kingbirds. (2) Female vermilion flycatcher may suggest Say's phoebe. It has breast streaks."

B. Distinguishing characteristics

Intraspecific - Ligon (1961), "Seven to eight inches long. Color pattern of sexes alike."

S. s. quiescens - Bent (1942), "described this race of Say's phoebe as similar to the well-known northern form, but ~~tone~~ of coloration paler" (as compared to S. s. saya).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

S. s. saya - AOU (1957), "Breeds from northeastern British Columbia, southwestern Mackenzie (Fort Simpson), northeastern Alberta (Fort Mac-Murray), central Saskatchewan (Carlton House, Indian Head), southwestern Manitoba (Aweme), central North Dakota (Minot, Bismarck), central South Dakota (Tuttle, White River), east-central Nebraska (Rock County, Red Cloud), western Kansas (Coolidge, Decatur County), western Oklahoma (Kenton), and west-central Texas (Armstrong County, Painted Grove) south to southern California (rarely west of the coastal ranges), northern Sonora (Rancho la Arizona, Magdalena), northwestern Durango (Rio Sestin), central Zacatecas (Sombrerete), and southeastern Coahuila (Saltillo, Diamante Pass). Winters north to northern California (rarely Samoa, Standish), northern Arizona (Cebat Mountains, Tuba City), central and southeastern New Mexico (Albuquerque, Carlsbad), and southern Texas (San Angelo, Corpus Christi), and south to southern Baja California, Mexico, Puebla (Puebla, Chapulco), and central Vera Cruz (Orizaba, Jalapa). Casual in coastal British Columbia (Victoria, Chilliwach), western Washington (Cape Disappointment, Puyallup), western Oregon (Portland, Corvallis, Coos Bay), insular California (San Clemente Island); occasional east to western Iowa (Havarden, Mills County), western Missouri (Butler, Stotesbury), and eastern Texas (Gainesville, Dallas, Houston). Accidental in Wisconsin (Racine), Illinois (Cook County), Indiana (Wilson), New York (Brooklyn), Connecticut (Gaylordsville), Massachusetts (North Truro, Ipswich), and Quebec (Godbout)."

Sayornis saya (con't.)

S. s. quiescens - AOU (1957), "Resident in the northern half of Baja California, principally on the western side; wandering after the breeding season to southeastern California (Kelso, Needles, Kane Spring, Laguna Dam), western Arizona (Colorado River basin), southern Baja California, and western and southern Sonora."

S. saya - AOU (1957), "Central Alaska, Yukon western Mackenzie, central Alberta, southern Saskatchewan, and southwestern Manitoba south to Zacatecas and Durango; in winter to Puebla and central Vera Cruz."

B. California distribution of the species

S. saya - Small (1974), "Range in California - more arid regions east of Sierra Nevada but also drier interior valleys of Coast Range and San Joaquin Valley north to Contra Costa County" (resident).

S. s. saya - Grinnell and Miller (1944), "In summer, arid interior; chiefly east of Sierran divides, but also westwardly onto Pacific slopes to include dry parts of San Joaquin Valley and interior parts of San Diegan and central coast-range districts."

S. s. quiescens - Grinnell and Miller (1944) reported northward winter visitant into southern counties from across Mexican border.

C. California desert distribution

Wauer (1964), "The Say phoebe is a resident bird" (in Panamint Mountains, Death Valley, California). Miller and Stebbins (1964), "Resident. Population sparse but widely distributed" (Joshua Tree National Monument). Hanna (1933) notes first nesting of Say's phoebe in San Bernardino Valley (1932); often nest near Corona and Elsinore, Riverside County: "breed commonly on both the Mohave and Colorado deserts." Willett (1951), "Mojave desert in summer; more widespread in winter" (in southern California desert).

S. s. quiescens - Grinnell and Miller (1944), "Note - The status of the breeding population of southeastern deserts is uncertain... There is suggestive evidence that this population may be closer to quiescens than to S. saya saya."

D. Seasonal variations in distribution

Calder (1926), "The first Say phoebe for the autumn... appeared here (Buena Park, Orange County) 22 September."

S. s. saya - Grinnell and Miller (1944), "In winter, retreats from northern and higher portions of breeding range, and then occurs (September to March) westwardly to seacoast from Mexican line in San Diego County at least... to head of Sacramento Valley."

Sayornis saya (con't.)

IV HABITAT

A. Biotopic affinities

Small (1974), "Habitat - arid scrub and desert during the breeding season; more open country during the western excursion." Phillips, Marshall, and Monson (1964), "Fairly common breeding bird about cliffs and structures throughout less densely wooded parts of the Sonoran zones, locally higher." Carter (1937), "A common resident of both the oasis and the surrounding desert" (Twentynine Palms, San Bernardino County). Oberholser (1974), "inhabits open, arid regions... typical in the vicinity of ranches... moves into groves along streams... (never) into heavily wooded situations." Monson and Phillips (1964), "Fairly common breeding bird about cliffs and structures throughout less densely wooded parts of the Sonoran zones" (Arizona). Ligon (1961), "shuns heavily forested areas... utilizing outbuildings, caves, canal fumes or other protected places for shelter during storms."

S. s. saya - Grinnell and Miller (1944), "Habitat - open, sunny, arid terrain." Bent (1942), "is a bird of the open country, the prairie ranches, the sagebrush plains, the badlands, the dry, barren foothills, and the borders of deserts... also found in the mouths of canyons or rocky ravines."

B. Altitudinal range

Wauer (1964) reported Say's phoebe ranges from about sea level to nearly 6000 feet in the Panamint Mountains, Death Valley, California. Ligon (1961), "inhabits the entire state up to about 6000 feet" (New Mexico).

S. s. saya - Grinnell and Miller (1944), "Altitudes of breeding extend from 200 feet below sea level, in Death Valley, up to at least 4500 feet, in Inyo County."

C. Territory requirements

Perch sites - Ligon (1961), "It lives near the ground, usually perching on fence wires or low bushes."

S. s. saya - Grinnell and Miller (1944) reported perch sites: bush and weed-tips, rocks, fence-posts and wire, and corners of buildings. Bent (1942), "favors rather low perches, on some small bush, tall weed stalk, or low rock, seldom higher than a fencepost."

Nest sites - Dawson (1923), "Nest: placed on ledges, under eaves of outbuildings, under bridges, or on cliffs." Wauer (1964), "Nesting occurs in erosion holes in the banks of washes throughout the alluvial fan areas and up into the canyons to the pinon-juniper woodlands." Miller and Stebbins (1964), "Nests are placed on solid supporting ledges of cliffs or banks and more recently on buildings under eaves... thus protected from wind and sun." Lamb (1912), "The favorite nesting site

Sayornis saya (con't.)

was in deserted mine and prospect holes in the mountains" (Mojave desert, near Doggett). Carter (1927), "Eaves of buildings were apparently a favorite nesting site" (Twentynine Palms). Ohlendorf (1976) reported 8.0% of nest sites were in "natural" locations, while 92.0% were in bridges, culverts, and buildings (Texas). Ligon (1961), "nesting site... is about porches of either occupied or vacant dwellings, wherever a plate, shelf, or other projection is available. It prefers exposed rather than the concealed locations selected by the ash-throated flycatcher."

S. s. saya - Grinnell and Miller (1944) noted nest sites: rock walls, undercut banks of firm earth or gravel, buildings. Bent (1942), "Before ... man-made structures, the primitive nesting sites of Say's phoebe were evidently on shelves or in crevices of rocky cliffs, protected from the weather by overhanging rock."

V FOOD

A. Food preferences

Bryant (1911) noted Say's phoebe feed heavily on butterflies; 75% of all stomachs examined contained butterflies (= 10% of diet). Ohlendorf (1976) reported major prey items of Say's phoebes in Texas were Orthoptera (35.1%), Diptera (19.5%), Coleoptera (14.0%), and Lepidoptera (13.9%).

S. s. saya - Bent (1942), "Animal food made up 99.78% and vegetable food 0.22%... beetles (Cicindelidae, Carabidae, and Coccinellidae) amount to 5.95%. Hymenoptera seem to be the largest item of food, 30.72%. The young are fed entirely on insects, mainly on small butterflies."

B. Foraging areas

Miller and Stebbins (1964), "Say's phoebes forage in very open terrain... Insects seem available for them both over open creosote flats and in denser desert woodland and along cliff faces" (California deserts). Hoffmann (1921) reported Say's phoebes feeding on insects along the beach near Ventura.

C. Energy requirements

Smyth and Coulombe (1971) noted Say's phoebe drinking from desert springs in Riverside County.

VI REPRODUCTION

A. Territorial behavior

Oberholser (1974), "This bird is... (a) solitary flycatcher; rarely are more than two seen together."

Sayornis saya (con't.)

B. Courtship and mating behavior

Dawson (1923) describes (briefly) courtship behavior; both sexes call during activities. Carter (1937), "The breeding song was heard continually from early February on" (Twentynine Palms). Oberholser (1974), "Song is most frequent from March well into July."

C. Nesting phenology

Dawson (1923), "Season: varying with locality - March-June; two broods." Carter (1937) reported two broods are often attempted at Twentynine Palms, San Bernardino County. Ligon (1961), "Often the same nests are used in bringing off two, sometimes three, broods in a season."

S. s. saya - Bent (1942), "Egg dates - California: 44 records, March 7 to June 16; 22 records, April 1 to May 6, indicating the height of the season. Apparently two broods are generally raised in a season... and in the southern portions often three" (The male cares for the first brood while the female begins a second).

D. Length of incubation period

S. s. saya - Bent (1942), "Incubation lasts about twelve days."

E. Length of nestling period

Hall (1924), "At six weeks old the young ones would sit on the fence... and yell for food, especially night and morning" (Nebraska).

S. s. saya - Bent (1942), "young... are ready to leave the nest in about two weeks."

F. Growth rates

S. s. saya - Bent (1942), "The newly hatched young are naked... until six days old their eyes are closed... and during this time they are fed by regurgitation... and in two weeks have their feathers... for their first attempts to fly."

G. Post-breeding behavior

Dawson (1923) states that the birds are solitary in winter. Monson and Phillips (1964), "A post-breeding migration carries most of the birds out of the southwestern part of the state, where virtually absent in July and August."

VII POPULATION PARAMETERS

A. Clutch size

Ohlendorf (1976), "Clutch size ranged... from 1 to 6 (mean = 3.77 ± 0.30) for 69 clutches." Oberholser (1974), "Eggs: 3-6, usually 4-5." Hall (1924), "She lays one egg a day until there are five; begins setting the first night."

Sayornis saya (con't.)

S. s. saya - Bent (1942), "Say's phoebe lays ordinarily four or five eggs, sometimes as few as three, and very rarely as many as six or seven."

B. Nesting success

Ohlendorf (1976) reported young fledged/nest = 2.13; young fledged of eggs laid = 56.8%; young fledged of eggs hatched = 77.4%. Successful nestings = 66.7% (at least one young fledged) (Texas).

S. s. saya - McClure (1946) noted nesting success as 80% for first brood and 86% for second brood; young to leave nest as 91% for first brood and 90% for second brood (Nebraska).

C. Mortality rates per age class

Ohlendorf (1976), "I attributed almost half of the egg loss before hatching to human destruction of nests located under culverts and bridges."

Carter (1937), "the second (brood) often perishes from the heat, in spite of their (adults) attempts to provide shelter" (Twentynine Palms).

D. Habitat density figures

Zemba (1974) reported Joshua tree-blackbush-bladder-sage association, Inyo County; Say's phoebe = less than one territorial male per 100 acres.

III INTERSPECIFIC INTERACTIONS

A. Predation

Miller and Stebbins (1964), "an accipitrine hawk took three newly hatched Say phoebes from a nest under the eaves of a porch" (Twentynine Palms). Cade, White, and Haugh (1968) reported Say's phoebe listed as an uncommon prey of peregrine falcons in Alaska.

B. Competition

Verbeek (1975), "When the two phoebe species (black and Say's) occasionally interacted, the larger Say's was always dominant."

S. s. saya - Grinnell and Miller (1944), "... the Say's phoebe, as regards relation to the water, shade and sunshine factors, is the very opposite of the black phoebe. The ecological ranges of the two species are altogether complementary to one another."

C. Parasitism

Friedmann (1963) reported uncommon host; stated that cowbirds do not greatly affect this flycatcher.

Sayornis saya (con't.)

IX STATUS

A. Past population trends

Lamb (1912) reported Say's phoebe: "common resident everywhere" (Doggett, San Bernardino County, California). Cade and White (1973) describes recent range expansion into Alaska due to presence of nesting sites and food source during breeding.

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Sayornis saya (con't.)

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WILLOW FLYCATCHER
Empidonax traillii

I TAXONOMY

A. Type description

Empidonax traillii brewsteri - AOU (1957) Oberholser, Ohio Journ. Sci., 18, no. 3, January 1918. Cloverdale, Nye County, Nevada. Family: Tyrannidae.

B. Current systematic treatments

Cory and Hellmayr (1927) recognize 2 races of E. traillii, including brewsteri, whose range is given as: "Western North America, breeding from southern British Columbia, western Montana, and Idaho south to the northern edge of lower California, Sonora, Durango, and New Mexico, east to Colorado, Oklahoma, and Texas, wintering in southern Central America."

Ridgway (1907) does not recognize E. t. brewsteri; mentions plumages and measurements of E. t. traillii; very detailed.

Aldrich (1951) "consider E. t. zopholegus a synonym of E. t. brewsteri ... and to apply the name brewsteri to the Pacific coast race from Vancouver Island southward."

Phillips (1948) recognizes five races of willow flycatcher, including E. t. brewsteri; is most similar to E. t. adustus.

Aldrich (1953) states that song is useful in separating the various races of willow flycatchers.

C. Recent taxonomic revisions

AOU (1973), "Empidonax traillii is divided into two species: Empidonax traillii, the generally more southern and western bird... and Empidonax alnorum, the generally more northern bird... The English name for the species Empidonax traillii will be willow flycatcher, and for the species Empidonax alnorum will be alder flycatcher; where circumstances do not permit specific identification, 'Traill's flycatcher' remains available for the complex." Small (1974), "Note - this flycatcher has been elevated to species status but may still be referred to as the Traill's flycatcher."

D. Synonymies

Grinnell and Miller (1944) - Myiobius pusilla; Empidonax pusillus; Tyrannula traillii; Empidonax traillii var. pusillus; E. t. adustus. Little pewee flycatcher; little flycatcher; Brewster flycatcher; mountain flycatcher.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "Larger than least, with greater contrast between white throat and olive sides. Browner backed than acadian, yellow-bellied, and the western species." Peterson (1961), "This widespread species is the brownest of the genus and averages a bit larger than the others." Bennett (1934) notes willow flycatcher with white head (partial albino); was breeding in Yosemite (female).

B. Distinguishing characteristics

Intraspecific - Ligon (1961), "Five and one-half to six inches long. Color pattern of sexes alike." Bent (1942), "The sexes are alike in all plumages, and the young in juvenal plumage is essentially like the adult."

C. Vocalization

Weydemeyer (1973), "comparison with published data... discloses a considerable variation among localities in the calls, songs, and singing habits of this species" (detailed paper). McCabe (1951) discusses song of the eastern and midwestern forms.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Empidonax traillii brewsteri - AOU (1957), "Breeds from southern British Columbia (Nootka Sound, Okanagan Landing), northern Montana (Fortine, Great Falls), southwestern Wyoming (Laramie), Colorado, and western Oklahoma south to southwestern California (San Diego), southern Nevada (Clark County), southern Arizona, southwestern New Mexico (Redrock), and western Texas (Brewster County); possible to northern Baja California (Las Cabras). Winters from Guatemala (Las Amates), El Salvador (Rio San Miguel), and Nicaragua (Greytown) south to northern Peru (El Tingo, Saposo), Bolivia (Yungas), and western Venezuela (Coro, Encontrados). Casual in Mississippi (Deer Island)."

Empidonax traillii - AOU (1957), "Central Alaska, central Yukon, northwestern Mackenzie, northeastern Alberta, northern Saskatchewan, northern Manitoba, northern Ontario, Quebec, Newfoundland, Cape Breton Island, and Nova Scotia south to northern Baja California, Missouri, and Virginia. Winters from southern Mexico to Argentina."

B. California distribution of the species

Grinnell and Miller (1944), "Roughly, entire length of states, both east and west of Sierran axis... this flycatcher exists... wherever its special habitat exists" (see HABITAT, Biotopic affinities). Small (1974), Range in California - length of state... but not at high elevations, nor

Empidonax traillii (con't.)

in humid northwest coniferous forests, nor southeastern deserts during breeding season; crosses deserts as transient" (Summer resident, late April to September).

C. California desert distribution

Grinnell and Miller (1944), "But as breeding, really very much restricted (to riparian willow thickets), to avoid in major part forested areas including northwest coast belt, the open desert, and the higher mountains." Miller and Stebbins (1964) called a common fall migrant in late August and early September. Not known to breed (Joshua Tree National Monument). Oberholser (1974), "It has the reputation of being the only Empidonax which will set up breeding territories along wooded desert streams."

D. Seasonal variations in distribution

Grinnell and Miller (1944), "In spring migration, advances widely over lowlands of state; in southward migration, which begins by end of July, invades higher mountains, often far above highest breeding level" (Summer resident; May to September). Dawson (1923), "it arrives in Los Angeles County not earlier than the 1st of May." Monson and Phillips (1964), "migrants pass through south chiefly in first half of June (extremes May 15, in California, to June 23) and through most of August and September."

IV HABITAT

A. Biotopic affinities

Small (1974), "Habitat - typically a riparian bird, especially for breeding; favors willows surrounded by meadows and near water." Grinnell and Miller (1944), "Habitat - In breeding season, strikingly restricted to thickets of willows, whether along streams in broad valleys, in canyon bottoms, around mountain-side seepages, or at the margins of ponds or lakes." Phillips, Marshall, and Monson (1964), "Breeds locally in dense willow association and buttonbush swamps of Sonoran zones." Linsdale (1951), "E. t. brewsteri is summer resident; occurs mainly in the willow thickets bordering the larger streams and lower portions of the mountains" (in Nevada). Van Rossem (1936) notes birds nesting in willow and apple orchards in Nevada. Bent (1942), "in California, it is a lover of the half-open situations, bushy rather than timbered, of clearings, low thickets, and river banks... it will follow a stream out into the desert." King (1955), "nests in xeric uplands as well as relatively mesic riparian sites" (in Washington). Monson and Phillips (1964), "Breeds... in dense willow association and buttonbush swamps of Sonoran zones (very locally in Transition zone)" (Arizona).

B. Altitudinal range

Grinnell and Miller (1944), "Altitudes of known nestings extend from within a hundred feet of sea level, up to at least 8000 feet." Bent (1942), "The highest elevation at which I have ever found this species

Empidonax traillii (con't.)

breeding is at Mammoth Camp, in southern Mono County, at an elevation of 8000 feet." Ligon (1961), "at 6500 feet... indicating a preference for the intermediate rather than the high elevations" (New Mexico).

C. Territory requirements

Perch sites - King (1955), "In its feeding habitats... seek an exposed perch from about one foot to about eight feet above the ground."

Nest sites - Dawson (1923), "Nest: placed 3 to 10 feet up in crotch of bush or sapling of lowland thicket or swamp." Bent (1942), "The height of the nest averages 3 feet (30 inches - 5½ feet up)." (Nests are usually placed in a small bush or willow near streams). Campbell (1936) describes concentration of nests due to water collecting in holes. Berger and Parmelee (1952), "In general, this bird is an edge-nester" (Michigan). Walkinshaw (1966), "Ninety-four of the Traill's flycatcher nests... were in upright crotches in small trees or bushes and 14 were on horizontal branches of similar trees" (Michigan). King (1955), "a suitable habitat must provide low crotches or forks of branches sufficiently small that the sides of the nest may be woven to them." Oberholser (1974), "nests in willow, cottonwood, and mesquite groves lining western creeks." Ligon (1961), "Nests 6 to 10 feet above ground, pendent, or nearly so, in salt cedars, tornillos (Prosopis odorata), or vines."

V FOOD

A. Food preferences

Bond (1947) notes willow flycatchers feeding on bitter cherries (Oregon). Bent (1942), "Animal food made up 96.05% and vegetable food 3.95%. Beetles... amount to 17.89%; Hymenoptera are the largest item of animal food (41.37%); Diptera... amount to 14.20%."

B. Foraging strategies

Salt (1957) noted willow flycatchers listed as members of the "air-perching" foraging guild.

C. Energy requirements

Miller and Stebbins (1964), "suggests that daily food intake is required" (California deserts). Bent (1942), "To satisfy these four open mouths (young) means a trip every two minutes or oftener."

VI REPRODUCTION

A. Territorial behavior

Walkinshaw (1966), "The limiting factors to territorial boundaries... were dry land, woodland, other Traill's flycatcher territories, and probably necessary foods." King (1955), "Territorial disputes among

Empidonax traillii (con't.)

males are frequent and violent during the pre-nesting period." States that disputes are infrequent after egg-laying.

B. Nesting phenology

Dawson (1923), "Season: June; one brood." Bent (1942), "Egg dates - California: 94 records, April 19 to July 21; 48 records, June 6 to 28, indicating the height of the season." Walkinshaw (1966), "On no occasion have I found evidence of... renesting after a brood has been reared" (will renest if eggs or young are destroyed). King (1955), "the considerably later blooming dates... had a significant quantitative effect on the periodicity of insects used as food for the nestlings" (breeding season likely keyed into food availability, which was based on plant blooms).

C. Length of incubation period

Walkinshaw (1966), "Eggs are usually laid during the early morning... The incubation periods were: 15 days (3), 14 days (3), and 13 days (1)" (in Michigan). Bent (1942), "incubation lasts about 12 days." King (1955) noted incubation period of 12 days in Washington.

D. Length of nestling period

Walkinshaw (1966) reported average nestling period given as 13.8 days, range = 12-16 days. Bent (1942), "Young... remain in the nest about two weeks." King (1955), "the nestling period to vary from 13 to 15 days" (Washington).

E. Growth rates

Walkinshaw (1966) reported growth rates: Day 0, young averaged 1.28 grams; Day 1, 2.57 grams; Day 3, 4.2 grams; Day 7, 8.1 grams; Day 10, 11.5 grams; Day 11, 11.7 grams. King (1955) presented very detailed description of growth and development. Between day 2 and day 9, young gained 1.5 grams/day; 0.7 grams/day was gained until day 12; 0.85 grams per day was lost from day 12 to 14, when the young fledged.

F. Post-breeding behavior

Dawson (1923) reported family groups move to higher elevations in August.

VII POPULATION PARAMETERS

A. Clutch size

Bent (1942), "The number of eggs to a set varies from two to four and is usually three or four." Oberholser (1974), "Eggs: 2-4, usually 3-4."

Empidonax traillii (con't.)

B. Fledging success

Walkinshaw (1966), "Of 92 nests... young hatched in 64 (69.6%) and young left from 60 (65.2%). Of 302 known eggs, 223 (73.8%) hatched while 198 (65.6%) fledged." King (1955) reported fledging success given as 44.6% in Washington. Holcomb (1972), "The 91 nests had 272 eggs from which 99 young fledged for a total success of 36.4%" (Nebraska and Ohio).

C. Mortality rates per age class

Holcomb (1972), "Of 272 eggs, 149 or 54.8% hatched... 6 infertile eggs, 3 embryos interrupted in development, 96 eggs removed by predators, 41 nestlings removed by predators, 8 eggs and 1 nestling destroyed by rain and windstorms, 7 nestlings that starved, 4 eggs not hatching because of brown-headed cowbird, 3 eggs lost through weak nest construction, and 4 eggs abandoned because of human disturbance." Ingersoll (1913) notes common destruction of willow flycatcher eggs by jays and heavy snow (in Sierra Nevada, California). King (1955) reported hatching failure ranged between 2 and 16 percent in Washington (2-year study).

Holcomb (1972), "probably adult mortality between a first and second breeding season is... 50 percent."

D. Longevity

Kennard (1975) reported willow (Traill's) flycatcher from Minnesota at least 4 years old.

E. Habitat density figures

Salt (1957) reported densities of willow flycatchers in Wyoming given as: willow-sedge swamp - 51.7 birds/100 acres; scrub-meadow - 10.0 birds per 100 acres; and flatland aspen - 43.4 birds/100 acres. Walkinshaw (1966), "Seventy-three territories in southern Michigan averaged 1.74 (0.8-2.9) acres." King (1955) noted 14 breeding pairs per 100 acres in Washington. Stewart and Kantrud (1972) noted mean density of 0.89 pairs per square mile (range = 0.38-1.41 pairs/square inch) in North Dakota.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Miller and Stebbins (1964) reported willow flycatcher captured by a speckled rattlesnake (Crotalus mitchelli) in California desert.

B. Parasitism

Friedmann (1963), "Both races... (brewsteri and traillii) are known to be victimized by the brown-headed cowbird... of 859 nests... almost 11%, were parasitized." Walkinshaw (1966), "out of 94 Traill's flycatcher nests, only 5 (5.3%) have been parasitized (by brown-headed cowbirds)."

Empidonax traillii (con't.)

EX STATUS

A. Past population trends

Remsen (1977), "Status and range: Once a breeding bird throughout much of California, this species has undergone a drastic population decline in recent decades. Formerly common in riparian of the Central Valley, the willow flycatcher has now completely disappeared from all known localities and may be extirpated." McCaskie (1975), "A singing willow flycatcher, near Santee, San Diego County, and another at nearby Otay Lake, are of interest since the species appears to be gone from the area as breeders."

B. Present population status

Phillips, Marshall, and Monson (1964), "As a breeding bird, Traill's (= willow) flycatcher has decreased in Arizona" (no reasons given).

C. Environmental quality: adverse impacts

Remsen (1977), "Reasons for decline: Although destruction of willow riparian habitat has undoubtedly played a role in the decline of this species, ... cowbird parasitism... is almost certainly involved" (in California).

D. Potential for endangered status

Remsen (1977) reported willow flycatcher placed on "Second Priority" list, meaning that the species is definitely on the decline in California. Also, "further information may show this species should be placed on the 'Highest Priority' list" (face immediate extirpation if current trends continue).

E. Management recommendations

Remsen (1977), "Recommendations: (1) Save and protect willow riparian areas throughout the state, particularly in the Sacramento and San Joaquin Valleys and along the southern California coast. (2) Initiate cowbird removal programs on an experimental basis in selected riparian areas to determine if cowbirds can be controlled on a local level."

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VERMILION FLYCATCHER
Pyrocephalus rubinus

I TAXONOMY

A. Type description

Pyrocephalus rubinus flammeus - AOU (1957) Van Rossem, Trans. San Diego Soc. Nat. Hist., 7, no. 30, May 31, 1934. Brawley, Imperial County, California; Family: Tyrannidae.

B. Current systematic treatments

Ridgway (1907) does not recognize P. r. flammeus as a distinct race (not separated from P. r. mexicanus); gives detailed description of plumages and measurements of P. r. mexicanus.

Cory and Hellmayr (1927) recognize 8 races of Pyrocephalus rubinus, but does not separate flammeus from (apparently) P. r. mexicanus.

Synonymies - Pyrocephalus rubineus; P. rubinus mexicanus; P. mexicanus (Grinnell and Miller, 1944). Red flycatcher; scarlet-crowned flycatcher; western vermilion flycatcher.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "Decidedly smaller than cardinal and tanagers, it is readily recognized by its small bill and flycatching habit. Male is unmistakable. Finely streaked sides and strawberry wash on flanks identify the female. Say's phoebe has longer tail and no streaks." Peterson (1961), "Male: crown, throat, and underparts, flaming vermilion; upper parts and tail dusky brown to blackish. Crown often raised in bushy crest. Female and immature: upper parts brownish gray; breast white, narrowly streaked; lower belly and under tail coverts washed with pinkish or yellow." Under similar species: "Say's phoebe might be confused with female."

B. Distinguishing characteristics

Intraspecific - Ligon (1961), "Five and one-half to six and one-half inches long. Color pattern of sexes different." (Adult male... with full vermilion crest; adult female... grayish brown... tinged with yellow, salmon, or red.)

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Pyrocephalus rubinus flammeus - AOU (1957), "Breeds from southeastern California (Mohave and Colorado deserts, Coachella), southern Nevada (Ash Meadows, Pahrump Ranch), southwestern Utah (Virgin River Valley,

Pyrocephalus rubinus (con't.)

probably Kanab), central Arizona (Prescott, Camp Verde), southwestern New Mexico, and western Texas (Brewster County) south to southern Baja California (Cabo San Lucas) and Nayarit (San Blas). Winters in Mexico and west and north sparingly in California (Santa Barbara, San Diego) and Nevada (Alamo). Casual in Colorado and Nebraska."

Pyrocephalus rubinus - AOU (1957), "Southwestern California, southern Nevada, southwestern Utah, central Arizona, southwestern New Mexico, and western and central Texas south to Guatemala and Honduras; South America from the Galapagos Islands, Colombia, and Venezuela to central Chile and southern Argentina."

B. California distribution of the species

Small (1974), "Range in California - Colorado and Sonoran deserts; stragglers often reach coastal areas after breeding season; has ranged as far north as San Joaquin County." Rare resident on breeding grounds. Grinnell and Miller (1944), "As breeding, Colorado desert; north from Mexican boundary in Imperial County, along valley of Colorado River to the Nevada line north of Needles, in eastern San Bernardino County, and northwest through Imperial Valley at least to vicinity of Coachella, Riverside County." (Eds. note: "California desert distribution" is thus the same as California distribution.). Rett (1940) reported specimen of vermilion flycatcher taken in Santa Barbara, California in April. Hanna (1937) noted vermilion flycatcher in late fall near South Pasadena, Los Angeles County, California. McCaskie (1977), "A male vermilion flycatcher at Oasis August 19 - October 2 established the northernmost record for California."

C. California desert distribution

Small (1974), "most persistent population is at Covington Park, San Bernardino County, where it regularly breeds." Dawson (1923), "Normally confined in summer to the mesquite area of the Colorado desert, the Imperial Valley, and the borders of the Colorado River." Miller and Stebbins (1964), "Vagrant or casual visitant, chiefly in early spring" (Joshua Tree National Monument). Huey (1944) reported summary of literature concerning the vermilion in California; occurrence of the species is sporadic. Jaeger (1947) notes nesting of vermilion flycatchers at Camp Cody, eastern San Bernardino County; is an "island habitat" (oases) several hundred miles north of major breeding locations. Fish (1950), "The present record extends the breeding range of the vermilion flycatcher still another 100 miles to the northern limit of the Mohave." Hanna (1929) notes nesting of vermilion flycatcher (15 April 1928) in Coachella, Riverside County, California; calls this the most westerly breeding location to that date. Willett (1951), "Resident of Colorado desert and north along Colorado River to Nevada line. More widespread in winter" (southern California deserts).

D. Seasonal variations in distribution

Rowley (1930) calls vermilion flycatcher rare but annual fall and winter visitor in El Monte, Los Angeles County, California. Bent (1942), "During

Pyrocephalus rubinus (con't.)

September, the fall migration begins, southward and westward, and by the first of October very few are left in their summer homes in Arizona and New Mexico... a few are scattered westward into southern California, even to the coastal counties as far north as Santa Barbara." Monson and Phillips (1964), "Winters in moister valleys of most of breeding range. Uncommon transient at or near water in southwestern deserts" (of Arizona, and thus, also southeastern California deserts).

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - for all purposes, concerned with both nesting and foraging, low-lying areas in vicinity of accessible water and where mesquite and screwbean dominate in the vegetation." Small (1974), "Habitat - desert riparian woodlands and oases with open water available; also desert thickets if water is nearby." Huey (1944) feels that unplowed pastures provide suitable habitat for this species in California. Bent (1942), "We found it to be abundant... where willows and cottonwoods with thickets of smaller trees and underbrush grew along irrigating ditches, separating the fertile areas from the more arid surroundings" (in southern Arizona). Oberholser (1974), "desert or semi-arid habitat, haunts the vicinity of cottonwood, willow, oak, mesquite, and sycamore-lined streams, lakes, and ponds." Monson and Phillips (1964), "Common to abundant summer resident in mesquites, willows, and cottonwoods... Also nests locally in sycamore-ash-cottonwood associations. Casual in pine-oak-juniper" (Arizona). Ligon (1961), "chosen place of action is usually an opening among mesquite, oak, cottonwood, or similar types of trees without dense foliage, where there are convenient perches."

B. Altitudinal range

Oberholser (1974), "Breeding: altitudinal range, 1800 to 5000 feet" (Texas). Grinnell and Miller (1944), "altitudes of known nestings all below 500 feet."

C. Territory requirements

Perch sites - Grinnell and Miller (1944) reported foraging perches are relatively "low to medium" in height, while singing posts are higher. Oberholser (1974), "The bird flits from perch to perch on the outer portions of low trees, bushes, and tall weed stalks."

Nest sites - Dawson (1923), "Nest: a neat cup settled into crotch of large horizontal limb of mesquite, willow, hackberry, or other tree - 10 to 40 or even 60 feet." Phillips, Marshall, and Monson (1964) noted nests in mesquites, willows, and cottonwoods; also locally in sycamore-ash-cottonwood associations. Wiley (1916) notes vermilion nest in a screw-bean containing eggs near hatching (17 April 1916); nest was re-used same year. Bent (1942), "The nests that we found in Arizona were in willows or sycamores, in horizontal forks, at heights ranging from 8 to 20 feet... generally not far from an irrigation ditch, stream..."

Pyrocephalus rubinus (con't.)

Other nests have been found there in cottonwoods, oaks, mesquites, palo verde, and hackberry trees." Tinkham (1949) gives description of nest-building behavior; male took no part in this activity; female made trips every hour or so (Arizona). Ligon (1961), "Nest: shallow and compact; usually in cottonwood, willow or mesquite; placed in fork of limbs or saddled on horizontal branches, 6 to 20 feet above ground."

V FOOD

A. Food preferences

Bent (1942), "Its food consists of insects... seen it alight on the ground to pick up a grasshopper or small beetle. Both large and small grasshoppers are captured, as well as small beetles, flies... honeybees."

B. Foraging areas

Grinnell and Miller (1944), "The foraging level of this flycatcher... is medium to low; and the lookout post correspond in position."

C. Foraging strategies

Bent (1942) noted most food is caught while in flight from a perch, although they will go to the ground. Oberholser (1974), "rather frequently it flies to the ground to pick up a beetle or small grasshopper."

VI REPRODUCTION

A. Territorial behavior

Rand (1943), "This species is strictly territorial... he gave his display flight and song (when disturbed)." Oberholser (1974), "not gregarious, it is usually seen singly or in pairs; even in winter it does not associate with other birds."

B. Courtship and mating behavior

Dawson (1923) describes courtship behavior; uses song flight. De Benedictis (1966) describes flight song, which is likely important in formation and maintenance of the pair bond. Smith (1967) describes breeding displays; includes vocalizations, plumage ruffling, tail flicking, wing flirting, wing whirr, gape and bill snap, and nest-site-showing. Bent (1942), "the males were busy with their courtship flight songs... he mounts upward 20, 30, or even 50 feet... then slowly he flutters down to claim her, and the two fly off together." Oberholser (1974), "... in the air from ten to forty feet above the ground he hovers... pouring out his... song before slowly fluttering down to territory... Hover singing lasts usually from mid-March to early July."

C. Nesting phenology

Bent (1942), "Two broods are occasionally raised in a season. Egg dates - Arizona: 70 records, March 4 to July 4; 36 records, April 30 to May 28,

Pyrocephalus rubinus (con't.)

indicating the height of the season. California: 4 records, March 20 to May 9. Lower California: 36 records, April 7 to June 3; 18 records, May 4 to 18."

D. Length of incubation period

Bent (1942), "The incubation period is said to be about 12 days" (The female does most of the incubating, although the male occasionally helps).

E. Length of nestling period

Bent (1942) reported nestling period given as 14 to 16 days (southern Arizona). "On the fourth day... down stood out thickly on the crown and along the back. On the tenth day they were fairly feathered, but remained in the nest until the 14 and 16th days."

F. Post-breeding behavior

Bent (1942), "During August, families of young with the parents in attendance, were frequently seen."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1942), "Three eggs seem to constitute the usual set for the vermilion flycatcher, though sometimes only two are laid and rarely four." Oberholser (1974), "Eggs: 2-4, usually 3." Dawson (1923), "Eggs: 3."

VIII INTERSPECIFIC INTERACTIONS

A. Parasitism

Hanna (1936) notes parasitism of vermilion flycatchers by cowbirds in Coachella Valley, Riverside County, California. Friedmann (1963), "This flycatcher is an uncommonly reported host" (cowbird).

IX STATUS

A. Present population status

Remsen (1977), "Status and range: Formerly fairly common the entire length of the Colorado River and also the Imperial and Coachella Valleys, this species has now completely disappeared as a breeding bird from most of its breeding range. This species no longer breeds in Coachella Valley or Imperial Valley." Flavin (1953) notes occurrence of vermilion flycatcher in Colorado; second state record. McCaskie (1974), "the only breeding vermilion flycatchers were birds of a pair in Morongo Valley; since the land at Morongo Valley has been allowed to go from irrigated alfalfa back to desert scrub, vermilion flycatchers have steadily declined at that locality."

Pyrocephalus rubinus (con't.)

B. Population limiting factors

Miller and Stebbins (1964), "at Twentynine Palms... the elevation with correlated cold periods in the early spring may be a deterrent to breeding." Remsen (1977), "Reasons for the decline: The main cause of the decline is the destruction of cottonwood riparian woodland and groves in most of its range" (in California deserts). Huey (1944) states that shooting may have reduced numbers in California.

C. Management recommendations

Remsen (1977), "Recommendations: (1) Save and protect any surviving cottonwood riparian along the Colorado River. (2) Acquire land suitable for restoration of cottonwood riparian along the Colorado River. (3) Save and protect existing cottonwood groves and oases in the Imperial and Coachella Valleys. This species seems to prefer riparian bordering pastures or alfalfa fields."

D. Potential for endangered status

Remsen (1977) reported vermilion flycatcher placed on "Highest Priority" list. This species thus face immediate extirpation in California if current trends continue.

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HORNED LARK

Eremophila alpestris

There are 20 subspecies of horned larks in North America. Of these at least 10 occur in California and 6 occur in the desert areas of southern California. The data presented below refer primarily to the latter 6 subspecies (ed.)

I TAXONOMY

A. Type description of desert subspecies

Eremophila alpestris leucolaema: Otocoris alpestris leucolaema Cones, 1874, Birds Northwest p. 38, 39 - Fort Randall, S.D. (Peters 1960).

Eremophila alpestris enthymia: Otocoris alpestris enthymia Oberholser, 1902, Proc. U.S. Nat. Mus 23:807, 817 - St. Louis, Saskatchewan (Peters 1960).

Eremophila alpestris lamprochroma, Warner horned lark: Otocoris alpestris lamprochroma Oberholser, 1932, Sci. Publ. Cleve. Mus. Nat. Hist. 4(1):4 - Spanish Lake, Lake County, Oregon (Peters 1960).

Synonomies - Otocoris alpestris arenicola, O.a. practicola, O.a. merrilli, O.a. leucolaema, O.a. rubea, Chionophilos alpestris merrilli; prairie horned lark, dusky horned lark, desert horned lark, ruddy horned lark, Columbian horned lark, Oregon horned lark (Grinnell and Miller 1944).

Eremophila alpestris utahensis: Otocoris alpestris utahensis Behle, 1938, Condor 40:89 - Salt Lake City, Utah (Peters 1960).

Eremophila alpestris ammophila, Mohave horned lark: Otocoris alpestris ammophila Oberholser, 1902, Proc. U.S. Nat. Mus. 24:806, 849 - Coso Valley, California (Peters 1960).

Synonomies - Eremophila cornuta, Otocoris alpestris arenicola, O.a. chrysolaema, O.a. actia, O.a. pallida, Chionophilos alpestris amonophilus; shore lark, horned lark, desert horned lark, Mexican horned lark, Sonoran horned lark (Grinnell and Miller 1944).

Eremophila alpestris leucansiptila, Yuma horned lark: Otocoris alpestris leucansiptila Oberholser, 1902, Proc. U.S. Nat. Mus. 24:806, 864 - Yuma, Arizona (Peters 1960).

Synonomies - Eremophila cornuta, Eremophila alpestris chrysolaema, Otocoris alpestris pallida, Chionophilos alpestris leucansiptila; horned lark, bleached horned lark, Sonora horned lark (Grinnell and Miller 1944).

B. Current systematic treatment

Order Passenformes, family Alandidae, genus Eremophila Bore, 1928, Isis von Oken, 21, Col. 322 (Peters 1960).

Behle (1942) studied the amount of intergradation among the numerous subspecies of horned lark. Concerning the desert subspecies, he found the following

Eremophila alpestris (Cont'd.)

subspecies intergrading: leucansiptila with actia although these are usually allopatric, ammophila with actia in the southern San Joaquin Valley, utahensis with leucansiptila, lamprochroma with ammophila. Behle (1942) concluded that actia, ammophila, leucansiptila, lamprochroma, and utahensis have molded in situ.

The subspecies enthymia is considered to be doubtfully distinct from leucolaema. Other California subspecies are rubea, actia, insularis, sierrae (Peters 1960).

C. Recent taxonomic revisions

The supplement to the AOU "Checklist of North American Birds" (1973 Auk 90:411-419) indicates that there have been no revisions in horned lark systematics since the 5th edition of the Check-list (1957).

II DESCRIPTION

A. External morphology of adults

The horned lark is "a slender, long winged... bird. Head marked in male by black forehead and lateral crown streaks...; anterior face, suborbital patch, and broad anterior chest area black; frontal, superciliary, and throat areas whitish to yellow. Similar head markings of female variously developed, but black of crown usually lacking. Back and sides pinkish brown to clay color...; posterior breast and belly white; tail black, except central pair of feathers, which are brown; lateral rectrix white-bordered. Bill and feet black... spur on hind toe" (Miller and Stebbins 1964).

The male horned larks are larger and heavier than the females; they are more highly colored on the occiput, nape, interscapular region and bend of wing; the yellow is more prominent, the black areas more extensive; the horns occur only in males (Behle 1942). There is also a great deal of variation among males in the degree of coloration.

"The races show a pronounced trend of decreasing size from north to south" (Behle 1942). "The palest, most bleached appearing races occur in arid desert areas, whereas the darker races are found in areas of greatest... humidity." The yellow throat also becomes more pronounced toward the south (Behle 1942).

B. External morphology of subadult age classes

The juvenile plumage is spotted for concealment (Behle 1942).

The first year birds and the adults are essentially the same once the post-juvenile molt is completed (Behle 1942).

C. Distinguishing characteristics

Intraspecific - Eremophila alpestris lamprochroma is "darker and browner than the ashy gray of utahensis...; lighter... more bleached than merrilli... with more ruddy on nape...; larger and duller than ammophila; grayer than sierrae and lacking the ruddy brown and yellow underparts" (Behle 1942).

Eremophila alpestris (Cont'd)

Eremophila alpestris utahensis is "most... like lamprochroma, but slightly larger, darker in worn plumage, but more grayish, less brownish in fresh fall plumage; ... smaller, more grayish than leucolaema" (Behle 1942).

Eremophila alpestris leucansiptila is "the palest of all American horned larks... characters distinguishing leucansiptila from actia and ammophila are the more uniform upper surface and the much more pinkish shade of the cervix, upper tail coverts and bend of wing;... from leucolaema, reduced size and more uniform upperparts" (Oberholser 1902). E.a. leucansiptila is slightly larger than actia or ammophila and smaller than utahensis (Behle 1942).

Eremophila alpestris ammophila "may be easily distinguished (from actia) by its very much paler color above, while its decidedly smaller size, conspicuously more cinnamonaceous shade of nape, uppertail coverts and bend of wing render it readily separable from leucolaema" (Oberholser 1902). The coloration is midway between that of actia, darker than leucansiptila; ammophila is a warmer brown and less grayish than lamprochroma and utahensis (Behle 1942).

D. Special morphological features

The bill of the horned lark is pointed to enable it to pick up seeds and insects (Behle 1942). Hair-like feathers protect the nasal openings from dust during foraging. The wings are long and pointed for flight; the tarsi, toes, and claws are long for running. The coloration is concealing at all ages for protection from predation (Behle 1942).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Breeding range - Thirteen subspecies breed in Europe and Asia from the northern palearctic region south to the mountains of southeastern Europe, Asia Minor, India, and China. Two subspecies breed in Europe, three in Asia Minor, seven in Asia and one in Morocco (Peters, 1960).

Twenty-six subspecies breed in North America from Northern Alaska and Canada south to southern Mexico, Columbia (one subspecies) and North Carolina. Five subspecies breed in Mexico, one in Columbia and twenty in the United States and Canada (Peters, 1960).

Most of the subspecies are residents in their breeding ranges. However, the northernmost subspecies migrate south in winter. One European subspecies winters in Great Britain, one Asian subspecies migrates to southern Asia, and five North American subspecies migrate completely out of their breeding range in winter. In addition, nine North American subspecies migrate to more southerly portions of the breeding range and to areas just south of the breeding range (Peters, 1960).

B. California distribution of the species

Grinnell and Miller (1944) recorded the subspecies and California distributions as follows:

enthyrnia: San Bernardino, Imperial, Los Angeles counties as winter visitors;

Eremophila alpestris (Cont'd.)

leucolaena: winter visitor southward from Inyo county to San Bernardino and Kern Counties;

utahensis: winter visitor in the Mohave Desert;

lamprochroma: resident from northeast California to Mono County;

merrilli: resident from Siskiyou County east to Modoc County and woutheast to Lassen County;

sierrae: northern Sierra Nevada entirely within California, Lassen to Nevada County;

insularis: resident of the Channel Islands;

rubea: resident on the floor of the Sacramento Valley, Tehama to Solano County;

actia: coastal resident from Sonoma to San Diego County, and also in the San Joaquin Valley;

ammophila: resident of the Mohave Desert in Inyo, San Bernardino, Los Angeles, and Kern Counties.

leucansiptila: resident on the floor of the Colorado Desert in Imperial, Riverside and San Bernardino Counties.

C. California desert distribution

The Mohave Desert is occupied by ammophila as a resident and utahensis as a winter visitor (Grinnell and Miller 1944). Miller and Stebbins (1964) noted a few nesting pairs of ammophila in Joshua Tree National Monument (Pinyon Walls, Pinto Basin) which "represent a southern extension of the known breeding range of this ract."

The Colorado Desert is inhabited by leucansiptila which is resident there (Grinnell and Miller 1944).

"The San Gabriel-San Bernardino Mountains project southeastward into the desert region of southeastern California between the ranges of ammophila and leucansiptila, thus confining ammophila to the Colorado Desert. All examples taken from the mountains are referable to actia" (Behle 1942).

An unspecified subspecies of horned lark was reported to occur in Death Valley (Wauer 1962).

D. Seasonal variations in distribution

The subspecies enthymia, leucolaema, lamprochroma, and utahensis are winter visitors in southeastern California, migrating south from their respective breeding grounds (Behle 1942, Grinnell and Miller 1944, Peters 1960).

IV HABITAT

A. Biotopic affinities

In California, horned larks are found from the Lower Sonoran to the Alpine-Arctic life zones. The subspecies lamprochroma is found mainly on the flat valley floors of the Upper Sonoran life zone (vegetation: Sarcobatus, Artemesia, Chriothamnus), but it also occurs in untimbered high montane plateau where grassland is interspersed with sage brush (Grinnell and Miller 1944). Wauer (1964) also observed horned larks, perhaps of this subspecies, in the open sage flats and valleys just below the pinon pine-juniper woodland areas of the Panamint Mountains.

E.a. amonophila and E.a. leucansiptila both occur in the Lower Sonoran life zone where the ground is level and shrubby vegetation is sparse or absent; leucansiptila is generally found at lower levels than ammophila (Grinnell and Miller 1944). The vegetation in these areas is characterized by the presence of Larrea, Atriplex, Franseria, Lycium, and Suaeda, the latter being characteristic of the margins of alkaline valleys where horned larks are found (Behle 1942).

Kelso (1931) observed leucolaeolaema in Colorado. He found that 70% of the areas utilized by the horned larks for roosting and nesting belonged to the short grass association (vegetation: Bouteloua, Festuca, Muhlenbergia, Chrysothamnus, Opuntia, Gutierviezia). Old fields covered 10% of the terrain and were used extensively for foraging because of the presence of seeds in winter and insects in summer.

B. Altitudinal ranges

The following altitudinal ranges have been recorded for various desert subspecies of horned lark:

ammophila: 200 to 500 feet (Behle 1942), 400 to 5700 feet (Grinnell and Miller 1944);

actia: 0 to 8000 feet (Behle 1942);

lamprochroma: 4000 to 13000 feet in the White Mountains (Grinnell and Miller 1944);

leucansiptila: -246 to 500 or more feet (Behle 1942), -246 to 5167 feet (Grinnell and Miller 1944);

unspecified: 4000 to 5000 feet in Panamint Mountains (Wauer 1964).

C. Home range size

No information located for desert areas.

D. Territory requirements

Perch site - Trost (1972) reported that horned larks (subspecies ammophila) perched on top of creosote bush (Larrea), especially in the heat of the day.

Eremophila alpestris (Cont'd)

However, roost sites were holes dug behind vegetation which afforded protection from the prevailing winds (Trost 1972).

Courtship and mating sites - The horned lark performs an aerial display above the general nesting and foraging terrain (DuBois 1936).

Nest sites - The horned lark (subspecies leucotaema) prefers to nest on dry benchland on the ground in short grasses with little concealment (DuBois 1936). The nest is built in a rounded hollow in the ground which is excavated by the birds (DuBois 1936).

E. Special habitat requirements

Too much or too little vegetation are limiting factors for the occurrence of horned larks; they need vegetation for foraging and protection from the weather and predators, but the area must be open (Behle 1942).

"In the deserts of North America they are limited in the main to old drainage sinks where the sparse annual vegetation develops sufficiently to provide food, chiefly insects, in the spring and summer season" (Miller and Stebbins 1964).

F. Seasonal changes in habitat requirements

Horned larks are found wintering on the Yucca-grassland association of the Chihuahuan Desert in New Mexico (Raitt and Pimm 1976). The vegetation consists primarily of yucca, black grama, mesa dropseed, and/or tobasa grass. Horned larks are also found in the desert scrub where creosote bush, mesquite and tarbush occur (Raitt and Pimm 1976).

H. Physiological ecology

The xeric subspecies ammophila has a lower oxygen consumption, lower evaporative water loss and reduced lower critical temperature than the inland mesic subspecies actia. The desert subspecies was also able to maintain a lower body temperature under heat stress by exhibiting a higher evaporative heat loss. Thus ammophila is adapted to withstand the extremes of heat and cold encountered on the desert, even though it requires some water to survive (the above and the following is taken from Trost 1972).

	<u>actia</u>	<u>ammophila</u>	P
O ₂ consumption	3.91 cc O ₂ /g. hr.	2.97 cc O ₂ /g. hr	.01
Body temperature	45.9°C	44.2°C	.01
Evaporative water loss	103.7% body wt./day	87.7% body wt./day	.05

V FOOD

A. Food preferences

McAtee (1905) studied the subspecies actia and practicola. No information was located on other subspecies.

Eremophila alpestris (Cont'd)

E.a. praticola consumed an average of 79.4% vegetable food over the year. This material was composed primarily of weed seeds (foxtail grass, smartweed, bindweed, amaranth, pigweed, purslane, ragweed, crab and barn grass). Grain accounted for 12.2% of the yearly food (McAtee 1905). These figures agree well with those described by Beal (1907) for non-specified subspecies: 91% vegetable broken down into 40% grain (91% oats, 9% wheat) and 51% weed seeds (n = 259 stomachs). Of the animal food consumed, grasshoppers and weevils were deemed most important by McAtee (8% and 18% maxima in summer respectively), whereas Beal felt Coleoptera (5% overall) were the only principal sources of animal food. Similar figures of plant and animal consumption were reported for actia (McAtee 1905): 91% vegetable (40% grain, 51% weed seeds), 9% animal.

B. Foraging areas

Horned larks "require open, sparse, more or less flat ground over which they forage on foot" (Miller and Stebbins 1964).

C. Foraging strategies

No information located.

D. Feeding phenology

The proportion of animal food in the diet of the horned lark increases during the summer when young are being reared. E.a. praticola consumes 40% animal food in August, 20% in September, 10-20% in October, 5% in November, 2% in December and January, and 3% in February (McAtee 1905). Vegetable matter also varies in its seasonal contribution: oats make up 77% of the diet in November, and weed and grass seeds fluctuate from a low of 19% in January to a high of 99% in August (McAtee 1905, Beal 1907).

E. Emergy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

"Prior to the establishment of well-defined territories, fighting between males is promiscuous; after that fighting takes place only on territory boundaries, where two lark areas juxtapose. The males... frequently strut before each other and often peck the ground furiously, ... but all fighting is in the air" (Pickwell 1942).

The fighting exhibition takes place a few feet in the air, but no injuries result (DuBois 1936). Aerial chases are also observed in which 2 to 4 birds fly in close formation with a course of rapidly changing, meandering curves (DuBois 1936).

Eremophila alpestris (Cont'd)

C. Courtship and mating behavior

"The male frequently struts before the female with wings dropped, tail spread, and horns up" (Pickwell 1942). However, the most spectacular courtship display is the aerial song flight of the male. The ascent is a series of steep rises alternated with brief coasting intervals, proceeding upwards in a wide helix (DuBois 1936). The male remains aloft singing for a while then folds its wings and drops like a bullet, pulling out into a horizontal glide near the ground (DuBois 1936).

D. Nesting phenology

Bent (1942) recorded the following egg dates for the horned lark in California: 106 records, March 20 to June 23; 52 records, April 17 to May 20.

E. Length of incubation period

The incubation period has been reported to be 10 to 11 days (n = 5 nests, DuBois 1935) and 11 days (Pickwell 1942).

F. Length of nestling period

The nestling period has been reported to be 9 to 12 days (n = 5 nests, DuBois 1935), 8 to 12 days (n = 4 nests, Kelso 1931), 10 days (Pickwell 1942; Beason and Franks 1973). The young leave the nest before they are actually able to fly; flight appears after 1 to 2 days (Beason and Franks 1973) or 3 to 4 days (Pickwell 1942).

G. Growth rates

Beason and Franks (1973) recorded the weights of horned larks through the age of 8 days. The birds weigh 2.4g at hatching and gain weight rapidly through the 5th day (16.3g). Weight increase slows, and the larks weigh (20.7g) on day 8, just 2 days prior to fledging. The weight gain averages 3.5g/day for the first 5 days and 2.2g/day for the last 2 days (Beason and Franks 1973). The "lessening in weight growth occurs normally between the seventh and eighth days... brought about by the simultaneous unsheathing and drying of most of the feathers" (Pickwell 1942).

H. Post-breeding behavior

Large flocks of horned larks form soon after the second brood is fledged. Many of the birds in these flocks move southward, but a large portion are resident in the breeding range (Bent 1942).

VII POPULATION PARAMETERS

A. Clutch size

The normal clutch size is 3 to 4 eggs (n = 13 nests with 4 eggs, 34 nests with 3 eggs; DuBois 1935; see also Kelso 1931). Two clutches are frequently produced (Hill 1976).

Eremophila alpestris (Cont'd)

B. Nesting success

No information located. Adverse weather is reported to cause the greatest destruction of nestlings (DuBois 1936).

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

E. Seasonal abundance

Population size will vary with the seasons depending on the proportion of horned larks that migrate out of the breeding area for the winter.

F. Habitat density figures

Owens and Myres (1973) sampled populations of horned larks in grassland areas of Alberta under 5 different conditions. The numbers of lark territories under each of the conditions (2 sites per condition) were as follows.

Undisturbed fescue grassland and mowed grassland contained no horned lark territories (vegetation height: 0.1 to 0.2 m). Grazed grassland (height 0.05 to 0.15 m) contained 2 and 3 territories on a 16.2 ha plot. Fallow grassland areas (vegetation height 0.01 m and thin) held 5 and 1 territory per 16.2 ha. Seeded fields (vegetation height 0.0 to 0.2 m and thin) contained 2 and 2 territories per 16.2 ha.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Duck hawks, pigeon hawks, prairie falcons, and sparrow hawks have been reported to capture horned larks in flight and on the ground (Behle 1942). Prairie falcons in particular follow flocks in the fall and winter, striking down individuals (Behle 1942). Horned larks accounted for 9% and 22% of the prey items found at prairie falcon roosts and eyries (Marte and Braun 1975; Ogden and Hornocker 1977). Shrikes have also been observed preying on horned larks (Behle 1942). Ground squirrels, ravens, and snakes prey on eggs, and weasels and skunks prey on horned lark nestlings (DuBois 1936, Behle 1942).

B. Competition

No information located.

C. Parasitism

Cowbirds parasitized 45% of the horned lark nests ($n = 31$ nests) in one area of Kansas (Hill 1976). Each parasitized nest contained an average

Eremophila alpestris (Cont'd)

of 1.7 cowbird eggs. Of these eggs 25% ultimately fledged (0.5 cowbirds fledged per parasitized nest). Only 0.7 horned larks fledged from parasitized nests compared to 1.4 fledglings in non-parasitized nests. There was no parasitism in the first clutch (n = 8 nests), but 63% of the second clutches contained cowbird eggs (14/22 nests).

IX STATUS

A. Past population trends

No information located.

B. Present population status

The Seventy-seventh Audubon Christmas Bird Count (1977) indicated that horned larks were present in 16 out of 21 desert or near desert census areas. The areas (and numbers of individuals sighted) were as follows: Big Bear Lake (50), Bakersfield (2), Butterbread Springs (835), Carrizo Plains (6900), China Lake (620), Granite-Woody-Glennville (14), Idylwild (91), Joshua Tree National Monument (2), Orange County NE (1003), Salton Sea S (300), San Bernardino Valley (41), San Fernando Valley (36), Sespe Wildlife Area (76), Springville (15), Thousand Oaks (18), Parker, Ariz.-Colorado River (35).

C. Population limiting factors

No information located.

D. Environmental quality: adverse impacts.

"Plowing and harvesting... destroy great numbers of eggs and nestlings in cultivated fields. Livestock crush eggs and young in pastureland and open range" (Behle 1942).

Horned larks frequented areas of the Mohave Desert utilized by off-road vehicles (ORV), because the larks prefer open and disturbed habitats and exploit the temporary availability of insects and seeds (Bury et al 1977). However, ORVs destroy horned lark nesting sites and disturb nesting birds (Bury et al 1977).

E. Potential for endangered status

In Kansas, Owens and Myres (1973) found that the total elimination of native grassland by plowing and cultivation eliminated all passerine species except the horned lark.

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CLIFF SWALLOW
Petrochelidon pyrrhonota

I TAXONOMY

A. Type description

Petrochelidon pyrrhonota pyrrhonota, common cliff swallow: Hirundo pyrrhonota pyrrhonota Vieillot, 1817, Nouv. Dict. Hist. Nat. 14:519 - Paraguay (Peters, 1960).

Synonomies - Hirundo pyrrhonota Vieillot, Hirundo albifrons Rafinesque, Hirundo lunifrons Say, Petrochelidon albifrons Oberholser (Peters, 1960); Hirundo fulva, Petrochelidon lunifrons (Grinnell and Miller, 1944); common cliff swallow, republican swallow, eave swallow, northern cliff swallow (Grinnell and Miller, 1944).

Petrochelidon pyrrhonota hypopolia, greater cliff swallow: Petrochelidon albifrons hypopolia Oberholser, 1920, Can. Field-Nat. 33:95 - Fort Norman, Mackenzie.

Synonomies - Petrochelidon lunifrons, Petrochelidon albifrons; greater cliff swallow, northern cliff swallow, Great Basin cliff swallow (Grinnell and Miller, 1944).

Petrochelidon pyrrhonota tachina: Petrochelidon lunifrons tachina Oberholser, 1903, Proc. Biol. Soc. Wash. 16:15 - Langtry, Texas.

B. Current systematic treatments

Order Passeriformes, family Hirundinidae, subfamily Hirundininae, genus Petrochelidon Cabanis, 1850, Mus. Hein, Thi, 1850-1851 (Peters, 1960).

Peters (1960) recognizes four subspecies of cliff swallows: pyrrhonota, tachina, minima, melanogaster. Peters considered that minima was doubtfully distinct from melanogaster and included hypopolia under pyrrhonota.

Behle (1976) recognizes six subspecies of cliff swallows: pyrrhonota, tachina, hypopolia, aprophata, minima, melanogaster. All but aprophata were accepted by the AOU Checklist of North American birds (1957).

C. Recent taxonomic revisions

Mayr and Bond (1943) suggested placing all Hirundo sp. and Petrochelidon sp. in one genus named Hirundo on the basis of similarities in color pattern and nest construction. They noted also that both genera were obviously of Old World origin.

The supplement to the AOU Checklist of North American birds (1973, Auk 90: 411-419) indicates that there have been no changes made in cliff swallow taxonomy since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The swallow family is characterized by the presence of "tiny feet, long pointed wings, and short bills with very wide gapes" (Peterson, 1961). The cliff swallow in particular displays a glossy blue head and back, with a rusty or buffy rump, a dark chestnut throat patch, and a buffy forehead and belly (Peterson, 1961; see also Chapman, 1902). According to Behle (1976) "no one... has postulated any distinctions between sexes in coloration", nor has he detected any. Mayhew (1958) used the presence or absence of a brood patch to sex adults during the breeding season; 0/32 verified males and 26/28 verified females had brood patches.

B. External morphology of subadult age classes

In Bent (1942) Brewster, 1878, describes the juvenal plumage as follows: "Top of head, back and scapulars dark brown, collar around nape, dull ashy, tinged anteriorly with rusty. Rump as in adult, but paler; forehead sprinkled with white, and with a few chestnut feathers. Secondaries broadly tipped with ferruginous. Throat white, a few feathers spotted centrally with dusky. Breast and sides ashy, with a rusty suffusion, most pronounced on the latter parts. A very small area of pale chestnut on the cheeks." This plumage is retained until the birds reach winter quarters. Bent (1942) reported that "according to Dwight, 1900, the first winter plumage is acquired by a complete post juvenal molt... The birds acquire a glossy blue head and back and the rich chestnut of the chin and auriculars and a black throat spot. The breast and throat feathers are streaked, and they have a conspicuous crescent on the forehead. The first nuptial plumage is acquired by wear."

C. Distinguishing characteristics

Interspecific - Peterson (1961) reports that the eave swallow (Petrochelidon fulva) is similar, but has face colors reversed; i.e., throat and cheeks buffy, forehead dark.

Intraspecific - Petrochelidon pyrrhonota pyrrhonota: Behle (1976) describes this subspecies as intermediate in size with variation in forehead color ranging from white to pale cinnamon brown, though generally cream colored. The pectoral region is buffier and less gray than hypopolia, with underparts and rump darker and frontal stripe less white. As compared with tachina, the forehead of pyrrhonota is whiter.

Petrochelidon pyrrhonota hypopolia: Behle (1976) characterized this subspecies as the largest of the three. This subspecies is in general lighter than pyrrhonota, but with a darker pectoral region.

Petrochelidon pyrrhonota tachina: Behle (1976) describes tachina as similar to pyrrhonota, but smaller with a forehead of light cinnamon, rather than cream color (see also Oberholser, 1903; Bent, 1942).

Petrochelidon pyrrhonota (con't.)

II GEOGRAPHICAL DISTRIBUTION

A. Overall breeding distribution of the species

Petrochelidon pyrrhonota pyrrhonota: eastern United States west to Rocky Mountains, Canada west to Manitoba (except southwestern part), southwestern British Columbia south through Washington, Oregon and California west of the Cascade-Sierra Nevada Cordillera to northwestern Baja California (Behle, 1976; see also Bent, 1942; Peters, 1960).

Petrochelidon pyrrhonota hypopolia: central Alaska, Yukon, Mackenzie, Alberta, Saskatchewan, and extreme southwestern Manitoba south through central and southeastern British Columbia, eastern Washington, eastern Oregon to east central California, central Nevada, northern Utah, Montana and northwestern Wyoming (Behle, 1976).

Petrochelidon pyrrhonota tachina: extreme southwestern Utah south through lower Colorado River Valley to extreme northeastern Baja California, northern Arizona, central New Mexico to southwestern Texas (Behle, 1976; see also Bent, 1942; Peters, 1960).

Comment: Behle (1976) indicates that "an area of intergradation between pyrrhonota and hypopolia extends from south central Oregon southward through northeastern California along the east side of the Sierra Nevada into Inyo County." This means that the breeding range of pyrrhonota is split, with the eastern and western ranges being separated by the range of the hypopolia-aprophata complex.

Petrochelidon pyrrhonota aprophata: Warner Valley region of central southern Oregon (Behle, 1976).

Petrochelidon pyrrhonota minima: southeastern Arizona to central Mexico (Peters, 1960).

Petrochelidon pyrrhonota melanogaster: southern portion of the Mexican Plateau.

B. California breeding distribution of the species

Mayhew (1961) band P. pyrrhonota, undistinguished as to subspecies, in 61 colonies in Yolo, Sutter, Placer, Solano, Sacramento and El Dorado Counties in the Sacramento Valley, in three colonies in Stanislaus County in the San Joaquin Valley, and in one colony in Riverside County in the San Bernardino Valley.

Petrochelidon pyrrhonota pyrrhonota: length and breadth of state, interrupted by heavy forests, mountain masses above middle altitudes and unwatered deserts (Grinnell and Miller, 1944; see also Behle, 1976).

Petrochelidon pyrrhonota hypopolia: eastern border of California in Mono County and presumably also Inyo County (Grinnell and Miller, 1944; see also Behle, 1976).

Petrochelidon pyrrhonota (con't.)

Petrochelidon pyrrhonota tachina: through the lower Colorado River Valley (Behle, 1976).

C. California desert distribution

Petrochelidon pyrrhonota pyrrhonota: western portions of Riverside County and southwestern corner of San Bernardino County and in a corridor southward from Salton Sea in Imperial County. Present throughout San Diego County and all but the western portions of Los Angeles and Kern Counties (Grinnell and Miller, 1944).

Petrochelidon pyrrhonota hypopolia: Mono County and Inyo County (Grinnell and Miller, 1944).

Petrochelidon pyrrhonota tachina: through the lower Colorado River Valley (Behle, 1976).

D. Seasonal (winter) distribution

Petrochelidon pyrrhonota pyrrhonota: migrates through Mexico, Central America, Columbia and western Brazil; winters from southern Brazil to Paraguay and northeastern Argentina (Peters, 1960).

Petrochelidon pyrrhonota hypopolia: no information located.

Petrochelidon pyrrhonota tachina: migrates through Central America; winter range not known (Peters, 1960).

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) reported that "nesting takes place... from lower Sonoran up through Transition, rarely higher."

B. Altitudinal range

Cliff swallow nest at altitudes ranging from sea level to 9000 feet (Grinnell and Miller, 1944).

C. Home range size

Cliff swallows defend only the area immediately surrounding the nest entrance (see below). undefended areas utilized in daily activities, especially foraging, occur mostly within the immediate vicinity of the colony (Emlen, 1952; Rotenberry and Wiens, 1976), but swallows will forage at sites as much as four miles from the colony (Emlen, 1952).

D. Territory requirements

Perch sites - Cliff swallows congregate along telephone wires or on the branches of trees during the breeding season and during post breeding and

Petrochelidon pyrrhonota (con't.)

migration periods (Emlen, 1952). The birds maintain an individual distance of at least 4 inches between birds which corresponds to striking distance in the absence of a change in position (Emlen, 1952).

Courtship and mating sites - Emlen (1952) reported that copulation is restricted to the nest.

Nest sites - "The primitive nesting sites... are in various situations afforded by bluffs, cliffs, and the perpendicular walls of deep gorges... many of the largest colonies... are located on cliffs" (Bent, 1942). One unusual nest site was recorded by Dawson, 1923, in Bent (1942) in the San Bernardino Mountains of California: colonies of nests were found on the trunks of yellow pine trees beneath the larger branches.

"When the cliff swallows resort to buildings, they usually plaster their nests under the protecting eaves on the outside of the structures, but not infrequently they may enter the building" (Bent, 1942). Cliff swallows also nest in or on other man-made structures and Mayhew (1958) reported that "almost every colony of swallows... in the Sacramento Valley was located beneath a bridge or culvert" while in the San Bernardino Valley, "the vast majority of the nests are under the eaves of buildings."

E. Special habitat requirements

Grinnell and Miller (1944) state that "requirements for presence through breeding season include at least: (1)... rough rock surfaces... to which the mud nests will adhere; (2)... mud for nest material; (3)... smooth-surfaced fresh water for drinking; (4) insect-carrying airways, over water, marshes, or grassland, for forage purposes." Emlen (1954) added that the nest site should also have an overhang and a clearance of "three feet if over water and eight feet if over land." Mayhew (1958) remarked that both the Sacramento Valley and the San Joaquin Valley appear to have an abundance of these required features, although the cliff swallow is abundant in the former and relatively uncommon in the latter.

F. Seasonal changes in habitat requirements

No information located. Probably not relevant to California deserts.

V FOOD

A. Food preferences

Beal (1918) reported on the stomach contents of 375 adult cliff swallows. He found insects in the following percentages, in decreasing order of importance: Hymenoptera (28.75%), Coleoptera (26.88%), Hemiptera (26.32%), Diptera (13.95%), Orthoptera (0.71%), Lepidoptera (0.46%), other (2.97%, includes Odonata, Ephemeroptera, spiders, 1 snail). Vegetable matter accounted for 0.66% of the food eaten. Ants (8.24%) and weevils (8.38%) were two major individual food sources. Beal, 1907, in Bent (1942) also

Petrochelidon pyrrhonota (con't.)

analyzed the stomach contents of 22 nestlings varying in age from two days to fledging age. "Beal found animal matter to be similar to that eaten by adults, but differing in its relative proportions. Soft-bodied insects, such as Hymenoptera and Diptera, ranked highest, amounting to three-fourths of the food eaten... Hemiptera and Coleoptera... freely eaten by the adults, represented a... small percentage of the food of the young" (Bent, 1942).

B. Foraging areas

"Foraging areas were determined... by... the distribution of grass and sedge meadows... Intervening hills and wooded areas were generally circumvented... Open water was no barrier, and shorelines were favored as foraging areas" (Emlen, 1954). "Much of the foraging was done locally within a quarter mile of the nesting colonies... but... as much as four miles distant" (Emlen, 1952). Samuel (1969) observed marked cliff swallows foraging up to three miles from the colony. These studies took place in Wyoming and West Virginia, respectively.

C. Foraging strategies

Emlen (1952) reported in depth on the group foraging activities of the cliff swallow: "most of the birds... were aggregated in a single foraging unit... Flock integrity was... maintained by the tendency for individual birds to turn and circle back as they found themselves pushing out...". Samuel (1971) suggested that the use of the chur call for nest departure and arrival was important for cliff swallow forage flocking.

Emlen (1952) indicated that cliff swallows vary their foraging altitude during the day: "During the warmer hours..., foraging flocks often operated high above the meadows,... at 500 to 1500 feet, possibly in response to the diurnal movements of flying insects."

D. Feeding phenology

Beal (1918) reported that Diptera accounted for 35.22% of the food eaten by cliff swallows in April, but only 13.95% during most of the rest of the breeding season (March to September). Ants formed a major part of the diet in September (20%) while averaging 8.24% at other times.

E. Energy requirements

Withers (1977) estimated the energetic cost of reproduction by cliff swallows using time-energy budgets and aerodynamic theory. His information is presented as: daily energy expenditure for nest building = 1.55 watts, for incubation = 1.23 watts, and nestling period = 1.28 watts; and food intake required for nest building = 3.95 watts, for incubation = 4.42 watts, for nestling period = 4.07 watts.

VI REPRODUCTION

A. Age at first breeding

No information located.

B. Territorial behavior

Cliff swallows are gregarious in their breeding habits (Bent, 1942; Emlen, 1952, 1954; Mayhew, 1958) and do not defend a large territory. There is a "fixed defense zone... surrounding the natural nest opening" (Emlen, 1952) which represents the area within reach of the bird's bill thrusts and which is defended against all intruders except the mate. Emlen (1954) reported that "defense by members of the pair was... entirely independent; an attack by one member rarely being joined by the mate."

Emlen (1952) hypothesized that the retort shaped nest "is a special adaptation for the intense localized type of territorial behavior associated with colonial nesting." He observed that "song and threat displays were repeatedly in evidence at the nest site especially during nest construction", but that the "completion of a narrow tunnel entrance apparently served to reduce the occasion for quarreling at the nest" (Emlen, 1952). Emlen (1952) and Bent (1942) provide detailed descriptions of nest shape and construction.

C. Courtship and mating behavior

Mayhew (1958) reported that "birds are paired either before they arrive... or... immediately upon arrival" with new pairs being formed each year. He also observed that "the pairing bond may not be as strong... as it is in other species." The observation was also made by Emlen (1954) who reported that "the pairing bond appeared to be largely... a relationship of mutual tolerance at the nesting site." Emlen did not observe any pair-related behavior away from the nest and stated that "complete copulations regularly occurred on the nest and were never observed elsewhere" (Emlen, 1954).

With regard to breeding behavior in general, Emlen (1952, 1954) presents a detailed description of the high degree of social interaction among birds nesting at any one colony. He observed (1952) that "there was a general synchrony of the cycle in the members of any single colony", although "each colony has an independent synchrony within itself." Emlen (1952) particularly stressed the social, synchronized nature of mud and grass gathering during nest construction. He attributed this propensity for social mud gathering to the flock foraging behavior characteristic of cliff swallows.

D. Nesting phenology

Bent (1942) reported the following egg dates for cliff swallows in California: "109 records, April 27 to July 5; 55 records, May 8 to June 20, indicating the height of the season." This information is corroborated by Mayhew (1958) who found eggs in cliff swallow nests in California from April 5 to July 3, "with the majority being found from about April 20 to the end of May." Mayhew (1958) also commented that "there is a good deal

Petrochelidon pyrrhonota (con't.)

of variation in the time eggs are laid... both within... and between colonies." Myres (1957) claimed a high degree of synchrony in two colonies studied in British Columbia and one in Wyoming: 90% of the eggs were laid within 10 days at each colony. No comparable data is available for California colonies.

E. Length of incubation period

Incubation period has been reported as 1) "14 days, although 13 days may be more accurate" (Myres, 1957); 2) 16 days (Mayhew, 1958); 3) 15 days (n = 7 nests, Samuel, 1969); 4) "13.5 days (20 nests)... ranging from 11 to 16 days" (Grant and Quay, 1977). The latter two studies present more accurate data, but represent cliff swallow nests in West Virginia. Mayhew's estimate is based on observations in California, but is not backed by accurate data.

F. Length of nestling period

The nestling period has been reported as 23-26 days (Stoner, 1945), "as long as 28 days" (Myres, 1957), 23 days (Mayhew, 1958), 23.6 days (n = 6 nests, Samuel, 1969). Mayhew (1958) commented that the young "returned to the nest for another two to three days before deserting it permanently" and after having demonstrated their ability to fly. Grant and Quay (1977) made similar observations, remarking in addition that this behavior made "an exact determination of... nestling period difficult."

G. Growth rates

Stoner (1945) reported the following observations on cliff swallow nestling growth rate: "weight increase... was most rapid between the 4th and 10th days; the average rate of increase, 2.36 grams a day... For seven birds ten days old, the average weight was 24.3 grams, was attained on the 12th day. This average held until the 17th day, then gradually diminished until ... the birds averaged 21.5 grams" at 23 to 26 days. These data are derived from weights of 83 nestlings in 33 nests and are referenced to a mean adult weight of 23.83 grams (range 21.1 to 25.6 grams, n = 3 adults). Mayhew (1958) observed that "young cliff swallows can survive relatively long periods without food if they remain inactive."

H. Post-breeding behavior

Mayhew (1958) reported that "adults had deserted the nesting site at night by the time the young could fly well." "After the nesting season the adults and offspring of a colony cling together for some time as a group... Later the colony groups join with others of the same and other species of swallows to roost in... traditional places... Such flocks... do not migrate en masse but travel in relatively small groups." (Bent, 1942).

II POPULATION PARAMETERS

A. Clutch size

The following figures have been reported for cliff swallow clutch size: 1) 3.67 (52 eggs in 15 nests in New York, Stoner, 1945); 2) 4.08 (436 eggs in 107 nests in British Columbia, Myres, 1957); 3) 3.31 ± 0.33 (116 eggs in 35 nests in West Virginia, Samuel, 1969); 4) 3.32 ± 0.72 (range 2 to 5 eggs, 60 nests in West Virginia, Grant and Quay, 1977). Mayhew (1958) observed that in California "3 to 4 eggs per clutch is the normal condition."

Samuel (1969) and Grant and Quay (1977) both observed a small number of second broods in cliff swallow colonies in West Virginia. They reported mean second brood clutches of 2.89 eggs (9 nests) and 3.00 eggs (12 nests) respectively. However, Mayhew (1958) concluded that "the production of two broods may be possible in some parts of the United States, but it does not appear to be true in the areas of California under investigation."

B. Fledging success

The only accurate data on fledgling success comes from two studies in West Virginia. For first broods egg loss ranged from 31.9% (Samuel, 1969) to 18.6% (Grant and Quay, 1977) resulting in mean brood sizes of 2.26 and 2.70 young respectively. Final numbers of young fledged were 2.20 (66.4%, Samuel, 1969) and 2.42 (72.9%, Grant and Quay, 1977). The second broods were less successful: 0.67 young fledged per nest (23.1%, Samuel, 1969) and 2.17 young fledged per nest (72.2%, Grant and Quay, 1977). In view of the differences between the second brood successes of the two studies, it seems appropriate to mention Foster's (1968) observations on late season mortality in cliff swallows nesting in Yolo County, California. He found positive evidence that second broods had been started in at least 37% (29/79) of the nests that contained abandoned eggs or young and observed that premature departure of the young from two nests "coincided with emigration of adults", and that "reduced weight gains shortly preceded it". Foster concluded that "although there is a wide variation in the time that broods are initiated, there is a narrow span of time during which broods are reared; thus broods initiated late in the breeding season suffer total mortality."

C. Mortality rates per age class

Mayhew (1958) reported that "of those present one year, approximately one-half return the following year." Of those returning "more females banded as adults return... than males," but this is not true for young "returning to nest for the first time". Mayhew (1958) found that 19% of the young banded returned after one year as did 48% of the banded adults.

Regarding mortality, Bent (1942) concluded that "unseasonable cold weather may prove most disastrous to the cliff swallow population... (The swallows) also suffer privation from the lack at such times of their essential food, flying insects."

Petrochelidon pyrrhonota (con't.)

D. Longevity

Mayhew (1958) reported that few birds lived to be more than 4 or 5 years old, but that he had recaptured a few "as long as five years after banding" indicating a minimal possible life span of six years.

E. Seasonal abundance

The cliff swallow migrates to South America for the winter months and is not present in California at these times. Bent (1942) reported an early spring arrival date of February 26 and a late fall departure date of October 28.

F. Habitat density figures

No information located.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Snakes may provide a source of predation (Sawyer in Bent, 1942; Cameron, 1908). Bent (1942) considered that predaceous birds could not "be considered as serious enemies of the cliff swallow... The appearance of a hawk... never creates any evidence of excitement."

B. Competition

Cliff swallows have been observed occasionally to associate with the barn swallows and cave swallows during foraging (Baker, 1962) and breeding (Baker, 1962; Martin, 1974) without any evidence of conflict or competition. However, the English sparrow can be a source of major nest site competition. Grinnell (1937) found that these sparrows confiscated old and new swallow nests in Berkeley, California, and he concluded that "the swallows, by furnishing... nest sites, brought the sparrows into a territory new for them" and that "partial supplantation... was in evidence." Bent (1942) cites several other observations of the ouster of cliff swallows from their nests by English sparrows in other regions of the United States.

C. Parasitism

The following parasites have been identified in association with cliff swallows: Oeciacus vicarius (Hemiptera) and Ceratophyllus petrochelidoni (Siphonoptera) (Foster and Olkowski, 1968); Argas cooleyi (Acarina) (Howell, 1976) and 18 other species of Acarina (Howell and Chapman, 1976); the blood parasites Hepatozoon, Trypanosoma, Haemoproteus, Leucocytozoon, and unidentified microfilariae (Clark and Swinehart, 1966); 5 species of nematodes, 4 species of trematodes, and 6 species of Acanthocephala (Kayton and Schmidt, 1975).

Petrochelidon pyrrhonota (con't.)

IX STATUS

A. Past population trends

No information located.

B. Present population status

No information located pertaining directly to this question.

C. Population limiting factors

Grinnell and Miller (1944) commented that the "sizes of colonies... are probably controlled by the minimal quantity of one or another factor" mentioned under special habitat requirements.

D. Environmental quality: adverse impacts

No information located.

E. Potential for endangered status

Bent (1942) commented on the changing status of the cliff swallow in New England: "In more recent years the prosperity of the cliff swallows in their newly acquired environment has suffered. Such factors as the invasion of English sparrows, the improvement and painting of barns, and the desire of owners to rid their buildings of the mud nests have affected the local fluctuations in the numbers of these valuable and attractive birds."

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COMMON RAVEN
Corvus corax

I TAXONOMY

A. Type description

Corvus corax - AOU (1957) Linnaeus. Syst. Nat. ed. 10, vol. 1, 1758. (Gray, 1840).

Corvus corax sinuatus - AOU (1957) Wagler; Corvus sinuatus "Lichtenst.", Wagler, Isis von Oken, 22, Heft 7, July 1829, col. 748. Mexico.

- B. Synonomies - Corvus corax; Corvus carnivorus; Corvus corax carnivorus; Corvus catototl; Corvus cacalotl (Grinnell, 1902). Corvus sinuatus; Corvus cacalotl; Corvus nobilis; Corvus corax clarionensis; Corvus corax richardsoni; Corvus corax sinuatus (Hellmayr, 1934). Corvus sinuatus; Corvus corax sinuatus; Corvus corax sinatus; Corvus caralotl; Corvus cacalotl; Corvus catotoll; Corvus major; Corvus nobilis; Corvus splendens; Corvus corax Woodhouse; Corvus carnivorus; Corvus corax var. carnivorus (Ridgway, 1904).

Western raven; Mexican raven; American raven (Dawson, 1923). Western raven; Mexican raven; American raven; Colorado raven (Grinnell, 1915).

II DESCRIPTION

A. External morphology of adults

Pearson (1936), "Length, 26½ inches. Plumage, black. Wing, long and pointed; tail, much shorter than wing; bill, compressed, and higher than broad; feet, stout... Entire plumage, deep, glossy black; the wing-coverts, secondaries, innermost primaries and tail, glossed with violet, primary-coverts and longer and outermost primaries, glossed with bluish or greenish; under parts glossed with blue or greenish-blue; iris, deep brown." Ridgway (1904), "Adult male - length (skins), 618.1-694.3 (654.2); wing, 396.2-459.7 (430.8); tail, 218.4-254 (236.7); exposed culmen, 66-80 (74.4); depth of bill at nostrils, 23.4-27.9 (25.6); tarsus, 64.8-73.7 (69.8); middle toe, 39.4-58.4 (47.2); graduation of tail, 39.4-63.5 (48.5). Adult female - length (skins), 592.7-656.2 (631.6); wing, 386.1-431.8 (408.9); tail, 208.3-251.5 (228.8); exposed culmen, 64.8-76.2 (69.8); depth of bill at nostrils, 22.9-27.4 (24.4); tarsus, 63.5-73.1 (66.8); middle toe, 40.1-47 (41.7); graduation of tail, 34.3-61 (48.5)." Udvardy (1977), "Twenty-one and one half inches to twenty-seven inches (55-69 cm). Large, black bird. Thick bill, shaggy ruff at throat, and wedge-shaped tail." Sexually monomorphic (Verner and Willson, 1969).

B. External morphology of subadult age classes

Tyler (1933), "description of a chick just out of the shell... quite unlike that of a nestling raven a few days older... Entirely a rich orange color, including legs, feet and bill. The bill however, being paler colored toward the tip... entirely naked save for a sparse growth of inch-long bluish filaments along the spine... blind but with large blue bulges at either side of the head. The orange color in a young raven soon fades out, leaving the skin a dirty flesh color, and in a few days the body grows out of all proportion to the head."

Corvus corax (con't.)

C. Distinguishing characteristics

Interspecific - Peterson (1969), "Much larger than common crow. Hawklike, it alternates flapping with soaring. It soars on flat wings; the crow with wings 'bent upward'. When it is perched, not too distant, note the 'goiter' (shaggy throat feathers) and heavier 'Roman nose' effect of bill." Dawson (1923), "In appearance the raven presents several points of difference from the western crow, with which it is popularly confused. The raven is not only larger, but its tail is relatively much longer, and the end of it is fully rounded. The head, too, is fuller, and the bill proportionately stouter, with a more rounded culmen. The feathers of the neck are more loosely arranged resulting in an impressive shagginess... quite in contrast with the unctuous sleekness of the crows. Recognition marks - large size; more than twice the bulk of a crow; long, rounded tail; harsh croaking notes; uniform black coloration." Udvardy (1977), "Alternately flaps and soars like a hawk, flapping less and soaring more than common crow."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Corvus corax - AOU (1957), "Holartic regions from subarctic Alaska, northern Canada, Greenland, Iceland, British Isles, northern Scandinavia, northern Russia, and Siberia south through western United States and Mexico to Nicaragua; in central and eastern North America to Minnesota, Wisconsin, northern Michigan, central Ontario, southern Quebec, and Maine, and south in the Appalachian Mountains to northwestern Georgia; in the Eastern Hemisphere south to northwestern Africa, Lake Chad, northern Kenya Colony, Italian Somaliland, Arabia, Iran, northwestern India, Nepal, Tibet, northwestern China, Mongolia, and Japan. Fossil, in the Pleistocene of Oregon, California, and Nuevo Leon."

Corvus corax sinuatus - AOU (1957), "Resident in the mountains from south central British Columbia (Okanagan Valley), northern Idaho, western and south central Montana, and southwestern South Dakota south to southern California, Arizona, and Mexico (except Baja California and adjacent islands), and through Guatemala, Honduras, and El Salvador to northwestern Nicaragua (San Rafael del Norte); farther east through Wyoming, Colorado, western Oklahoma (Boise City), New Mexico, and western Texas (Pecos, Fort Davis, formerly east to Tom Green County)."

B. California distribution of the species

Bendire (1895), "One is liable to meet with them singly or in pairs, and occasionally in considerable numbers, along the cliffs of the seashore, and the adjacent islands of the Pacific coast, from Washington south to lower California, as well as in the mountains and arid plains of the interior, even in the hottest and most barren wastes of the Colorado desert, as the Death Valley region, and through all the states and territories west of the Rocky Mountains." Dawson (1923), "Resident but wide ranging, hence, of casual occurrence nearly throughout the state; common or abundant locally."

Corvus corax (con't.)

The chief centers of distribution are the semi-arid interior coast ranges of south-central California, the larger islands, and the northwestern humid coastal strip. Rare or wanting in the high Sierras and almost disappearing from the more thickly settled regions." Dawson (1916), "The two 'associational keys' to the current distribution of the raven in California are cattle and sea-bird eggs, and the raven holds no dwelling where neither of these factors is present." Grinnell and Miller (1944), "Phenomenally extensive (geographic range); practically all parts of state, at least formerly, from most and southeastern deserts to rainiest parts of northwest coast belt, and from Nevada line and Colorado River valley westward to outermost of the islands. Present centers of abundance lie in semi-arid hills and mountains around southern (upper) end of San Joaquin Valley, on parts of Mohave desert, on larger of Santa Barbara Islands, and along sea-coast of north coast counties." Small (1974), "The common raven, for example, is found in the deserts of California, in grasslands, on rocky cliffs, along the seacoast, in mountain forests, and above timberline in the alpine fell-fields."

C. California desert distribution

Guillion, Pulich, and Evenden (1959), "Corvus corax. Common raven. Uncommon but widely distributed permanent resident on the desert... The density of ravens in the vicinity of these highways (major-with road kills) is normally much higher than in more remote areas." (Nevada desert abuts California desert). Ridgway (1904), "Range essentially coinciding with limits of arid division of the upper and lower Sonoran or Austral life zones, but invading, locally, portions of the Boreal 'islands', and probably also, sporadically. The western and central portions of the humid division of the Sonoran or Austral life zones." Small (1974), "Ravens are the only large corvids found here (Great Basin). The Mojave desert... Joshua Tree 'woodland'... if cliffs are nearby, ravens... establish their eyries high upon them..."

D. Seasonal variations in distribution

Bendire (1895), "The American raven is usually a resident wherever found, but is likely to wander considerable distances in winter, congregating in localities where food is most easily obtained." Grinnell and Miller (1944), "... least numerous in heavily forested country and on higher, northern Sierra Nevada, but in summer and fall, foraging flocks or individuals are often observed up among the highest peaks."

IV HABITAT

A. Biotopic affinities

Udvardy (1977), "A great variety, including deserts, mountains, canyons, boreal forests, Pacific coast beaches." Small (1974), "The common raven, for example, is found in the deserts of California, in grasslands, on rocky cliffs, along the seacoast, in mountain forests, and above timberline in the alpine fell-fields. Being a predator and a scavenger, it survives well almost anywhere." Grinnell and Miller (1944), "Present

Corvus corax (con't.)

centers of abundance lie in semi-arid hills and mountains... Least numerous in heavily forested country and on lighter, northern Sierra Nevada; but in summer and fall, foraging flocks or individuals are often observed up among the highest peaks." Dixon (1954), "Excluded from this list (characteristic desert scrub assemblage) are species which range widely and, although foraging in desert scrub, are not attracted to this formation per se. Among these are... raven (Corvus corax)..." Bendire (1895), "It seems to make little difference to these birds how desolate the country which they inhabit may be, as long as it furnishes sufficient food to sustain life, and they are not hard to please in such matters."

B. Altitudinal range

Grinnell and Miller (1944), "Nesting has been noted from below sea level, in Death Valley, up to 7500 feet, near Waucoho Pass, Inyo Mountains (both points in Inyo County)." Small (1974), "... has been found nesting from sea level to about 8000 feet. Occasionally ravens are found in the subalpine forest up to 10,000 feet."

C. Home range size

Craighead and Craighead (1969), "Raven: observed area of range in square miles - 4.06, 2.63, 4.17 (3 ranges). Maximum diameter of range in miles - 3.6, 2.8, 3.3 (3 ranges). Raven ranges were usually, but not always, distinct."

D. Territory requirements

Nest sites - Bowles and Decker (1930), "... The territory where outcroppings of rock ranging up to cliffs several hundred feet in height are the favorite nesting sites. Here the nest is occasionally built in a 'pothole' in the cliff, but far more often on a ledge projecting from the rocky wall. (When natural nest sites are lacking, ravens use manmade areas - houses, wind mills, bridges, oil derricks, telephone poles, etc. - that are elevated and protected)." Grinnell and Miller (1944), "... faces of cliffs, bluffs or sea-walls which provide niches for nests safe from quadrupeds. While the nesting instincts require cliff sites as first choice, substitutes are afforded by trees (not commonly), deserted barns and windmills, and oil derricks." Pearson (1936), "Nest: located almost invariably on a ledge of inaccessible cliffs." Udvardy (1977), "... eggs in a large loose nest of sticks, bones, and some soft material, often wool, on a cliff face, tree, or saguaro cactus."

E. Special habitat requirements

Grinnell and Miller (1944), "Habitat - inclusive of two important factors: (1) great areas of open or semi-open terrain for foraging; (2) faces of cliffs, bluffs or sea-walls which provide niches for nests safe from quadrupeds." Marshall (1957), "The raven's distribution must depend on cliffs for nesting sites, rather than on vegetation."

V FOOD

A. Food preferences

Bendire (1895), "Their food consists principally of carrion, dead fish, and frogs, varied with insects of different kinds, including grasshoppers and the large black crickets so abundant at some seasons in the west; they also eat worms, mussels, snails, small rodents, including some young rabbits, as well as refuse from the kitchen and slaughterhouse." Bent (1958), "Ravens are not at all particular about their choice of food; almost anything edible will do, from carrion to freshly killed small mammals and birds or birds' eggs, other small vertebrates, insects, and other small forms of animal life; garbage and various forms of vegetable material are also welcome." Bowles and Decker (1930), "... flesh of animals more or less decayed, small mammals, young birds in or out of their nests, insects in both the mature and larval stages, green vegetation, berries, and the eggs of all birds excepting those of the prairie falcon." Grinnell and Miller (1944), "... while omnivorous, it is more on the carnivorous side, bringing into its objective carrion of all sorts, living vertebrates of suitable sizes, and, in season, large insects, notably grasshoppers." Small (1974), "Creosote bush... produces large numbers of seeds essential to the survival of many desert rodents which form the primary food source for ravens."

B. Foraging areas

Grinnell and Miller (1944), "... great areas of open or semi-open terrain for foraging... The cruising radius of the raven is many miles in extent... The seashore provides a productive foraging beat comparable to desert floor, open upland, or sequestered mountain meadow." Small (1974), "... if cliffs are nearby (Mojave desert, Joshua Tree woodlands), ravens... establish their eyries high upon them and forage over the desert for reptiles, rabbits, rodents, and carrion."

C. Foraging strategies

Udvardy (1977), "It is a general predator and opportunistic feeder,... and often feeds at garbage dumps." Grinnell and Miller (1944), "The bird is somewhat vulture-like in its method of scrutinizing ground for food." Pearson (1936), "In the desert regions they eat dead jack rabbits and such other flesh, either fresh or putrid, as may be discovered." Small (1974), "Cliff-nesting ravens feast on road-killed animals (actually 'patrolling' the desert roads for such carcasses), carrion in general, and snatch eggs and young birds from the nests of smaller species."

D. Feeding phenology

Nelson (1934), "... examination of stomach contents of 18 adult and 66 nestling birds, the latter representing 18 broods... from June 1 to 23... bird remains about 6½%, birds' eggs - 2.03% by bulk, mammals - 37.07% (in nestlings) and 23.88% (in adults) or 34.26% (both), amphibians and

Corvus corax (con't.)

reptiles - 6.59%, fish about 3%, insects about 33%." Grinnell and Miller (1944), "... but in summer and fall, foraging flocks or individuals are often observed up among the highest peaks... and, in season, large insects, notably grasshoppers." Dawson (1923), "... main staples of spring and summer, the eggs and young of birds."

VI REPRODUCTION

A. Territorial behavior

Pearson (1936), "Though not distinctly gregarious, in the breeding season certain favorite localities are often used by from two to half a dozen pairs, and the same birds will resort to these places for many years. The birds are strongly attached to the (nest) site, returning year after year." Lack (1944), "In narrow circumscribed districts where the food would be insufficient for more birds than two, ravens are only found in isolated pairs; when their young are old enough to fly, the parent couple first eject them from the nest, and by and by chase them from the neighborhood. This belief concerning the raven (Corvus corax) is widespread but has not, so far as I know, been checked one way or the other by an ornithologist." Craighead and Craighead (1969), "Where overlap (or ranges) occurred near nest sites, it was the result of territorial aggression and was not with forceful and persistent defense. Nesting territory was defended against other ravens and against hawks, but the entire range was not."

B. Courtship and mating behavior

Bent (1958), "With the springtime urge of love-making, the otherwise sedate and dignified ravens let themselves go and indulge in most interesting and thrilling flight maneuvers and vocal performances. Chasing each other about in rapid flight, they dive, tumble, twist, turn somersaults, roll over side-wise, or mount high in the air and soar in great circles... varieties of their melodious love notes, soft modulations of their well-known croaks, varied with many clucking and gurgling sounds." Skutch (1961), "Nuptial feeding is common in the Corvidae" (by context, implies this does occur in the raven). Verner and Willson (1969), "Male 'occasionally' to 'frequently' gathers nest materials, and/or builds nest, and accompanies gathering and/or building female. Male 'occasionally' to 'frequently' incubates or covers eggs, and may feed female, usually as she incubates. Male feeds nestlings and fledglings - female participates more fully in all these activities, by inference. Corvus corax - normally monogamous."

C. Nesting phenology

Bendire (1895), "Nidification, in the vicinity of Camp Harney (Oregon) at least, usually begins in the first or second week in April, sometimes, however, in the latter part of March, and again not before the middle of May. I obtained a perfectly fresh set of five eggs as late as May 29, 1876, from a locality where none of these birds had been disturbed previously; it was apparently a first laying." Bowles and Decker (1930), "Nest building frequently begins early in March, and full sets are not

Corvus corax (con't.)

infrequent by the latter part of that month, but some seasons show them to be considerably later as a whole. The first week of April is, perhaps, the best average date. Should their first set of eggs be taken another is laid, usually in the same nest." Bent (1958), "Egg dates - California: 96 records, March 2 to May 19, 48 records, April 1 to 16, indicating the height of the season." Craighead and Craighead (1969), reported in 1947 that the first selection of a nesting territory was March 5; the earliest hatching date was May 3; the latest hatching date was May 8; the earliest brood departure date was June 5; the latest brood departure date was June 7; and the average brood departure date was June 6.

D. Length of incubation period

Bancroft (1927), "They lay their two to seven eggs any time from early in March to late in April. The eggs, which are extremely thin-shelled, are laid one a day and require two weeks to incubate." Bendire (1895), "Incubation lasts about three weeks, commencing when the set is completed."

E. Length of nestling period

Craighead and Craighead (1969), "Span of nestling period - 36 days. The average number of days in nest - 36 days." Bendire (1895), "The young are able to leave the nest about a month after they are hatched, and are cared for by both parents for some time thereafter. Only one brood is raised in a season."

F. Post-breeding behavior

Bent (1958), "When the birds are four weeks or a month old their wings are sufficiently developed for flight and they are ready to leave the nest. Attended by their parents for some time after that, they are taught to forage for themselves... After a few weeks, the family party breaks up, and the young... are deserted by their parents."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1958), "The American raven lays from four to seven eggs to a set, but five and six are the commonest numbers, and as many as eight have been recorded. In California... Kern County... we collected five sets of eggs, two of six, two of five, and one of four eggs." Craighead and Craighead (1969) noted the average clutch size as 5.7 eggs and the maximum observed as 7 eggs.

B. Fledgling success

Craighead and Craighead (1969) reported average of 5.7 eggs gave 3.3 young produced per pair. Out of 10 eggs laid, the fledgling success was 59%.

Corvus corax (con't.)

C. Mortality rates per age class

Craighead and Craighead (1969) noted 33-1/3% mortality of nestlings in 1947. A survey showed incomplete clutches and failure to lay eggs as 4 eggs for 19%; egg destruction, infertility, and failure to hatch as 2 eggs for 12%; juvenal mortality (mortality in nest after hatching) as 5 eggs for 33%; and nesting success from eggs laid (fledglings) as 10 eggs for 59%.

D. Habitat density figures

Craighead and Craighead (1969), "(In Wyoming) - 4 square miles/nesting pair" (no information as to why this seemingly low density). "There was an average of 38 hawk, owl, and raven nests per square mile (in Wyoming), a density more than twice that found in southern Michigan. The wilderness nature of the area, the low intensity of interference, direct or indirect by man, the numerous nest sites provided by a timbered butte and a wooded river bottom, as well as a plentiful food supply, were factors contributing to the high population density in the Wyoming study area."

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Bent (1958), "Old ravens' nests are often used by hawks and owls... It is a common occurrence to find ravens and falcons nesting in the same canyon, or on the same cliff, and not far apart... They nest together only where suitable sites are scarce... This community of interest is not due to any affection between the species, as is shown by the spirited encounters that sometimes occur between them." Williamson and Rausch (1956), describes aggressive and non-aggressive encounters between the two species - "Opportunities for contact between the two species would seem numerous and it is reasonable to assume that in some instances competitive situations might arise in relation to food. However, with one exception, the incidents witnessed were not of an aggressive nature."

B. Parasitism

Pemberton (1925), "On examination (of nest of flushed C. c. sinuatus) I found it to contain three eggs of the raven and one of the roadrunner (Geococcyx californianus). These were collected and now constitute set no. 1971 of my collection." (Tests showed that roadrunner egg was laid after raven eggs.)

IX STATUS

A. Past population trends

Grinnell and Miller (1944), "Status - resident, locally common, more widely so formerly than now; indeed, now scarce or absent in all settled parts of the state." Grinnell (1915), "Status - common resident locally

Corvus corax (con't.)

throughout the state, on the most arid deserts and in the northern humid coast belt as well as in the interlying area. Now scarce or absent in the most thickly settled counties. Notably numerous on and around the islands of the Santa Barbara group."

B. Population limiting factors

Nelson (1934), "No comprehensive study has ever been made to determine the economic status of the American raven (Corvus corax sinuatus), although there is, apparently, a general belief among sportsmen that any beneficial habits possessed by the raven are nullified by its depredations upon nestling birds and birds' eggs."

C. Potential for endangered status

Arbib (1976) reported the raven is not found on the Blue List. Ergo, American Birds, etc. does not consider it to belong to the class of endangered species. Remsen (1977) noted the raven is not considered under any category as a species of special concern.

Corvus corax (con't.)

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Corvus corax (con't.)

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VERDIN
Auriparus flaviceps

I TAXONOMY

A. Type description

Auriparus flaviceps acaciarum, California verdin: Auriparus flaviceps acaciarum Grinnell, 1931, Condor 33:168- Palm Springs, Riverside County, California.

Synonomies- Aegithalus flaviceps, Paroides flaviceps, Auriparus flaviceps flaviceps, A. f. ornatus, A. f. lamprocephalus; yellow-headed tit, yellow-headed titmouse, yellow-headed bust-titmouse, San Lucas verdin, Arizona verdin, Grinnell verdin (Grinnell and Miller, 1944).

B. Current systematic treatments

Order Passeriformes, family Remizidae, genus Auriparus Baird, 1864, Rev. Amer. Birds 1:85 (Peters, 1967).

There are currently three recognized subspecies of Auriparus flaviceps: flaviceps, acaciarum, ornatus (Peters, 1967).

C. Recent taxonomic revisions

The supplement to the AOU Checklist of North American birds (1973, Auk 90:411-419) does not indicate that verdin systematics has been revised since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The verdin is a "small (5-6 gram) member of the titmouse family, with yellow head and gray body, the belly paler than the back and almost white; bend of wing with small chestnut patch" (Miller and Stebbins, 1964). Yellow parts of males are more intense than on females (Taylor, 1971).

B. External morphology of subadult age classes

Birds in juvenile plumage have no yellow on the head and no chestnut on lesser wing coverts; the entire upper parts are uniform grayish brown, underparts are brownish gray; wings and tail as in the adult (Bent, 1946; Taylor, 1971).

C. Distinguishing characteristics

Interspecific- Immature verdins resemble common bushtits (Psaltiriparus minimus) and beardless flycatchers (Camptostoma imberbe), but are shorter tailed than the former and are purer gray and lack the wing bars of the latter (Peterson, 1961). The adults are paler below than are common bushtits (Bent, 1946).

Auriparus flaviceps (con't.)

Intraspecific- Grinnell (1931) describes acaciarum as "similar to... flaviceps... but with yellow of foreparts... less intense and extensive; body color... browner...; tail and wing... a little longer. Similar to "ornatus... but paler and a little smaller."

D. Special morphological features

no information located

III DISTRIBUTION

A. Overall distribution of the species

Verdins (subspecies acaciarum) occur in the "deserts of the Colorado River drainage, north to Inyo County, California, the Sierra Nevada, and southwestern Utah, south to about lat. 30° N in Baja California and to northwestern Sonora" (Peters, 1967; see also Bent, 1946). A. f. flaviceps occurs in Baja California and Sonora north to latitude 30° N (Peters, 1967). A. f. ornatus occurs in southern New Mexico, southeastern Arizona and Texas south to Durango and Tamaulipas, Mexico.

B. California distribution of the species

Auriparus flaviceps acaciarum occurs in the Colorado and Mohave deserts (Grinnell and Miller, 1944). On the Colorado Desert, it occurs from Fort Yuma west to eastern San Diego City and northwest to Riverside County (Palm Springs). On the Mohave Desert, it has been observed north to Death Valley (Inyo County) and west along the Mohave River to Victorville (San Bernardino County; Grinnell and Miller, 1944; Wauer, 1962).

C. California desert distribution

See III B. above. In addition, Smyth and Coulombe (1971) reported verdins as being permanent residents of the San Jacinto Mountains, Riverside County.

D. Seasonal variations in distribution

This species is a year-round resident (Grinnell and Miller, 1944; Raitt and Pimm, 1976).

IV HABITAT

A. Biotopic affinities

The verdin is generally found in the Lower Sonoran life zone (Grinnell and Miller, 1944; Wauer, 1964). It will follow this vegetation into the upper canyon regions to the edge of the piñon belt.

In mountains, the vegetation is composed of 1) Kochia americana, Chrysothamnus nauseosus (rabbitbush), Senecio elonglasii in the Panamint Mountains (Wauer, 1964) and/or 2) catclaw (Acacia), smoke tree (Dalea),

Auriparus flaviceps (con't.)

desert willow (Saliv), Joshua tree in Joshua Tree National Monument (Miller and Stebbins, 1964). Lower down, verdins are found in mesquites (Prosopis) and will forage into the creosote bushes (Larrea) although they will not rest there (Miller and Stebbins, 1964). They are often found along water courses where the vegetation is thick (Grinnell and Miller, 1944; see also Bent, 1946).

In New Mexico, Raitt and Pimm (1976) found verdins in two habitats: 1) desert scrub, dominated by Larrea, Prosopis, Flourensia (tarbush), and 2) yucca-grasslands dominated by Yucca, Bouteloua (blackgrama), Sporobolus (mesa dropseed), and Hilaria (tobosa grass) (see also Raitt and Maze, 1968). The former habitat was more heavily utilized. In Arizona, Taylor (1971) observed verdins in the Larrea-Franseria (bur sage)-Cercidium (palo verde) association which also contained Olneya (ironwood), Prosopis, Lycium (wolfberry), Celtis (hackberry), Lepidium (peppergrass) (see also Emlen, 1974).

B. Altitudinal range

Grinnell and Miller (1944) reported that A. f. acaciarum could be found from 240 feet in Death Valley to 3000 feet in the Santa Rosa Mountains. Miller and Stebbins (1964) found verdins as high as 4200 feet in Joshua Tree National Monument. Wauer (1964) observed verdins breeding from 3000 to 4000 feet in the Panamint Mountains.

C. Home range size

Emlen (1974) described the territory as large with a foraging area included. Taylor (1971), also working in Arizona, observed a mean breeding home range of 23.7 acres (range, 8.9 to 31.2 acres; n = 6 territories). A third Arizona study, by Hensley (1954), reported much smaller territories: 1.3 acres in 2 washes (n = 6, 4 territories) and 5.7 acres in the open desert (n = 4 territories).

D. Territory requirements

Roost site- Verdins have been observed roosting in larger tree forks (Austin, 1976). They also roost in nests year round (see below).

Courtship and mating sites- no specific information located; by implication, in foliage normally used for foraging and nesting (Taylor, 1971).

Nest site- "Nests are typically placed in thorny shrubs and are constructed on the outside of thorny sticks of the same or other available shrubs" (Miller and Stebbins, 1964). The nests are usually located at or near the end of a low limb and are not hidden (Bent, 1946). The entrance faces outward from the center of the tree, the orientation varying with the season to maximize protection from the midday sun while permitting early morning warming exposure (Austin, 1976).

Auriparus flaviceps (con't.)

Nests have been found in mesquite, hackberrys, catclaw, palo verde, cholla, condalia, ironwood, Acacia, sumac, desert willow. Taylor (1971) reported that 26/28 breeding nests and 57/59 roosting nests in Arizona were located in palo verdes; breeding nests were built at a mean height of 6.2 feet (3.3 to 13.5 feet), and roosting nests occurred at a mean height of 4.9 feet (2.8 to 8.7 feet) (see also Hensley, 1954). This corresponds to the lower half of the tree or the upper half of a shrub (Bent, 1946). Raitt and Maze (1968) commented that the distribution of the verdin was limited by the presence of shrubs over 4 feet for nesting. Roost nests were always found at least 100 feet away from breeding nests (Taylor, 1971).

E. Special habitat requirements

"The only essential condition... appeared to be stiff-twigged thorny bushes or trees" (Grinnell, 1914) at least 4 feet in height (Raitt and Maze, 1968) for nesting.

F. Seasonal change in habitat requirements

Verdins are year-round residents

G. Physiological ecology

Verdins use their small domed nests all year round to avoid environmental extremes since the nests buffer temperature and humidity (Goldstein, 1974; Austin, 1976).

The lower critical ambient temperature for the verdin is 20° C and its standard metabolic rate under thermoneutral conditions is 4.34 ml O₂/g·hr (Goldstein, 1974). Birds exposed to 40° C died within a few hours, indicating the importance of the domed nests as a refuge from heat (Goldstein, 1974).

V FOOD

A. Preferences

Verdins consume insects (adult, larvae, eggs) and wild fruits and berries (Bent, 1946). Taylor (1971) listed the following food sources: vegetable (wolfberry, date palm fruit, pulp of pods from ironwood, palo verde and mesquite trees); animal (adult Homoptera, Coleoptera and spiders, and Lepidopteran larvae). The immatures diet differs from the adult by having a higher proportion of Lepidopteran larvae and spiders (Taylor, 1971).

B. Foraging areas

Verdins examine the foliage and blossoms of palo verde, mesquite, ironwood, wolfberry, creosote bush, sahuaro (Taylor, 1971). They also examine the twigs and bark of all woody plants present. These two areas yield insects. In addition, they seek fruits on palo verde, ironwood and mesquite trees (Taylor, 1971).

C. Foraging strategies

Verdins examine foliage, blossoms, bark and twigs for insects (Taylor, 1971). Once an insect is located, they will hold it with their feet, as is true also for twigs and berries. Verdins are opportunistic feeders, and one item will frequently predominate in their diet (Taylor, 1971).

Verdins usually do not forage with members of their own species, but are commonly found with other species (eg. black-tailed gnatcatcher, sparrows, warblers; Taylor, 1971). They flit about actively in bushes and trees, clinging to branches, searching every crevice and the undersides of foliage (Bent, 1946).

"Foraging is the principal activity at temperatures below 35° C, taking more than 80% of the time" (Austin, 1976). Verdins will forage in shade if possible to keep the mean exposure temperature below 38° C. Above 38-40° C, they use shaded microhabitats almost exclusively and may cease foraging periodically (Austin, 1976).

D. Feeding phenology

Insects are gleaned from foliage, blossoms, bark and twigs year round. In fall and winter, verdins feed on the seed pods of palo verde, mesquite, and ironwood, taking the pulp, not the seeds or insects (Taylor, 1971).

E. Energy requirements

The standard metabolic rate is 4.34 ml O₂/g·hr and the lower critical temperature is 20° C (Goldstein, 1974).

VI REPRODUCTION

A. Age of first breeding

no information located

B. Territorial behavior

Male aggression increases in the spring as indicated by the increasing frequency of "tseet" calling (Taylor, 1971). Once the birds have paired, the male and female travel around together. The male doesn't appear to defend an area as much as the female, although he will defend the area around the breeding nest (Taylor, 1971). The female is more aggressive than the male in defending the nest, especially against thrashers and cactus wrens (Taylor, 1971).

C. Courtship and mating behavior

The "tseet" call is used by unmated males to attract females, and it serves as a contact call once the pair bond is formed (Taylor, 1971). There are no clear cut courtship displays. The female will beg for food, but the male

Auriparus flaviceps (con't.)

is rarely seen to respond, and he never responds with food (Taylor, 1971). Copulatory chases have been observed (Taylor, 1971). Both sexes participate in building breeding nests, although roost nests are always built by individuals (Taylor, 1971). Both sexes feed the young (Taylor, 1971).

D. Nesting phenology

In Arizona, verdins can begin pairing in late January, and egg laying lasts from early March to early June (Taylor, 1971). In New Mexico, breeding occurs primarily in April and May (Raitt and Pimm, 1976). The only information located for California is egg date as reported by Bent (1946): 56 records, March 6 to June 8; 28 records, March 28 to April 11. These dates correspond well to those of other areas in the southwestern U. S.

E. Length of incubation period

Incubation period has been reported as 10 days (Bent, 1946) and 14 to 17 days (n = 5 nests; Taylor, 1971).

F. Length of nestling period

Nestling period has been reported as three weeks (Bent, 1946) and 17 to 19 days (Taylor, 1971).

G. Growth rates

no information located on growth rate- Both sexes feed the young (Taylor, 1971) and fledglings continue to be fed for some time after they leave the nest and are able to fly (Bent, 1946).

H. Post-breeding behavior

Parental care continues for about 18 days after fledging, with the male providing most of the attention (Taylor, 1971). The family roosts together at night until the young gradually disperse. As the young disperse, increasing numbers of immature birds arrive in the breeding area (Taylor, 1971). Taylor commented that by the end of the summer the banded adults have disappeared from his Arizona study site, having been replaced by the incoming immatures which became the breeding population of the following year.

Bent (1946) observed that verdins are shy and inobtrusive during the breeding season, only scolding if the nest is approached. They become more obvious and social in winter, roaming the desert in pairs or small family groups which use a "silp" note to maintain contact. More than one verdin may even use the same roost nest in winter (Bent, 1946).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1946) reported a clutch size of 3 to 6 eggs, usually 4 eggs although clutches of 5 were not rare. Taylor (1971) found a mean clutch size of 3.82

Auriparus flaviceps (con't.)

eggs (n = 28 nests) with common clutch size decreasing from 4 and 5 eggs in March and April to 3 and 4 eggs in May and June.

Both Bent (1946) and Taylor (1971) indicated that two clutches may be laid, although the incidence may be low. Taylor (1971) found only 5 second clutches.

B. Nesting success

Data are available from 2 Arizona studies. Hensley (1954) reported that 96% of the eggs in 15 nests hatched and 82% of the eggs subsequently fledged. Taylor (1971) found a hatching success of 54.5% and a fledging success of 32.4% (based on total number of eggs laid in 20 nests).

C. Mortality rates per age class

no information located

D. Longevity

no information located- Taylor's (1971) observation that all banded breeding adults disappeared at the end of the summer to be replaced by immatures who formed the breeding population of the following year indicates that post-juvenile longevity may be only a year.

E. Seasonal abundance

Verdins are year round residents (Grinnell and Miller, 1944; Raitt and Pimm, 1976), so there is little population fluctuation due to migration. However Raitt and Pimm (1976) indicate that some migrants may come into the yucca-grassland areas of New Mexico in autumn and again in February since high numbers of verdins have been observed at these times.

F. Habitat density figures

Habitat density can vary significantly from area to area and from time to time. Emlen (1974) found densities of 2.5 birds/100 acres in Arizona desert and 14 birds/100 acres in urban Arizona areas. Hensley (1954) studied densities in different desert areas with the following results: desert wash (2 sites, 11 and 13 breeding pairs per 100 acres), open desert (Colorado- 14 and 8 pairs/100 acres in 2 different years; Arizona- 5 and 9 pairs/100 acres in 2 different sites). This study indicates that the increased floral diversity and abundance in desert washes provide more suitable habitat for verdins than does the open desert. Raitt and Maze (1968) found a density value of 2.65 pairs/100 acres for a desert area in New Mexico.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

No information was located that reported observed predation or verified evidence of predation. However, Taylor (1971) indicated that the coachwhip

Auriparus flaviceps (con't.)

snake was a suspected nest predator and that verdins uttered a "gee-gee-gee-gee" warning call in the presence of red-tailed hawks, Harris' hawks, sparrow hawks, turkey vultures, and roadrunners.

B. Competition

There is competition for nests between the verdin and the house sparrow (Bent, 1946; Taylor, 1971) and between the verdin and the cactus wren (Taylor, 1971). Both competitors build and use similar nests in similar sites and will take over verdin nests and harass the verdins if they attempt to renest in the same area.

C. Parasitism

Dwarf cowbird eggs have been found in several verdin nests, although the entrances had been enlarged and the nests might have been abandoned (Bent, 1946).

IX STATUS

A. Past population trends

no information located

B. Present population status

In the 1974 Audubon Christmas count, verdins were found at only 5 of the 22 sampling areas in or near the southern California desert areas. The sites (and numbers observed) are as follows: Joshua Tree National Park (2), Salton Sea North (87), Salton Sea South (254), Parker-Colorado River (153), Yuma (139).

C. Population limiting factors

no information located

D. Environmental quality: adverse impacts

no information located

E. Potential for endangered status

no information located

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BUSHTIT
Psaltriparus minimus

I TAXONOMY

A. Type description of desert subspecies

Psaltriparus minimus minimus, common bushtit: Parus minimus Townsend, 1837, Journ. Acad. Nat. Sci. Phila. 7:190- forests of Columbia River (Peters, 1967).

Synonomies- Parus minimus, Psaltria minima, Acredula minima, Psaltriparus minimus californicus, Aegithalos minimus californicus; Chestnut-crowned titmouse, least titmouse, least chickadee, least tit, least bush titmouse, California bushtit, Sacramento bushtit, Pacific coast bushtit, coast bushtit (Grinnell and Miller, 1944).

Psaltriparus minimus plumbeus, lead-colored bushtit: Psaltria plumbea Baird, 1854, Proc. Nat. Acad. Sci. Phila. 7:118- Little Colorado River, Arizona (Peters, 1967).

Synonomies- Psaltria plumbea; plumbeous bushtit (Grinnell and Miller, 1944).

Psaltriparus minimus sociabilis, common bushtit: Psaltriparus minimus sociabilis Miller, 1946, Condor 48:78- Pinyon wells, 4000 feet, Little San Bernardino Mountains, Riverside County, California.

Synonomies-

B. Current systematic treatments

Order Passeriformes, family Aegithalidae, genus Psaltriparus Bonaparte, 1850, Compt. Rendu. Acad. Sci. (Paris) 31:478 (Peters, 1967).

There are currently seven recognized subspecies in the United States: minimus, californicus, sociabilis, melanurus, grindae, plumbeus, providentialis (Peters, 1967).

Raitt (1967) commented on the recognition of two species of bushtits by the fifth edition of the AOU Checklist (P. melanotis or black-eared groups and P. minimus or plain-eared groups): "In vocalizations, general behavior, ecology, and other color characters, black-eared populations fail to exhibit differences from plain-eared (plumbeus) ones sufficient to differentiate them at the species level... The steep slope and short lengths of clines, especially in black; the parallelism in these clines; and the variability of intermediate populations point to previous geographic isolation of black-eared populations followed by secondary contact and retrogressive hybridization... All bushtits should be considered as a single species, Psaltriparus minimus (Townsend)."

C. Recent taxonomic revisions

The supplement to the AOU Checklist of North American Birds (1973, Auk 90: 411-419) does not indicate that bushtit systematics has been revised since 1957.

II DESCRIPTION

A. External morphology of adults

Peterson (1961) describes bushtits as very small plain birds with gray back, pale underparts, brownish cheeks, stubby bill and longish tails. The eyes of the female are light; those of the male are dark (Peterson, 1961; Ervin, 1975).

Swarth (1914) commented on color variation in bushtits as follows: "There is probably hardly another species of bird as plainly colored as the California bushtit and with as few distinctive markings, which shows such a wide range of variation in appearance in individuals taken under different circumstances... They differ: (1) seasonally, through fading and abrasion; (2) at different ages, adult and juvenile plumages being readily distinguishable; (3) geographically (the various species and subspecies, or geographical races)."

B. External morphology of subadult age classes

Ervin (1975) observed that all nestlings possessed dark brown irides. This coloration was retained in male bushtits, but changed from dark brown to gray by 1½ months and to yellow by adulthood in females.

Juvenile plumage of P. m. minimus looks much like the faded and worn plumage of the spring and summer adults; it is rather mottled and uneven (Bent, 1946).

Juvenile plumage of P. m. plumbeus is very similar to adult plumage, however a large proportion of the young have more or less extensive black markings on the head (Swarth, 1914).

C. Distinguishing characteristics

Interspecific- P. minimus differs from P. melanotis by the absence of black coloration in the cheeks of the male; the females are virtually indistinguishable (Peterson, 1961; see also Raitt, 1967).

Intraspecific- P. m. minimus is darker colored than californicus and the underparts are heavily suffused with dusky, the flanks being more vinaceous (Swarth, 1914).

P. m. plumbeus differs from the other subspecies by having a gray crown (Peterson, 1961). "It is intermediate in its characters between the California bushtit... and Lloyd's..., being a plain colored bird without the distinctive head markings of either of the other two forms" (Bent, 1946. comparison is with P. m. californicus and P. melanotis respectively).

P. m. sociabilis is similar to minimus in that the dorsal head and neck is darker than the back, but the pileum is sooty and less brown,

Psaltriparus minimus (con't.)

near deep mouse gray; back is less brownish, near mouse gray; underparts paler (Miller, 1946). The grayish hue and pallid sides are more like providentialis, and Miller and Stebbins (1964) hypothesized that sociabilis was derived from a mixed minimus-providentialis heritage.

D. Special morphological features

no information located

III DISTRIBUTION

A. Overall distribution of the species

Psaltriparus minimus minimus: "West coast and coast ranges of North America from extreme southwestern British Columbia south to Mexican border. Intergrading with californicus in interior Oregon and northern and central California, and with melanurus at Mexican border" (Peters, 1967).

Psaltriparus minimus plumbeus: "Great Basin and Rocky Mountains... north to southeastern Oregon, southern Idaho, and southwestern Wyoming; west to northeastern California, western Nevada, northern Arizona, and northern Sonora; east to Colorado, northern Oklahoma, and western Texas...; and south to central Sonora and Trans Pecos, Texas. Intergrades with californicus in northeastern California and with providentialis in central California..., southern Nevada, and southwestern Utah" (Peters, 1967).

Psaltriparus minimus sociabilis: "Little San Bernardino Mountains and adjoining mountains to north, and Eagle Mountain, Riverside and San Bernardino Counties, California" (Peters, 1967).

Psaltriparus minimus providentialis: White, Inyo, Providence Mountains in California; Charleston, Grapevine Mountains in Nevada; mountains of southwestern Utah (Peters, 1967).

Psaltriparus minimus californicus: central and northcentral California and southern Oregon (Peters, 1967).

Psaltriparus minimus grindae: Cape district of Baja California (Peters, 1967).

Psaltriparus minimus melanurus: Baja California south to latitude 30° N (Peters, 1967).

B. California distribution of the species

Psaltriparus minimus minimus: Coastal belt of the entire state as a resident species (Grinnell and Miller, 1944).

Psaltriparus minimus plumbeus: resident of Lassen and Modoc Counties and possibly Alpine County (Grinnell and Miller, 1944).

Psaltriparus minimus (con't.)

Psaltriparus minimus providentialis: resident in the mountains of Mono, Inyo, San Bernardino Counties (Grinnell and Miller, 1944).

Psaltriparus minimus sociabilis: piñon-juniper-scrub oak association of Little San Bernardino Mountains and adjoining mountains to northward, disconnectedly east to Eagle Mountain, all in Riverside and San Bernardino Counties (Miller, 1946).

C. California desert distribution

Psaltriparus minimus providentialis: mountains of Mono, Inyo, San Bernardino Counties (Grinnell and Miller, 1944; Wauer, 1962, 1964).

Psaltriparus minimus sociabilis: endemic to Joshua Tree National Monument, especially Little San Bernardino Mountains and Eagle Mountain (Miller and Stebbins, 1964).

D. Seasonal variation in distribution

The bushtits of southern California are primarily resident (Grinnell and Miller, 1944; Miller and Stebbins, 1964; Peters, 1967).

IV HABITAT

A. Biotopic affinities

The common bushtit occurs primarily in the Upper Sonoran life zone (Grinnell and Miller, 1944) in association with the piñon-juniper woodland vegetation (Miller and Stebbins, 1964; Wauer, 1964; Raitt, 1967; Laudenslayer and Balda, 1976). In addition to piñon pine and various species of juniper the following plants also occur in this habitat: mountain mahogeny, willow, oak scrub. The bushtit may also range down canyons to dwell on canyon bottoms at the base of the mountains, overlapping the ecological range of the verdin, the Lower Sonoran (Linsdale, 1938; Grinnell and Miller, 1944; Miller and Stebbins, 1964). Here it is found in association with sage brush, mesquite, catclaw, scrub oak, deer brush, Artemisia, Brickellia, Tetradymia, Chaemaebatearia, Vitis, Corvania (Grinnell and Miller, 1944; Miller and Stebbins, 1964; Wauer, 1964). There is little difference in the habitat distribution of the subspecies.

B. Altitudinal range

The ranges of the four subspecies found in southern California are as follows: minimus (0 to 6000 feet); plumbeus (4500-5600 feet); providentialis (4500-8500 feet; Grinnell and Miller, 1944); sociabilis (3600 to 4750 feet; Miller, 1946). An unspecified subspecies was recorded breeding at 5500-6500 feet in the Panamint Mountains (Wauer, 1964). In Arizona Bent (1946) reported that the species is most common between 4000 and 7000 feet.

Psaltiriparus minimus (con't.)

C. Home range size

Addicott (1938) observed territories that varied in diameter from 50 yards to 300-400 yards, "depending on the nature of the area and on the abundance of nesting materials and food". A more recent study in the same oak woodland areas of Santa Clara County, Hertz et al (1976) reported a mean territory size of 0.4 ± 0.08 ha ($n = 12$ nests) and indicated that territory size did not vary through the nesting cycle. Laudenslayer and Balda (1976), studying in Arizona, observed a breeding density of 19.8 pairs per 100 ha with a mean territory size of 1.4 ha.

D. Territory requirements

Roost site- Baldwin (1933) found that bushtits roosted in small groups of 3 to 5 birds on the limbs of trees as for example, live oak.

Courtship and mating- No specific information. Baldwin (1933) implied that courtship and mating occurred in the same vegetation used for foraging and nesting (see also Addicott, 1938).

Nest sites- The nests of the bushtit are found primarily in the live oak association in Santa Clara County. The nests are built in oaks, toyon bushes, madrona trees among others, usually not over 15 feet high (Baldwin, 1933; Bent, 1946). They are also found in willows and cottonwoods along streams (Baldwin, 1933).

"The nest built by the... bushtit is an intricate pendant structure, hung in a concealing clump of leaves of an overhanging branch, and it is built of materials which blend with its surroundings, such as mosses, lichens, oak leaves, and spider webs" (Addicott, 1938).

E. Special habitat requirements

Bushtits are found "in the mouths of canyons, in foothills, on lower mountain slopes especially where large trees are scattered, leaving large, open sunny areas overgrown with... a variety of... shrubbery" (Bent, 1946).

F. Seasonal changes in habitat requirements

The bushtits are year round residents, but may shift up into chaparral from lower habitats in the winter (Cody, 1974).

G. Physiological ecology

Miller and Stebbins (1964) reported that they have never seen bushtits come to the springs to drink.

V FOOD

A. Food preferences

Bushtits consume 81% animal matter annually and only 19% vegetable matter (Beal, 1907). Among animals, Beal (1907) found the following representation

Psaltiriparus minimus (con't.)

of prey items: Hemiptera (44% of total food volume; scales account for 19%), Coleoptera (10%), Lepidoptera (16%), Hymenoptera (1.5%), miscellaneous (especially spiders, 8%).

Nestling diet was similar to that of adults, except for a high proportion of codling moth larvae (Beal, 1907).

B. Foraging areas

Bushtits forage in the trees and shrubs of the same habitats in which they roost and nest (Addicott, 1938; Miller and Stebbins, 1964; Hertz, 1976; Wagner, 1977). They "frequent areas where trees and shrubs are abundant and avoid sparsely covered territories" (Baldwin, 1933).

C. Foraging strategies

Bushtits forage primarily in the foliage layers of trees such as piñon, juniper, oak, mountain mahogany, and willow (Miller and Stebbins, 1964). In Arizona, 45% of the foraging time is spent in pine trees, 55% in junipers (Laudenslayer and Balda, 1976). In Santa Clara County, 80% of the foraging time is spent in trees such as black, blue and live oaks, and 20% of the foraging time is spent in shrubs (toyon, poison oak, buck-eye, honeysuckle, coffee berry), 70% in honeysuckle alone (Hertz et al, 1976).

Bushtits tend to use the upper and outer foliage layers more extensively than the inner core and stem substrates: 95% vs 5% in Arizona, 90% vs 10% in Santa Clara County (Laudenslayer and Balda, 1976; Hertz et al, 1976, respectively). Foraging height is commonly between 0 and 6 m from the ground (Laudenslayer and Balda, 1976). Hertz et al (1976) found that the bushtits used black oak for stem foraging and blue and live oaks for foliage gleaning. While gleaning in the foliage, bushtits spend a large proportion of their time hanging upside down (56% in Arizona; Laudenslayer and Balda, 1976).

Bushtits forage in loosely organized flocks (Baldwin, 1933). The flocks usually contain 15 to 25 birds and may contain individuals of other species (Wagner, 1977). The foraging routes are circuitous and extremely variable, and the "length of time spent in a tree... is dependent on the available food, as well as the size of the flock" (Baldwin, 1933). Hertz et al (1976) found that the average amount of time spent at each foraging station was 57.9 ± 37.7 sec.

D. Feeding phenology

Beal (1907) found the following peak consumptions among the major food types: vegetable matter (47% total food consumption in March), Lepidoptera (69% in May), scales (Hemiptera, 33% in June, 46% in July), Coleoptera (27% in September).

E. Energy requirements

no information located

VI REPRODUCTION

A. Age of first breeding

no information located

B. Territorial behavior

Territoriality is poorly developed. "When a stray bird enters the territory of a nesting pair, the latter may respond by chasing the intruder for a few seconds, giving... excited alarm notes and trills, until the intruder leaves. However, in many instances a stray bird is ignored [or] allowed to forage with the mated pair" (Addicott, 1938).

C. Courtship and mating behavior

"Courtship consists chiefly of excited location notes, trills, and sexual posturing" (Addicott, 1938). Both sexes build the nest, incubate the eggs, and feed the young.

If the birds are disturbed during nest building, one or both birds may desert and seek new mates (Baldwin, 1933). "The constant presence of unmated birds in small flocks during the nesting season may be of significance here" (Baldwin, 1933).

D. Nesting phenology

In Santa Clara County, winter flocks start breaking up in January and February: the flocks dissolve into small groups and pairs start to wander off (Baldwin, 1933). March and April are the height of the breeding season, which ends in July (Addicott, 1938; Miller and Stebbins, 1964). If two broods are raised, the first is produced in February and March, and the second is fledged in June (Baldwin, 1933).

Bent (1946) listed the following egg dates for California: 124 records, February 26 to July 15; 62 records, April 1 to May 7.

E. Length of incubation period

The incubation period is 12 days (Addicott, 1938; Bent, 1946).

F. Length of nestling period

The nestling period lasts 14 days (n = 1 nest, Addicott, 1938).

G. Growth rates

Both parents feed the young. Bushtit nestling weight increases from 0.65 g on day 1 to 2.98 g on day 7, compared to an adult weight of 5-6 g (Addicott, 1938 on nestlings; Miller and Stebbins, 1964 on adults). The weight increase represents 0.39 g/day. The young are fed 8 to 14 days after fledging (Addicott, 1938).

Psaltiriparus minimus (con't.)

H. Post-breeding behavior

Flock size increases after the breeding season from 6 to 15 birds up to at least 15 or 20 birds, and flocks of 150 to 200 bushtits can be observed from October through January when flock size decreases to 25 or 30 birds (Baldwin, 1933). Average winter flock size in Santa Clara County was reported to be 50 to 100 birds (Baldwin, 1933). In Joshua Tree National Monument flock size averaged 15.1 birds (range, 10-25 birds; n = 14 flocks; Miller and Stebbins, 1964). In Santa Barbara, 4 flocks varied in size from 10 to 24 birds (Ervin, 1977). Baldwin (1933 or see Addicott, 1938) reported that bushtit flocks were smallest in the early morning and late afternoon. Small flocks merged in mid-day to form large aggregations and reformed in late afternoon for roosting (Baldwin, 1933).

The bushtits utter location notes continually while foraging to maintain flock integrity. The volume and amount of trilling increases as the birds spread out (Baldwin, 1933). Stragglers hurry to catch up with the main body of the flock, calling loudly until they rejoin the flock. Ervin (1977) studied flock composition and integrity over four years in Santa Barbara. He observed only 2 switches in flock membership even though flocks frequently mingled. In fact, male bushtits drove off strangers which attempted to join the flock, although the flocks did not systematically or routinely defend territories. Ervin found that the same birds were present in the same flocks in consecutive years: 94/101 birds returned to the same flock after successive breeding seasons. All members of flocks studied in detail (n = 4 flocks) were related to some degree.

VII POPULATION PARAMETERS

A. Clutch size

Clutch size has been reported as follows by various investigators:

- 1) Baldwin (1933)- mean size is 6 eggs (range, 3-8 eggs; n = 3 nests); "average size of a set of eggs is five to seven".
- 2) Bent (1946)- P. m. minimus lays 5 to 7 eggs and as many as 12 to 15 eggs have been found, probably the result of 2 females laying in one nest; P. m. plumbeus lays 5 to 6 eggs and often has 2 clutches.
- 3) Miller and Stebbins (1964)- P. m. sociabilis lays clutches of 5 to 6 eggs.

B. Nesting success

Miller and Stebbins (1964) reported that fall young to adult ratios varied from 3:6 to 3:19 over 2 successive years in Joshua Tree National Monument.

C. Mortality rates per age class

no information located

Psalttriparus minimus (con't.)

D. Longevity

no information located

E. Seasonal abundance

The bushtits are year round residents

F. Habitat density figures

Cody (1974) reported a density figure of 0.20 bushtit pairs per acre. He also found a change in the proportion of a habitat utilized between the breeding season and winter. Utilization of oak woodland decreased from 92% in the breeding season to 26% in the winter. Utilization of north slope chaparral decreased from 95% to 85% and south slope chaparral utilization increased from 57% to 59%.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Baldwin (1933) observed bushtits uttering the confusion chorus (quavering location notes after sharp alarm notes) at the appearance of sharp-shinned, Cooper, sparrow, and pigeon hawks and owls. There was no such reaction to buteos. Jays are also scolded as they approach the nest and may open nests to prey on eggs and nestlings. Gophers have been observed entering bushtit nests to eat eggs and young (Baldwin, 1933; Ervin and Rose, 1973).

B. Competition

Hertz et al (1976) found that bushtits and the titmouse Parus inornatus overlapped spatially by 56% of the total combined utilization area and that bushtits and chickadees (Parus rufescens) overlapped by 40%. However competition did not seem to be a serious problem for the bushtit since the birds differed in foraging strategies: the bushtit is a foliage gleaner, titmice are bark foragers, and chickadees have a composite strategy. In addition, bushtits spend more time on shrubs (20% vs 2.5% for titmice and 7% for chickadees).

C. Parasitism

no information located

IX STATUS

A. Past population trends

no information located

B. Present population status

In the 1974 Audubon Christmas bird count, bushtits were found in 15 of the 21 sampling areas in or near the southern California desert areas. The sites

Psaltriparus minimus (con't.)

(and numbers observed) are as follows: Bakersfield (102), Butterbread Springs (20), Carrizo Plains (30), Claremont (321), Granite-Woody-Glennville (30), Idylwild (261), Joshua Tree National Monument (5), Orange County NE (731), Pasadena (383), Redlands (204), San Bernardino Valley (335), San Fernando Valley (140), Sespe Wildlife Area (229), Springville (249), Thousand Oaks (323).

C. Population limiting factors

no information located

D. Environmental quality: adverse impacts

The use of rootplowing has had an adverse impact on bushtit populations, since bushtits prefer dense vegetation and will not remain in an area that has been rootplowed even if chaparral is broken up in small dispersed units rather than destroyed completely (Loe and White, 1974).

E. Potential for endangered status

no information located

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WHITE-BREASTED NUTHATCH
Sitta carolinensis

I TAXONOMY

A. Type description

Sitta c. aculeata - AOU (1957) Cassin, Proc. Acad. Nat. Sci. Philadelphia, 8, No. 5. September-October, 1856. California.

Sitta carolinensis tenuissima - AOU (1957) Grinnell, Condor, 20, No. 2, March, 1918. Hanaupah Canyon, Panamint Mountains, Inyo County, California, 8700 feet.

B. Current systematic treatments

In Monson (1946), "Miller says these forms of nuthatch, which are not too well differentiated, might of course have occasional aberrant individuals that look like members of another race population."

S. c. aculeata - Hellmayr (1934) recognizes eight races of Sitta carolinensis, including aculeata, whose range is given as follows: "Transition and upper Austral zones from southern British Columbia to extreme northern lower California and from the Pacific coast east to the Cascades and Sierra Nevada."

S. c. tenuissima - Hellmayr (1934) recognizes eight races of Sitta carolinensis, including tenuissima, whose range is given as follows: "Panamint and White Mountains, California."

Synonomies - S. c. tenuissima, Grinnell and Miller (1944), Inyo slender-billed nuthatch; Inyo white-breasted nuthatch; and Inyo nuthatch.

II DESCRIPTION

A. External morphology of adults

Hawbecker (1948) gives detailed description of plumages, measurements and variations of races of the white-breasted nuthatch. Aldrich (1944) reviews the geographical variation of this species over its entire range.

S. c. aculeata - Ridgway (1904) gives detailed descriptions of plumages and measurements of adults and nestlings.

S. c. tenuissima - Grinnell (1918) gives detailed descriptions and measurements of adults and a description of type specimen.

B. Distinguishing characteristics

Interspecific - Peterson (1961), "This species is known by its black cap and beady black eye on a white face. Chestnut under tail coverts."

Intraspecific - S. c. tenuissima, Grinnell (1918), "Similar to Sitta carolinensis aculeata from west-central California, but bill much longer

Sitta carolinensis (con't.)

and slenderer, size larger, back of a darker tone of gray, and flanks paler; similar to S. c. nelsoni from southern Arizona, but bill much slenderer, and sides, and lower surface generally, whiter."

C. Special morphological features

Marshall (1957), "Its large agile feet permit movement on all bark surfaces."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), range of species "Southern British Columbia, southeastern Alberta, northwestern and central Montana, southern Manitoba, southern Ontario, southern Quebec, northern Maine, north central New Brunswick, Prince Edward Island, Cape Breton Island, and central Nova Scotia south to southern Baja California, central Guerrero, northern Puebla and central Vera Cruz. Absent from most of the Great Plains area of the United States." Johnson (1965), "Fairly common in the Sheep Range in mixed conifers from 7500 feet in the pinon woodland-ponderosa pine forest ecotone to 9200 feet in mixed bristlecone pines and white fir. Similar habitat was occupied at apparently comparable densities between 7600 and 9600 feet in the Spring Range. At the latter elevation the species used limber pine extensively."

S. c. tenuissima - AOU (1957), range "Resident from southern interior British Columbia (Cranbrook, Ashcroft, Okanagan Valley), central and eastern Washington (Bumping Lake, Colville, Spokane, Entiat), northern and central Idaho (Usk, Clark Fork, Coeur d'Alene, Meridian, Salmon River Mountains), western Wyoming (Gros Ventre Mountains), and northern Utah (Providence Canyon) south through eastern Oregon (Lava Butte) to eastern California (eastern California - eastern Siskiyou County, Eagle Lake, crest of Sierra Nevada, Inyo Range) and western and southern Nevada (Galena Creek, Carson City, White, Quinn Canyon, Charleston, and Sheep Mountains)." Hawbecker (1948), "Its range is from southern British Columbia to the southern Sierra Nevada and adjacent ranges."

S. c. aculeata - AOU (1957), range "Resident in the western coast ranges from northwestern Washington (Puget Sound) through western Oregon (Dayton, Corvallis, Rogue River Valley) and central California (both slopes of the Sacramento Valley and interior coast ranges) to southwestern California (Kern Basin, Santa Barbara, San Bernardino and Laguna Mountains) and extreme northern Baja California (Sierra Juarez). Casual in southwestern British Columbia."

B. California distribution of the species

S. c. aculeata - Hawbecker (1948), "found west of the Sierra Nevada - Cascade chain but east of the humid coastal belt."

Sitta carolinensis (con't.)

S. c. tenuissima - Hawbecker (1948), "... ranges westward to the Canadian and Hudsonian life-zones of the Sierra Nevada - Cascade Mountain system."

C. California desert distribution

Gilman (1935) reported seen "at work" on trunk of date tree on Furnace Creek Ranch, October. Clary and Clary (1936) noted seen on morning of September on Coral Reef Ranch. Miller and Stebbins (1964), "... has been detected only in or near the pinons in the western part of the Monument."

D. Seasonal variations in distribution

Miller and Stebbins (1964), "It is not regularly migratory in this part (Joshua Tree National Monument) of California, but some autumnal dispersal takes place and probably the occurrences in the Monument represent such scattering or vagrancy in winter." Forbush (1929), "Their winter movements are governed largely by the abundance or scarcity of food such as appears to a nuthatch. They seem to be quite regular in returning to the same wintering grounds..." Grinnell and Miller (1944), "There is some late summer and autumn wandering of individuals out of breeding range, both uphill and down slope."

IV HABITAT

Small (1974), "... riparian woodland, broken oak woodland, mixed coniferous and deciduous woodland, coniferous forest of montane or even subalpine types."

A. Biotopic affinities

Wauer (1964) notes breeding in the pinon-juniper woodlands. Bock and Lynch (1970) reported breeding in both burned and unburned areas. Tatschl (1967), "Common... from ponderosa pine community to spruce-fir community. Uncommon in oak and pinyon-juniper woodlands." Hand (1941), "... seen individuals on infrequent occasions in the yellow pines of the transition zone and among the white-barked pines of the Hudsonian zone but never in the intervening areas." Phillips, Marshall, and Monson (1964), "...common resident throughout transition and lower Canadian zones, also locally among larger trees of the upper Sonoran zone... also locally in riparian lower Sonoran zone. Fairly regular, August to early April, in nearby upper Sonoran zone and cottonwoods of lower Sonoran zone, in major flight years even to lower Colorado River..."

S. c. tenuissima - Grinnell and Miller (1944), "Coniferous trees of the region; chiefly pinon and limber pine, but also white fir, and lodgepole and hickory pines."

S. c. aculeata - Hawbecker (1948), "seldom found above the transition life-zone." Bent (1948), "Its haunts are in the coniferous forests of the mountains from 4000 to 9400 feet, among the yellow pines on mountain

Sitta carolinensis (con't.)

slopes, and in the oaks of the higher foothills." Most frequented trees in the Lassen Peak region were blue oak, valley oak, digger pine, and along stream courses, cottonwood.

B. Altitudinal range

S. c. tenuissima - Grinnell (1918) noted 6200 feet to 10,600 feet.

C. Home range size

Bagg and Eliot (1937), "Twenty-five acres of trees, up to fifty acres where trees are fewer is the normal extent of a pair's range."

D. Territory requirements

Perch sites - S. c. aculeata, Bent (1948) reported will roost communally at night, but not usually gregarious according to G.V. Harvey, 1902.

Nest sites - Allen (1924) reported nest hole between 15 and 40 feet above the ground. Allen (1912) noted nest usually made in hole in decayed part of living tree or in dead tree or stub. Bent (1948) reported commonly builds high up in a tall tree, using either a natural cavity or old woodpecker hole, according to W. Brewster, 1906. Kilham (1971) reported white-breasted nuthatches prefer roost and nest holes double or triple the size (width) of their bodies.

S. c. tenuissima - Grinnell and Miller (1944), 7000 feet to 10,600 feet.

E. Special habitat requirements

Marshall (1957) noted nuthatches require snags. "Favors branches unobstructed by foliage in middle and upper portions of all the various pines, oaks, and riparian trees."

F. Seasonal changes in habitat requirements

Grubb (1975), "White-breasted nuthatches were the least affected by weather variation. In the mildest conditions this species preferred large trunks and dead large branches of oaks at 6-10 m. In the most severe weather nuthatches relied more on large oak trunks slightly nearer the ground (2-6 m)."

V FOOD

A. Food preferences

Allen (1912) noted feeds on beetles, including boring beetles, scale insects, hibernating larvae and pupae as well as insect eggs. Also ants, spiders, canker-worms, forest caterpillars, and plant lice. Eats seeds and nuts when insect food scarce.

Sitta carolinensis (con't.)

B. Foraging areas

Marshall (1957), "... takes insects from trunks and main branches of live and dead trees."

C. Foraging strategies

Oberholser (1974), "... the bird has been observed catching falling nuts in mid-air." Marshall (1957), "The members of the pair tend to work in adjacent trees rather than in the same tree. Sometimes nuthatches alight on the ground to retrieve food dropped from above and to collect the rocks and crystals. Ten stomachs also contained beetles, caterpillars, other insects, pine seeds, parts of acorns, and various other seeds. Picks insects... from the interior of the wood for it frequently pounds loudly like a woodpecker." Allen (1912) reported wedges nuts and seeds into cracks and crevices to hold them while the bird hammers them open. Kilham (1974), "... occasionally cover stores of food with bits of bark and lichens."

VI REPRODUCTION

A. Courtship and mating behavior

Moll (1974) gives description of mating behavior.

B. Nesting phenology

Allen (1912) reported nest prepared in March or April according to locality. Bent (1948) noted California egg dates: March 21 to June 29; height of season was April 6 to May 17.

C. Length of incubation period

Godfrey (1966), "Incubation 12 days, according to A.A. Allen."

VII POPULATION PARAMETERS

A. Clutch size

S. c. aculeata - Bent (1948) reported 5 to 9 eggs; oftener 6 or 7; sets of 8 fairly common.

B. Habitat density figures

Marshall (1957), "Although families are seen in late July and August, the usual occurrence throughout the year is in pairs spaced beyond hearing distance of each other. In the Sierra Madre a pair was found at each camp and at every stop along the way, suggesting that the rather sparse population is uniform in the proper environment of tall timber with plentiful snags." Van Velzen (1972) noted in riparian willow wood-

Sitta carolinensis (con't.)

land, location: San Mateo County, California that 1.5 territorial males or females/10.0 acres existed with 37 territorial males or females/km² and 15 territorial males or females/100 acres. Van Velzen (1974) noted in mixed oak-digger pine woodland, location: Butte County, California that 2.5 territorial males or females/17.1 acres existed. In ponderosa pine forest, location: Boulder, Colorado 2 territorial males or females/20 acres occurred. Van Velzen (1977) reported in sycamore-coast live oak-riparian woodland, location: California, Orange County that 2.5 territorial males or females on 16.8 acres existed. Balda (1969) noted nesting density in oak-juniper woodland = 7 pairs per 100 acres with a total nesting density of 267 pairs (all species) per 100 acres. Bock and Lynch (1970) reported burned plot with pairs/plot = 0.50 in 1966, 0.50 in 1967 and 0.50 in 1968. The number of pairs/100 acres was 2.4. In the unburned plot pairs/plot were 0.25 in 1966, + in 1967 and + in 1968. The number of pairs/100 acres was 0.6. Also noted in the burned area was 86.4 g/100 acres of standing crop biomass with 36.4 g/100 acres of consuming biomass. The unburned plot had 21.6 g/100 acres standing crop biomass and 9.1 g/100 acres consuming biomass.

C. Flocking behavior

Wing (1941) reported using Christmas count data, white-breasted nuthatches have the smallest flock sizes reported in winter averaging 2.29 individuals per flock.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Kilham (1971) noted white-breasted nuthatches practice roost hole sanitation, perhaps to keep from having predators attracted to the roost hole. Phillips, Marshall, and Monson (1964), "Phillips once took one from the stomach of a black-tailed rattlesnake in the Hualapai Mountains," Allen (1924) reported one nest contained an egg which may have been destroyed by squirrels. Kilham (1968) noted white breasted nuthatches will "sweep" the inside and outside of their nest holes with insects and plant material and perform "distraction displays" to ward off possible predation by squirrels. Gross (1944) noted snowy owls have been known to eat white-breasted nuthatches.

B. Competition

Oberholser (1974), "Loose groups form during cooler months, often with small woodpeckers, chickadees, and brown creepers, an association that is due largely to a similarity in diet."

C. Parasitism

Farner and Morgan (1944) noted host to the parasite, Collyriclum faba.

Sitta carolinensis (con't.)

IX STATUS

Marshall (1957), "This nuthatch is rare or absent on mountains lacking snags (San Luis), including those which have been extensively logged and burned (Cananea, El Tigre) and those on which the trees are small."

Sitta carolinensis (con't.)

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Sitta carolinensis (con't.)

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Sitta carolinensis (con't.)

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RED-BREASTED NUTHATCH
Sitta canadensis

I TAXONOMY

Hellmayr (1934) recognizes one race of Sitta canadensis. Grinnell and Miller (1944), "Canada nuthatch; red-bellied nuthatch."

II DESCRIPTION

A. External morphology of adults

Ridgway (1904) gives detailed descriptions of plumages and measurements of adults and nestlings.

B. External morphology of subadult age classes

Michael (1934), "When the young leave the nest they are in full plumage."

C. Distinguishing characteristics

Interspecific - Peterson (1961), "Our only nuthatch with a broad black line through the eye and a white line over it. Small; rusty below."

Intraspecific - Howell and Van Rossem (1911) noted birds measured on average, smaller than those from the mainland and the east.

III GEOGRAPHICAL DISTRIBUTION

Johnson (1972) reported substantial populations were probably present during cool and moist post-Pleistocene times.

A. Overall distribution of the species

AOU (1957), "Breeds principally in the Canadian zone from southeastern Alaska, southern Yukon, southwestern Mackenzie, central Saskatchewan, James Bay, western and northern Ontario, southern and eastern Quebec, Newfoundland and St. Pierre and Miquelon Islands south to central coastal and southern California, Guadalupe Island, southeastern Arizona and central western and south central Colorado, Wyoming, southwestern South Dakota, Montana, southeastern Manitoba, central Minnesota, Wisconsin, northern Michigan, southern Ontario, through the Appalachians to eastern Tennessee, and western North Carolina, southern New York, western Connecticut, and Massachusetts."

B. California desert distribution

Miller and Stebbins (1964) noted found in Joshua Tree National Monument only in the fall. "Dates range from August 28 to November 1." Swarth (1899) reported abundant in vicinity of Los Angeles in fall 1898. Clary and Clary (1936), "A red-breasted nuthatch was seen in a cottonwood tree on Coral Reef Ranch, Coachella, California on October 8, 1935 at 45 feet below sea level." Monson (1949) noted in Bill Williams Delta on Septem-

Sitta canadensis (con't.)

ber 26, 1947 and in Topock on September 30, 1947. Miller and Russell (1956) noted summer resident in small numbers. Wauer (1962), "Although the species is common in the mountains surrounding Death Valley, this is the only record for the study area. A single individual was observed at Cow Creek on October 10, 1959." Miller (1940) reported specimen collected from Transition zone timber.

C. Seasonal variations in distribution

Small (1974), "considerable down-mountain and southward movement in fall." AOU (1957), "Winters throughout most of its range, except in higher latitudes and altitudes, erratically south to southern Arizona, southern New Mexico, Texas, southern Louisiana, southern Mississippi and northern Florida." Phillips, Marshall, and Monson (1964), "One casual summer record from Tuba City, July 2, 1936 according to Phillips, MNA." "... most regular as a fall transient in mountains and mesas of the north..." Miller and Stebbins (1964), "It occurs in this season (midwinter) in the Providence Mountains to the north in the Mohave desert." Phillips, Marshall, and Monson (1964) reported fall migration period principally from late September to early November but has begun as early as September 5, 1950. Willard (1901) noted comparatively numerous in 1899, less so in 1901. Grinnell (1914) reported irregularly common winter visitant. Earliest date of observation September 24, 1908 with the latest date of observation March 24, 1913. Linsdale (1932) gave the percent frequency for each month as: Jan. (39); Feb. (38); Mar. (60); Apr. (71); May (74); June (61); July (44); Aug. (53); Sept. (66); Oct. (48); Nov. (89); and Dec. (41). Williamson, Peyton and Islieb (), "
"...this bird is a breeding resident in coastal forest north to the Kenai Peninsula and Cook Inlet, and that numbers vary widely from year to year."

IV HABITAT

A. Biotopic affinities

Bent (1948), "In winters when the birds occur as commonly as in summer, they may be found locally in all the forest types which they frequent during the breeding season, showing the same preference for fir-larch woods in the Transition zone and heavily-forested high valleys and basins in the Canadian zone. During winters when most of the nuthatches have migrated from the region, a few remain throughout the season in the Hudsonian and upper Canadian zones even when they are entirely absent from the Transition and Canadian zone forests of the lower valleys and foothills." Allen (1912) reported prefers coniferous woods or mixed woods with a large percentage of conifers. Bock and Lynch (1970) noted vagrant in burned areas and bred in unburned areas. Tatschl (1967), "Common from ponderosa pine community to spruce-fir community, uncommon in pinyon-juniper woodland." Phillips (1935), "... always in the Canadian zone." Schaefer (1917), "On January 18, 1917, I observed a single red-breasted nuthatch (Sitta canadensis) near the northeast edge of the Coconino Plateau, about forty miles south of Winslow, Arizona. The birds was seen in the pinyon and juniper zone at an elevation of 7000 feet..."

Sitta canadensis (con't.)

Emerson (1899) noted found in blue gum, live oak, and almond trees. Marshall (1957), "not in pine-oak woodland." Found in the spruce and fir forests south to Pinaleno, Catalina and Chiricahua Mountains probably nests in Huachuca Mountains. Phillips, Marshall, and Monson (1964), "Resident in all or nearly all, of Boreal zone. During the fall sometimes found in Transition and Sonoran zones, usually in large trees but casually in desert shrubs."

B. Altitudinal range

Grinnell and Miller (1944) reported at 2500 feet up to 10,000 feet.

C. Territory requirements

Nest sites - Bent (1948) noted nests as low as 5 feet or as high as 40 feet above the ground. Michael (1934) reported red-breasted nuthatches never occupy old nest holes. Allen (1912), "... excavates its nesting hole in dead or partly decayed trees." Young (1933) found red-breasted nuthatches nesting in hole made by downy woodpeckers in a dead pine in Diamond Canyon near Oakland. Dawson (1923), "Nest: of grasses, feathers, etc. in a hole of tree or stub, excavated by the bird, usually at lower levels." Small (1974), "Coniferous forests of higher montane and sub-alpine zones, notably Canadian life zone." Bent (1948) noted usually excavates a cavity in a rotten stub or branch of a dead tree. Sometimes uses old woodpecker holes and will use nest boxes.

V FOOD

A. Food preferences

Allen (1912), "Particularly fond of the seeds of pines and spruces." Bent (1948) reported seeds of pines, spruces, beetles, Hymenoptera, spiders, ribbed pine borer (Rhagium lineatum).

B. Foraging areas

Most foraging is carried on in the loftier branches of both red and white fir (Abies). "Foraging extends to practically every other type of conifer and, in winter especially, to some deciduous trees" (Grinnell and Miller, 1944).

C. Foraging strategies

Allen (1912) noted will investigate tufts of dead leaves in deciduous trees for insect food. Will also hide food in cracks and crevices. Bent (1948) reported wedges food in cracks while they pick it to pieces. Those birds feeding in lodgepole pines moved along the top of the limbs, but examined the sides and lower surfaces of the limbs as well (Grinnell, Dixon, and Linsdale; 1930). Gilman (1911), "... fly several times from a tree trunk, warbler like, and snap up worms hanging at the ends of webs." Silloway (1907), "... at times acts like a real flycatcher." Nuthatches hide food under flakes of bark and will feed with chickadees in mixed

Sitta canadensis (con't.)

flocks; foraging on hemlock seeds on ground became more pronounced as the season progressed, especially after the snow had laid on the ground for a time and seeds had time to accumulate (Kilham, 1975). Bailey (1928), "... at times acts like a flycatcher, leaving its investigation of bark crevices to fly out 'capturing a flying insect dexterously in the air', and returning to its gleaning on the pole..." Bent (1948), "Edward H. Forbush, 1929, states that they 'fly off into the air after flying insects or search about in the long grass for them'."

VI REPRODUCTION

Gunderson (1939), "... male always fed the female during incubation from outside the nest." Michael (1934) reports start to drill nest holes before mid-April... example: Apr. 13 both birds began drilling; Apr. 20 indulged in mating act; May 1 began lining nest with feathers; May 12 female incubating; May 19 male puts ring of pitch around nest hole; May 23 young hatched; June 10 young left nest; young birds spent 5 days in treetops; June 15 young birds came down and took a bath; and June 21 last seen together as a family group.

A. Courtship and mating behavior

Bent (1948), "A male strutted before a female in a manner similar to the courting pose of the white-breasted nuthatch. The pose was maintained but a moment or so and was accompanied with some rapid chippering notes. It consisted of a spreading and lowering of the wings and a spreading of the tail. There was, too, I think, a slight bowing downward and forward of the whole body."

B. Nesting phenology

Bent (1948) reported California egg dates: 10 records, May 20 to June 21. Extremes, all states: April 30 to June 25.

C. Length of incubation period

Woods (1927) reported incubation period = 16 days. In Bent (1948), "F.L. Burns, 1915 notes 12 days. Godfrey (1966), "Incubation 12 days according to F.L. Burns."

D. Length of nestling period

Bent (1948) noted young leave nest 18 to 21 days after hatching. Woods (1927) reported young leave nest after 19 days. "Leave the nest 18 to 21 days after hatching", Cordelia J. Stanwood(MS) in Bent (1948).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1948), "Four to 7 eggs; probably 5 or 6 eggs make up the usual set." Dawson (1923) reported 4 to 6 eggs.

Sitta canadensis (con't.)

B. Habitat density figures

Gabrielson (1931), "fairly common permanent resident which is most conspicuous in the lodgepole pine areas." Density of breeding birds in the climax coniferous forest: Rocky Mountain coniferous forest = less than one pair/100 acres; eastern coniferous forest in western Ontario = 3 pair per 100 acres; and eastern coniferous forest in Maine = less than 1 pair per 100 acres (Snyder, 1950). Dice (1921) reported 0.009 individuals per acre. Weydemeyer (1933), "(A census of the breeding birds inhabiting an 80-acre tract of fir-larch-yellow pine woods near Fortine, taken each season during the four years of 1928 to 1931, showed the presence of 11, 9, 14, and 11 pairs respectively of red-breasted nuthatches.)" Val Velzen (1974) noted mature Douglas-fir forest had 1 territorial male or female per 15.15 acres; location: 4 miles northwest of Bolinas, Marin County, California.

C. Seasonal variations

Weydemeyer (1973) reported mean arrival date = 9 April and range = 16 March to 28 April.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1948), "Joe T. Marshall, Jr., 1942, lists a red-breasted nuthatch as having been found in a pellet of the spotted owl."

B. Competition

Grey (1925), "... each nuthatch had to have a tree to itself, one chasing the other away whenever two happened to get into the same tree", October, 1919 during migration. Forbush (1929) noted red-breasted nuthatches may take over tree swallow nests. Red-breasted nuthatches will compete for nest holes with boreal chickadees, displacing them, and appropriating the nest holes for their own use (McLaren, 1975).

IX STATUS

A. Environmental quality: adverse impacts

Wright (1933) reported red-breasted nuthatches are adversely affected by the clearing of dead snags.

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BEWICK'S WREN

Thryomanes bewickii

I TAXONOMY

A. Type description

Thryomanes bewickii eremophilus, desert Bewick's wren: Thryomanes bewickii eremophilus Oberholser, 1898, Proc. U.S. Nat. Mus. 21:427 - Big Hatchet Mountains, Grant County, New Mexico (Peters 1960).

Synonomies - Thryothorus leucogaster, Thryothorus bewickii bairdii, Thryomanes bewickii leucogaster, Thryomanes bewickii bairdii; white-bellied wren, Baird wren, desert wren (Grinnell and Miller 1944).

Thryomanes bewickii correctus, San Diego Bewick's wren: Thryomanes bewickii correctus Grinnell, 1928, Condor 30:154 - Pasadena, Los Angeles County, California (Peters 1960).

Synonomies - Troglodytes bewickii, Thryothorus bewickii, Thryothorus bewickii spilurus, Thryothorus spilurus, Thryothorus bewickii bairdii, Thryomanes bewickii drymoecus, Thryomanes bewickii charienturus, Thryomanes bewickii spilurus, Thryomanes spilurus; Vigor's wren, western mocking wren, Baird wren, southwest Bewick wren, San Diego wren, San Joaquin wren (Grinnell and Miller 1944).

B. Current systematic treatment

Order Passeriformes, family Troglodytidae, genus Thryomanes Sclater, 1892, Cat. Coll. Amer. Birds, p. 22 (Peters 1960).

The AOU Check-list of North American Birds (1957) recognizes 9 subspecies of the more sedentary Bewick wren as opposed to one subspecies of the wide-ranging house wren (Kroodsma 1973).

Peters (1960) listed 18 subspecies of Bewick wren, 13 of which occur in the U.S. (bewickii, altus, cryptus, eremophilus, calophonius, drymoecus, marinensis, atrestus, spilurus, correctus, nesophilus, catalinae, leucophrys).

C. Recent taxonomic revisions

The Supplement to the AOU Check-list of North American Birds (1973, Auk 90:411-419) indicates that there have been no changes in wren taxonomy since the fifth edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The Bewick wren is "a fairly slender, small (8-10 gram) long tailed wren with conspicuous superciliary line. Back brown, underparts light gray, darker on the flanks; tail black with white tips on four lateral pairs of feathers, the central pairs barred black and brown; undertail coverts barred black and white" (Miller and Stebbins 1964).

Miller and Stebbins (1964) comment that there is a "large amount of individual variation in this species. In almost any large sample, brown and gray variants may be sorted out with several stages between extremes."

B. External morphology of subadult age classes

In juveniles, the color above varies from light rufescent gray to dark, dull, brownish gray. The undertail coverts are less distinctly barred (Bent 1948). The first winter plumage is virtually indistinguishable from adult winter plumage (Bent 1948).

C. Distinguishing characteristics

Interspecific - The Bewick wren is smaller and more slender than the Carolina wren and larger than the house wren (Bent 1948). It has a much longer tail than either of the other two species. The back is grayer, less reddish brown than the Carolina wren, and the underparts are lighter colored (Bent 1948).

Intraspecific. - T.b. eremophilus is similar to cryptus but is decidedly grayer above; upper tail is clearer gray; underparts are still whiter (Bent 1948).

T.b. correctus has a dorsal coloration which is lighter and warmer brown than drymoecus; the light bars on the tail are paler, and the tail is longer (Bent 1948).

D. Special morphological features

"The tail is habitually carried above the line of the back, although its position and inclination are constantly changing" (Bent 1948).

III DISTRIBUTION

A. Overall distribution of the species

The U.S. subspecies are found from south of the U.S.-Canadian border south to central Mexico; three of the 13 subspecies are restricted to islands off southern California. The five other subspecies are found on Baja California (3) and the central plateau of Mexico (2); (Peters 1960).

Thryomanes bewickii (Cont'd)

T.b. eremophilus is "resident in the mountains of southeastern California, southern Nevada, southern Utah, southwestern Wyoming, and Colorado south to northern Sonora, Chihuahua, Durango, Zacatecas, and southern Coahuila" (Peters 1960).

T.b. correctus is found in "southwestern California from Monterey and San Benito counties south to the Mexican border and west to the western slopes of the Sierra Nevada" (Peters 1960).

B. California distribution of the species

T.b. eremophila breeds in the mountains of Mono, Inyo, eastern San Bernardino counties, southeast of the Sierra Nevada (Grinnell and Miller 1944, Wauer 1964).

T.b. correctus is resident in the hills and mountains of the southern coastal region from the Mexican border in San Diego County through Monterey and San Benito County. It is also found east and north from Ventura County onto the western slopes of the southern Sierra Nevada to latitude 36°30'N (Grinnell and Miller 1944).

C. California desert distribution

The Bewick wren breeds in the Panamint Mountains (Wauer 1964) and in other mountains of Mono, Inyo and eastern San Bernardino counties (Grinnell and Miller 1944). They also breed in Joshua Tree National Monument, eg. on Eagle Mountain, Black Rock Spring, Stubby Spring, Pinyon Wells, Cottonwood Spring (Miller and Stebbins 1964) and in the San Jacinto Mountains (Smyth and Coulombe 1971).

T.b. eremophilus moves from the mountain areas of Mono, Inyo and eastern San Bernardino counties down to areas adjacent to and on the Mohave and Colorado Deserts (Grinnell and Miller 1944; Wauer 1964). It also occurs regularly in the Colorado River Valley (Grinnell 1914).

IV HABITAT

A. Biotopic affinities

The Bewick wren breeds in the Upper Sonoran Life Zone principally in juniper-pinon woodlands (Grinnell and Miller 1944, Wauer 1964). Typical vegetation includes juniper, pinon pine, mountain mahogany, Joshua tree vegetation, sage brush, Artesmia, Chamaebatiaria, Cowania (Grinnell and Miller 1944, Wauer 1964). In Arizona and New Mexico, these wrens are found chiefly in the live-oak associations near the mouths of the canyons and on the low foothills (Miller 1941, Bent 1948). The subspecies correctus is found more often in Upper Sonoran chaparral mixed with live oaks on hillsides, or with willows and vines along stream courses (Grinnell and Miller 1944).

Thryomanes bewickii (Cont'd)

B. Altitudinal ranges

T.b. eremophilus breeds from 3800 to 9500 feet in California (Grinnell and Miller 1944), and up to 6000 feet in Arizona (Bent 1948).

T.b. correctus is found from sea level to 6000 feet (Grinnell and Miller 1944).

An unspecified subspecies (probably eremophilus) was recorded breeding at 6000 feet in the Panamint Mountains (Wauer 1964).

C. Home range size

Miller (1941) observed 3 territories, each about 50 yd. x 100 yd. He stated that the territorial boundaries did not vary by more than a few feet from day to day. Bewick wren territories averaged 9.4 acres (range, 6.1 - 11.8 acres) in open woodland in Oregon and 4.9 acres (range, 3.1 - 9.4 acres) in denser riparian foliage (Kroodsma 1973).

D. Territorial requirements

Perch site - Conspicuous perches are chosen for singing. These sites are often on the outer small twigs near the top of a tree or bush (Miller 1941). The wrens use Joshua trees as song posts if there are low retreat tangles associated with the Joshua trees (e.g., downed Yucca logs, burro brush, chrysothamnus thickets (Miller and Stebbins 1964).

Courtship and mating sites - No specific information located.

Nest site - Nests are placed in cavities or within a few feet of the ground in crevices of rocky ledges and between boulders (Miller 1941). T.b. eremophilus nests have also been found in cavities in trees (Bent 1948).

E. Special habitat requirements

"There are but few features of habitat common to all races of Bewick's wren. Thick plant growth of a kind that will furnish the proper insect food seems to be the chief requisite. The kinds of plants in one part of the range... may be totally different from those in another part. The wrens may be found in trees more than 100 feet high or in brush not more than 3 feet high. In the Upper Sonoran Life Zone they are most abundant where the plant growth is thickest. They are particularly noted for their preference for mixed brush" (Miller 1941).

In Joshua Tree National Monument, the wrens are most abundant in the pinon belt which provides the low brush tangles these birds require. They are also found in canyons in catclaw, desert willow, cholla, and yuccas, but never on the desert flats (Miller and Stebbins 1964).

F. Seasonal changes in habitat requirements

T.b. eremophilus winters in thickets of mesquite, screwbean, catclaw, quail-brush, willow (Grinnell and Miller 1944), frequently at lower elevations than during the breeding season (Grinnell and Miller 1944, Wauer 1964).

The Bewick wren is a common winter visitor to the Colorado River Valley where it is found "chiefly in the sparse brush margining the washes leading down from the desert interior. The catclaw and larger creosote bushes appeared to afford both protective foraging grounds and safe retreats. It was rarely that this wren was seen near the river, and then only as far as the salt-bush belt" (Grinnell 1914).

G. Physiological ecology

Bewick wrens have not been seen drinking water (Smyth and Coulombe 1971). "It apparently meets the desert extreme chiefly by behavioral adjustments in the use of protective cover and moist foods" (Miller and Stebbins 1964). These wrens are insectivorous and use the "shade of bushes and of rocks and ledges (which provide) shelter from the sun" (Miller and Stebbins 1964).

V

FOOD

A. Food preferences

The Bewick wren yearly diet is composed of 97% insect matter and 3% vegetable matter (Beal 1907). The principal insect groups contributing to the diet are as follows: Heriptera (31% of the total food consumption), Coleoptera (21%, weevils, 10%), Hymenoptera (17%; ants 7%), Lepidoptera (12%), Odonata (4%), Diptera and miscellaneous (6%), spiders (5%).

B. Foraging area

"The characteristic area of foraging is on the lower, larger trunks and branches of weeds, brush and trees. The plants on which foraging takes place are almost any of those found in the birds habitat. The thick vegetation... contributes greatly to the efficiency of the process, for the branches are so close together that only short hops and few flights are necessary" (Miller 1941). These wrens also turn over litter on the ground on occasion.

Bewick wrens frequently forage within 4 feet of the ground, but they must have heavy cover overhead (Grinnell and Miller 1944, Cody 1974), and do not forage in the terminal foliage (Miller and Stebbins 1964).

C. Foraging strategies

Bewick wrens make short, quick hops from branch to branch picking up an insect from the bark or leaves every few seconds (Miller 1941, Miller and Stebbins 1964). Flights of 5 feet to 40 feet take the wrens to new locations (Miller 1941).

"Different methods of foraging are used, depending upon the nature of the vegetation. In low tangled mats, the bird moves about out of sight among the lower branches. In larger, more open brush, the wren usually begins at the base of the trunks and hops vertically upward, often working in a spiral fashion around the bush. Upon reaching the branching twigs of a bush or tree, a circuitous route around or through the inner portions is followed. If the brush is too thick to enter readily, or if the bushes are not close together, the bird hops around the bases on the ground and picks insects from the bark" (Miller 1941). On large trees, the wrens forage over the trunk, creeper-style.

In mated pairs, the male forages up in the trees while the female remains within 1 to 2 feet of the ground, but follows the male's foraging route. This feeding separation no longer occurs once nest building is completed (Miller 1941).

D. Feeding phenology

Plant matter, which provides only 3% of the yearly diet, reached a peak consumption in December and January when it contributes 12% to the diet (Beal 1907).

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

The Bewick wren male sings to advertise his presence on a territory. The singing lasts from early spring to late fall, even though some males remain on territory and are aggressive throughout the year (Miller 1941). Singing is most common in the early morning. The male sings from 1 to 18 times per minute with an average of 10 songs per minute. Song bouts last from 1 to 5 minutes (Miller 1941).

Thryomanes bewickii (Cont'd)

Territory boundary conflicts are common. They consist mostly of singing and uttering harsh notes and can last from a few minutes to 1/2 hour (Miller 1941).

C. Courtship and mating behavior

The male helps build the nest and feed the nestlings and fledglings (Miller 1941, Verner and Willson 1969). The male also feeds the female while she is incubating and probably does little incubation himself, at least in the early stages (Miller 1941).

The female gives "swee" notes in rapid succession which induces the male to feed her. These notes are heard throughout nest building and incubation (Miller 1941).

It is possible that Bewick wrens are bigamous in some situations. Kroodsma (1972) observed 2 males each with 2 females in the pre-breeding season and has also seen one male feeding two closely spaced broods. He implied that males on good territories might attract more than one female, since 9 out of 38 territorial males were unpaired and held territories in marginal habitats.

D. Nesting phenology

Bent (1948) reported the following egg dates for Bewick wrens in California: 120 records, March 26 to June 18; 60 records, April 17 to May 13, indicating the height of the season.

Miller and Stebbins (1964) observed males singing vigorously in late March in Joshua Tree National Monument. By mid-May, they saw well-grown young out of the nest, indicating laying dates of early April.

E. Length of incubation period

Incubation lasts for 14 days (Miller 1941), although periods as short as 10 days have been reported (Bent 1948).

F. Length of nestling period

The young remain in the nest for 14 days (Miller 1941, Bent 1948).

G. Growth rates

No information located.

H. Post-breeding behavior

The young are fed for about 2 weeks after they leave the nest (Miller 1941, Bent 1948). If the population is resident, males may retain territories beyond the breeding season, and if not, may still be aggressive to other males (Miller 1941).

VII POPULATION PARAMETERS

A. Clutch size

The Bewick wren lays 5 to 7 eggs, frequently 7 (Bent 1948). Clutch sizes of 4 to 11 eggs have been found, and nests with 8 or 9 eggs are not uncommon. Females commonly raise 2 broods per year and sometimes 3 (Bent 1948), although Oregon females may not lay a second clutch very frequently (Kroodsma 1973).

B. Nesting success

Miller and Stebbins (1964) observed a fall adult to young ratio of 18:14 which corresponds to a population with 44% immature birds and implies a high nestling and fledging mortality given the large clutch size.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

E. Seasonal abundance

No specific information located. Vertical migration in the fall could depopulate high elevation areas while increasing the population in the low-lying desert areas (see III D. and IV F. above).

F. Habitat density figures

Hensley (1954) observed a density of 5 breeding pairs per 100 acres on the Colorado Desert. Cody (1974) reported densities of 0.61 pairs per acre in chaparral areas on the California mainland and 1.27 pairs per acre on California islands with comparable habitats.

The wrens shifted their habitat utilization from summer to winter such that more oak-woodland was used during the winter months (Cody 1974; see following table).

<u>Area</u>	<u>Percent of habitat occupied</u>	
	Breeding season	Winter season
Oak woodland	10%	58%
Chaparral:		
North slope	92%	83%
South slope	49%	57%

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bewick wrens fall prey to sharp-shinned hawks and owls (Miller 1941), roadrunners and rattlesnakes (Bent 1948).

B. Competition

Bewick wrens compete with plain titmice and house wrens for nest sites (Miller 1941). House wrens frequently outcompete Bewick wrens, forcing them to breed in areas with less timber and fewer brush piles (Root 1969; see also Miller 1941). However, winter habitats do not overlap (Grinnell 1914, Root 1969).

C. Parasitism

No information located.

IX STATUS

A. Past population trends

No information located.

B. Present population status

Bewick wrens were reported in 20 out of 22 desert or near desert areas censused in the Seventy-seventh Audubon Christmas bird count (1977). The areas (and numbers of wrens observed) were as follows: Bakersfield (18), Butterbread Spring (1), Carrizo Plains (8), China Lake (1), Claremont (40), Granite-Woody-Glennville (2), Idylwild (10), Joshua Tree National Monument (6), Orange County NE (86), Pasadena (76), Redlands (26), Salton Sea N (2), Salton Sea S (4), San Bernardino Valley (67), San Fernando Valley (2), Sespe Wildlife Area (17), Springville (36), Thousand Oaks (2), Parker, Arizona-Colorado River (19), Yuma (5).

C. Population limiting factors

No information located.

D. Environmental quality: adverse impacts

No information located.

E. Potential for endangered status

No information located.

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Thryomanes bewickii (Cont'd)

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Wauer, R.H. 1964. Ecological distribution of the birds of the Panamint Mountains, California. Condor 66:287-301.

CANYON WREN
Catherpes mexicanus

I TAXONOMY

A. Type description

Catherpes mexicanus conspersus, dotted cañon wren Catherpes mexicanus conspersus Ridgway, 1873, Amer. Natur. F.:603- Fort Churchill, Lyon County, Nevada (Peters, 1960).

Synonomies- Salpinctes mexicanus conspersus, Catherpes mexicanus punctulatus, Catherpes mexicanus polioptilus, Catherpes mexicanus griseus (Peters, 1960), Troglodytes mexicanus; White-throated wren, Mexican wren, canyon wren, Auburn canyon wren, Ridgway canyon wren, dotted wren, Nevada canyon wren, intermediate canyon wren (Grinnell and Miller, 1944).

B. Current systematic treatment

Order Passeriformes, family Troglodytidae, genus Catherpes Baird, 1858, Rep. Pacific RR Surv. 9:356 (Peters, 1960).

Peters (1960) recognizes three subspecies: conspersus, albifrons, mexicanus.

C. Recent taxonomic revisions

The supplement to the AOU Checklist of North American Birds (1973, Auk 90: 411-419) indicates that there have been no changes made in wren taxonomy since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The canyon wren is a "moderate-sized (9-12 grams) wren with chestnut-brown belly and flanks contrasting with white chin and throat, upper parts grayish brown anteriorly, becoming rich brown posteriorly, and finely dotted with light gray and black; wings and tail chestnut-brown barred with black, the fine black bars of the tail widely spaced. Bill long (2 cm), moderately curved" (Miller and Stebbins, 1964; see also Bent, 1948).

B. External morphology of subadult age classes

The young birds look much like the adults, only duller. They have few white spots on the back and the abdominal brown area is paler and not spotted. In the first winter, the young resemble the adults (Bent, 1948).

C. Distinguishing characteristics

Interspecific- The canyon wren differs from the rock wren in the contrasting breast-belly coloration pattern; the rock wren has the same coloration pattern for the entire underparts. In addition, the rock wren tail has a conspicuous black band and whitish tips, "whereas the tail of the canyon wren has no terminal bands and only a few narrow dusky bars" (Bent, 1948).

Catherpes mexicanus (con't.)

D. Special morphological features

The canyon wren has sharp claws that are well adapted for climbing rocks (Bent, 1948). In addition, "the canyon wren has acquired a special flatness of body structure which is an obvious adaptation to allow it passage through horizontal crevices... The bird's legs are short and are held at an acute angle with the surface... so that the body is close to the substratum" (Grinnell and Storer, 1924).

III DISTRIBUTION

A. Overall distribution of the species

C.m. conspersus is "resident from coastal southern and central California and interior northern California through eastern Oregon and Washington, north to interior southern British Columbia, east to Idaho, southwestern Montana, Wyoming, southwestern South Dakota, Colorado, southwestern and extreme western Oklahoma, and central Texas, and south to Pecos River, Texas, northern Chihuahua, northern Sonora and southern Baja California (Peters, 1960).

C.m. albicans is found in southwestern Texas, Coahuila and Nuevo Leon.

C.m. mexicanus is found in central Mexico.

B. California distribution of the species

The canyon wren is resident in the interior, mountainous areas such as the in Coast Ranges and the Sierra Nevada. There are also sparse populations on the southeastern desert mountains (Grinnell and Miller, 1944).

C. California desert distribution

There are sparse populations of canyon wrens in the southeastern desert mountains (Grinnell and Miller, 1944). In particular, Grinnell (1914) saw canyon wrens in the Needles, in the hills above Big Williams River, and in the Riverside Mountains. They also occur in Joshua Tree National Monument (Miller and Stebbins, 1964) and in the San Jacinto Mountains (Smyth and Coulombe, 1971). The seventy-seventh Audubon Christmas Bird Count (1977) recorded canyon wrens in Joshua Tree National Monument but not in Death Valley, the Salton Sea area, China Lake, or along the Colorado River near Parker, Arizona.

D. Seasonal variations in distribution

Canyon wrens are year-round residents (Grinnell and Miller, 1944; Peters, 1960).

IV HABITAT

A. Biotopic affinities

Canyon wrens are typically found in the Upper Sonoran life zone, extending occasionally up into the Transition zone and down into the Lower Sonoran zone (Grinnell and Miller, 1944). They require cliffs and large tangles

Catherpes mexicanus (con't.)

of boulders with "shaded rock faces and deep crevices and crypts in which they forage and nest" (Miller and Stebbins, 1964). They are frequently found at the base of these cliffs and rock slides and close to the bottoms of canyons. These areas appear "to be more humid, and hence, to offer better forage situations for rock-haunting, insectivorous birds" (Linsdale, 1938).

B. Altitudinal range

Canyon wrens are found from sea level to 7500 feet (Grinnell and Miller, 1944), but frequently at 6500 to 7500 feet (Linsdale, 1938).

C. Home range size

Miller and Stebbins (1964) never observed more than one pair of wrens per canyon with suitable habitat.

D. Territory requirements

Perch sites- no information located

Courtship and mating sites- no information located

Nest sites- A typical nest site is in an inaccessible crevice above a little shelf in the roof of a cave (Wetmore, 1920; Grinnell and Miller, 1944; Bent, 1948; Miller and Stebbins, 1964). They rarely nest in crevices on buildings (Bent, 1948).

E. Special habitat requirements

Canyon wrens require cliffs and large tangles of boulders for foraging and nesting (Grinnell and Miller, 1944; Miller and Stebbins, 1964). They have a preference for areas near water and are "devoted to shade... and shadows" (Grinnell and Miller, 1944).

F. Seasonal changes in habitat requirements

Canyon wrens are year round residents (Grinnell and Miller, 1944; Peters, 1960).

G. Physiological ecology

The canyon wren habitat provides protective shade from the intense summer heat and exposure. "Thus their immediate habitat is not desert-like and their moisture problem would not seem to be serious" (Miller and Stebbins, 1964). The canyons frequently have residual tanks of water if not springs.

V FOOD

A. Food preferences

Beal (1907) commented that the small sample of canyon wren stomach contents indicated that their diet was similar to that of Bewick's wren. If true, the major constituents are Hemiptera, Coleoptera, and Hymenoptera.

B. Foraging areas

The humid environment among the rocks at the bottom of canyons offers a good foraging habitat for insectivorous birds such as the canyon wren (Linsdale, 1938).

Catherpes mexicanus (con't.)

C. Foraging strategies

Canyon wrens climb "over, under and around rocks, searching every nook and cranny for hidden insects and spiders" (Bent, 1948).

D. Feeding phenology

no information located

E. Energy requirements

no information located

VI REPRODUCTION

A. Age of first breeding

no information located

B. Territorial behavior

Male canyon wrens utilize song to advertize their territorial position. The song consists of 7-10 descending notes of a rich, vibrant, liquid quality which become plaintive at the end (Bent, 1948).

The males become very belligerent when exposed to immitations of their songs. They approach to sing competitively or give their location note (Miller and Stebbins, 1964).

C. Courtship and mating behavior

Little information located (ed.). The male canyon wren helps the female build the nest, incubate the eggs, and feed the nestlings and fledglings (Verner and Willson, 1969). Pierce (1907) reported that only the female brooded at night.

D. Nesting phenology

Miller and Stebbins (1964) did not observe males in breeding plumage until after early April, but nesting was in progress by early May in Joshua Tree National Monument.

Bent (1948) reported the following egg dates for California: 68 records, March 28 to July 11; 34 records April 21 to May 17, indicating the height of the season.

E. Length of incubation period

no information located

F. Length of nestling period

no information located

Catherpes mexicanus (con't.)

G. Growth rates

no information located

H. Post-breeding behavior

The young are fed after they leave the nest (Verner and Willson, 1969).

VII POPULATION PARAMETERS

A. Clutch size

Canyon wrens usually lay 5 or 6 eggs per clutch (Bent, 1948), sometimes 4 eggs (Wetmore, 1920), and rarely more than 6 eggs (Bent, 1948).

B. Nesting success

no information located

C. Mortality rates per age class

no information located

D. Longevity

no information located

E. Seasonal abundance

Canyon wrens are year-round residents (Grinnell and Miller, 1944; Peters, 1960).

F. Habitat density figures

Cody (1974) found that canyon wrens occupied only 27% of the available oak woodland habitat in the breeding season and 34% during the winter. They also were scarce in the chaparral, occupying only 22% of this habitat during the winter.

VIII INTERSPECIFIC INTERACTIONS

no information located

IX STATUS

A. Past population trends

no information located

B. Present population status

The Seventy-seventy Audubon Christmas bird count (1977) recorded canyon wrens at 11 out of 21 desert and near desert areas. The areas (and numbers of canyon wrens observed) were as follows: Bakersfield (1), Claremont (7), Granite-Woody-Glennville (3), Joshua Tree National Monument (2), Orange

Catherpes mexicanus (con't.)

County NE (3), Pasadena (10), Redlands (1), San Bernardino Valley (5),
Sespe Wildlife Area (4), Springville (14), Thousand Oaks (4).

C. Population limiting factors

no information located

D. Environmental quality: adverse impacts

no information located

E. Potential for endangered status

no information located

X Additional references

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ROCK WREN

Salpinctes obsoletus

I TAXONOMY

A. Type description

Salpinctes obsoletus obsoletus, northern rock wren: Troglodytes obsoletus Say, 1823, in Long. Exped. Rocky Mts. 2:4 - Douglas County, Colorado (Peters 1960).

Synonomies - Troglodytes latifasciatus, Salpinctes obsoletus notius (Peters 1960), Salpinctes obsoletus pulverius, Salpinctes pulverius; rock wren, San Nicolas rock wren (Grinnell and Miller 1944).

B. Current systematic treatment

Order Passeriformes, family Troglodytidae, genus Salpinctes Cabanis, 1847, Arch. Naturg. 13(1):323 (Peters 1960).

Peters (1960) recognizes 6 subspecies of rock wren: obsoletus, guadeloupensis, tenuirostris, exsul, neglectus, guttatus. Of these subspecies only obsoletus occurs in the U.S. and exsul is probably extinct.

C. Recent taxonomic revisions

The Supplement to the AOU Checklist of North American Birds (1973, Auk 90:411-419) indicates that there have been no changes in wren taxonomy since the 5th edition of the Checklist (1957).

II DESCRIPTION

A. External morphology of adults

The rock wren is a "moderate-sized (14-17 gram) wren, gray above with fine black and white flecks, buffy on the rump. Below whitish to light gray, obscurely streaked, the flanks pale buff; tail gray basically, finely barred with buff and with subterminal dark patches and light buff tips; edges of tail coarsely barred with black and buff; wings extremely finely barred with gray and buff. Bill long (1½ cm) and moderately curved" (Miller and Stebbins 1964). This coloration is particularly suited for blending into the rocks (Bent 1942).

B. External morphology of subadult age classes

In juvenile plumage the underparts are faintly and narrowly barred with dusky, instead of streaked, and lack white spots. There are no spots on the rump, and the underparts are whiter and unspotted with a brownish wash on the flanks (Bent 1948).

C. Distinguishing characteristics

Interspecific - The canyon wren has a white breast and brown abdomen in contrast to the uniform color pattern of the rock wren. In addition, the canyon wren has no terminal bands on the tail feathers (Bent 1948).

D. Special morphological features

The rock wren... has acquired a special flatness of body structure, which is an obvious adaptation to allow it passage through horizontal crevices" (Grinnell and Storer 1924).

III DISTRIBUTION

A. Overall distribution of the species

The rock wren occurs in the western half of North America from southern Canada south to the highlands of Nicaragua. All subspecies except obsoletus occur in Mexico and Central America, 3 on islands (guadeloupensis, tenuirostris, exsul) and 2 on the mainland (neglectus, guttatus) (Peters 1960).

S. o. obsoletus "breeds north to interior southern British Columbia, southern Alberta and southwestern Saskatchewan, east to western North Dakota, western Kansas, western Texas, Coahuila, San Luis Potosi, and southwestern Tamaulipas, west to the coast and nearby islands..., and south to Oaxaca, Puebla, western Veracruz, and southwestern Tamaulipas" (Peters 1960).

B. California distribution of the species

The rock wren breeds throughout California wherever there is suitable habitat (Grinnell and Miller 1944).

C. California desert distribution

The rock wren breeds in Inyo and San Bernardino Counties, in Death Valley, and in the Colorado River Valley (Grinnell and Miller 1944). Specific areas of desert inhabitation include Joshua Tree National Monument (Miller and Stebbins 1964), Panamint Mountains (Wauer 1964), and Death Valley (Wauer 1962).

D. Seasonal variation in distribution

The northern populations of rock wrens migrate to southern portions of the breeding range. Populations are largely resident below northern California, central Arizona, central New Mexico, and southern Texas southward (Peters 1960), although populations breeding at higher elevations move southward and downward to escape the snow (Grinnell and Miller 1944; Wauer 1964).

IV HABITAT

A. Biotopic affinities

The rock wren frequents the Upper and Lower Sonoran Life Zones and occasionally the Hudsonian life zone (Grinnell and Miller 1944). In the Panamint Mountains, rock wrens occur in valley alluvial fans where Atriplex and Larrea intermingle where they are the most common bird present (Wauer 1964). They are also found in higher zones such as the upper canyons of the Lower Sonoran Life Zone, high desert sage flats, pinon-juniper woodland and bristlecone pine associations.

The rock wren occurs in a more arid habitat than the canyon wren, although it still utilizes shade under rocks to avoid heat (Grinnell and Miller 1944, Miller and Stebbins 1964). Most activities occur on "bare, windswept, sunny, rocky surfaces, either steep or gently sloping, in valleys, foothills, or wide canyons, where there are piles of broken rocks or scattered boulders and generally little or no vegetation" (Bent 1948).

B. Altitudinal ranges

The rock wren occurs from -250 feet to 12,500 feet if the habitat is suitable (Grinnell and Miller 1944, Bent 1948).

C. Home range size

Hensley (1954) observed 5 and 8 breeding pairs per 100 acres in the Colorado Desert of Arizona.

D. Territorial behavior

Perch site - Rock wrens use rock "corners" as perch sites (Grinnell and Miller 1944).

Courtsip and mating sites - No information located.

Nest sites - Rock wren nests are found in natural holes or crevices in arroyo banks, walls, rocks, cliffs (Bailey 1904, Bent 1948). Smith (1904) observed 13 nests in a limestone quarry. There were 5 nests in crevices in the quarry wall at heights of 10 to 20 feet. Five occurred in cavities formed by large rocks on the canyon floor. One occurred in a tree root cavity, one in a building wall and one in a pipe outlet on a cistern.

One striking characteristic of rock wrens is their use of small stones to build a pavement or walk in front of the nest and in some cases, even a barrier to prevent entrance by other birds or animals (Bailey 1904, Smith 1904, Bent 1948).

E. Special habitat requirements

Rock wrens require rock crevices for foraging, shelter, emergency refuge and nest sites (Grinnell and Miller 1944).

F. Seasonal changes in habitat requirements

Rock wrens generally move downslope to just below snowline in winter. Some wrens stay in their rocky retreats all year, while others move to more sheltered brush lands or onto open mesas (Bent 1948).

G. Physiological ecology

Rock wrens have not been observed drinking in the field or in the laboratory, and did not lose weight or become dehydrated under the latter conditions (Smyth and Bartholomew 1966). The wrens forage around water holes after June when flying insects become scarce until new green vegetation appears. They probably rely on ground insects which are abundant in most areas (Smyth and Bartholomew 1966).

Rock wrens escape the heat by retreating into rock crevices and under boulders (Miller and Stebbins 1964, Smyth and Bartholomew 1966). They also move upslope to escape the summer heat of Death Valley, breeding in the Lower Sonoran, pinon-juniper woodlands, and high desert scrub (Wauer 1964).

V FOOD

A. Food preferences

Beal (1907) stated that the limited samples of stomach contents from rock wrens were similar to those of Bewick's wren. If this is true, the primary constituents of the diet are Hemiptera, Coleoptera, and Hymenoptera.

Knowlton and Harmeston (1942) observed the contents of 88 stomachs and found the following components: Hymenoptera (1171 individuals, 1097 ants), Homoptera (776, 326 leafhoppers), Hemiptera (418, 319 Nysius), Aphididae (417), Coleoptera (106), Orthoptera (104), Lepidoptera (43 plus 45 eggs), Diptera (29), miscellaneous (42), insect eggs (51), other arthropods (7), weed seeds (30).

B. Foraging areas

The rock wren forages over, under and around rocky taluses and outcroppings (Grinnell and Miller 1944, Bent 1948, Smyth and Bartholomew 1966).

C. Foraging strategies

No information located.

Salpinctes obsoletus (Cont'd)

D. Feeding phenology

No information located.

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

The male sings to advertise his presence on a territory and to attract and stimulate a mate (Kroodsma 1975). Each male has a large number of songs in his repertoire (70 - 120 songs) which may serve to reduce the habituation or increase the stimulation of nearby males and females. The wrens intersperse frequently-used song types (for recognition) with infrequently-used song types (for stimulation). Neighboring males tend to sing shared song types more often. These are used in territorial countersinging; the copy rate is 41% under these conditions as opposed to 8% if singing were random. Therefore, males in a given locality tend to share more song types.

C. Courtship and mating behavior

The male songs serve to attract and stimulate females. Kroodsma (1975) hypothesizes that the large song repertoire of the male functions to reduce habituation and enhance stimulation of the female.

The male helps build the nest, incubate the eggs, and feed the nestlings and fledglings (Verner and Willson 1969).

D. Nesting phenology

Bent (1948) reported the following egg dates for California: 77 records, February 5 to July 28; 47 records, April 3 to May 15, indicating the height of the season (see also Bailey 1904, Smith 1910).

E. Length of incubation period

No information located.

F. Length of nestling period

No information located.

Salpinctes obsoletus (Cont'd)

G. Growth rates

No information located.

H. Post-breeding behavior

Some rock wrens remain in their rocky habitats throughout the year, whereas others move down to more sheltered brush lands or open mesas (Bent 1948).

VII POPULATION PARAMETERS

A. Clutch size

Clutches of 5 and 6 eggs are commonest, but clutches of 4, 7, 8 and even 10 have been found (Bent 1948). Smith (1910) found 1 nest with 3 eggs, 4 nests with 5 eggs or young, 5 nests with 6 eggs or young, and 3 nests with 7 eggs.

Rock wrens frequently have 2 broods and sometimes 3 broods each breeding season (Bent 1948).

B. Nesting success

No information located.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

E. Seasonal abundance

No specific information located. Local fluctuations may occur in populations depending on the amount of in or out migration between summer and winter.

F. Habitat density figures

Hensley (1954) observed values of 5 and 8 breeding pairs per 100 acres in two years on the Colorado Desert in Arizona.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Taylor (1912) observed rock wrens chasing a chipmunk suggesting that small rodents might prey on rock wren eggs and nestlings.

Salpinctes obsoletus (Cont'd)

Ogden and Hornocker (1977) found remains of rock wrens in 2% of the prairie falcon eyries that they sampled in Idaho.

B. Competition

The rock wren is found in a more arid habitat than the canyon wren and the two probably come into contact only infrequently (Grinnell and Miller 1944, Miller and Stebbins 1964).

C. Parasitism

Rockwell and Wetmore (1914) found a nestling infested with large white grubs that were slowly killing it.

Friedmann (1934) reported that the rock wren is an occasional cowbird host.

IX STATUS

A. Past population trends

No information located.

B. Present population status

The seventy-seventh Audubon Christmas bird count (1977) observed rock wrens in 20 out of 22 desert or near desert areas censused. The areas (and numbers of rock wrens observed) were as follows: Bakersfield (1), Butterbread Spring (9), Carrizo Plains (3), China Lake (2), Claremont (16), Death Valley (1), Granite-Woody-Glenville (2), Idylwild (8), Joshua Tree National Mounment (8), Orange County NE (6), Pasadena (17), Redlands (13), Salton Sea N (2), San Bernardino Valley (21), San Fernando Valley (9), Sespe Wildlife Area (8), Springville (11), Thousand Oaks (6), Parker, Arizona-Colorado River (19), Yuma, Arizona (16).

C. Population limiting factors

No information located.

D. Environmental quality: adverse impacts

No information located

E. Potential for endangered status

No information located

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California. Condor 66:287-301.

BENDIRE'S THRASHER
Toxostoma bendirei

I TAXONOMY

A. Type description

Harporhynchus bendirei - AOU (1957) Coues, Am. Nat., 7, No. 6, June 1873.

B. Current systematic treatments

Mayr and Greenway (1960) lists 3 races, bendirei, candidum, and rubricatum, the latter 2 of which occur in Sonora.

Synonymies - Grinnell and Miller (1944), Harporhynchus bendirei.

II DESCRIPTION

A. External morphology of adults

Ridgway (1907), "Similar in coloration to T. curvirostris but browner above and with spots on chest smaller, more sharply defined, and more triangular, and proportions very different." (autumn and winter adults) "Similar to the spring and summer plumage, but color of upper parts grayer (between hair brown and drab-gray), tertials margined terminally with dull whitish, and markings on chest darker." Adult female - length 227-247 (235) mm; wing 97.5-108.5 (103.2) mm; tail 101.5-115.5 (107.8) mm; exposed culmen 21.5-25.5 (23.4) mm; tarsus 31.5-34.5 (33.2) mm; middle toe 21.5-24.5 (22.7) mm. Adult male - length 232-247 (240) mm; wing 103-107.5 (105.7) mm; tail 108-115 (111.4) mm; exposed culmen 21.5-25.5 (24.3) mm; tarsus 33-34.5 (33.8) mm; middle toe 22-24 (23.2) mm. Brandt (1951) noted natal plumage: top of head light drab; body drab gray; bill, legs, and feet, light drab. Peterson (1961), "... known by its shorter, more robin-like bill. Breast faintly spotted. Eye clear yellow."

B. External morphology of subadult age classes

Ridgway (1907) noted young - essentially like summer adults but lower back, rump, and upper tail-coverts more cinnamon... and under parts narrowly streaked with grayish brown. Bent (1948) reported juvenal plumage: upper parts tinged with brown, the secondaries and tertials edged with buffy brown, and the tail tipped with buffy brown. Bailey (1928), "young: similar (to adults), but wings and rump rusty or tawny; underparts narrowly streaked."

C. Distinguishing characteristics

Interspecific - Phillips et al (1964), "Bendire's thrasher is extremely similar in appearance to the abundant curve-billed thrasher... nests and eggs of the two are entirely different." Ligon (1961), "The Bendire's - whose range overlaps that of the curve-billed and crissal - is smaller than either." Diagrammatic representations of the variation in length and curvature of the bill in the various members of Toxostoma, including bendirei (Engels, 1940). Peterson (1961), "Similar species: curve-billed

Toxostoma bendirei (con't.)

thrasher usually has a longer, more curved bill... more orange eye." Robbins, Bruun, and Zim (1966), "The best field mark of this small thrasher is the short bill... note the indistinct breast streaks and the lemon-yellow eye."

Intraspecific - Ligon (1961), "Color pattern of sexes alike."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from southeastern California (Victorville, Warrens Wells, Rock Spring), northwestern Arizona (Beale Spring), southern Nevada (Delmar), southern Utah (Garfield, San Juan, and Kane Counties), and southwestern New Mexico (Millers Ranch, Rodeo) south to Sinaloa. Winters from southern Arizona (Phoenix) south to southern Sinaloa (Esquinapa Mountains). Accidental in southwestern California (Los Angeles), central northern Utah (Lehi), and Colorado (Austins Bluffs)." Ridgway (1907), "Desert districts (upper and lower Sonoran zone) of Arizona, southeastern California (Colorado desert) and northern Sonora (Ortiz); southward in winter to southern Sonora (Guaymas; Camoa; Alamos), and northern Sinaloa (Culiacan), accidental in Colorado (Colorado Springs)." Breeds from southeastern California, southern Nevada, and southern Utah south through Arizona and southwestern New Mexico to northern Sonora, Mexico; winters chiefly in Sonora and northern Sinaloa, Mexico (Mayr and Greenway, 1960). Peterson (1961), "Breeds locally from deserts of southeastern California, southern Nevada, southern Utah, northern Arizona, northwestern New Mexico to Sinaloa. Casual in southwestern California, Nevada, Colorado."

B. California distribution of the species

Grinnell and Miller (1944) noted in Colorado and Mohave deserts. Life-zone, lower Sonoran. Locations of occurrence are as follows: Palm Springs and Whitewater, Riverside County; Morongo Pass, near Victorville, near Cima, and near Rock Spring, San Bernardino County; immature taken in Los Angeles suburb (1912). Bent (1948), "The southwest is rich in species and subspecies of this genus. Bendire's thrasher is one of the most limited in its range, breeding only in southeastern California, Arizona, southwestern New Mexico, and northern Sonora." Dawson (1923), "Occurrence in California - not common breeder on the Mohave desert (at least near Victorville), probably also on the Colorado desert."

C. California desert distribution

McCaskie (1974), "A lone Bendire's thrasher at Stove Pipe Wells June 1 was a little to the north of its range, and may be the first recorded in Death Valley." Small (1974), "The Bendire's thrasher... has established a viable isolated population in the Joshua Tree forests south of Cima in northeastern San Bernardino County although they do not occur in California's intervening Sonoran desert or in the riparian woodlands of the lower Colorado River." Miller and Stebbins (1964), "... breeds in

Toxostoma bendirei (con't.)

the Mohave desert, but very locally, and the numbers are distinctly variable from year to year." First nesting record for California; nest and eggs taken 11 April 1920 - photo included with article of nest found near Victorville (Pierce, 1921). Heller (1901), "Found fairly common in May, 1896, at Warrens Wells" (Mohave desert).

D. Seasonal variations in distribution

Phillips, Marshall, and Monson (1964), "... differs from all other thrashers of our southern Arizona lowlands in its pronounced migrations... gone from northern half of state by late August... return to Tucson in late January. Migrations in southern Arizona are difficult to decipher... most leave in September and return in early February." Bailey (1928), "... winters south to northern Sinaloa." Johnson, Bryant, and Miller (1948), "The species was apparently migratory, because none was found in January near Cima, where the birds were conspicuous in May." Bendire's thrashers wander to coastal California from their inland breeding sites in winter (McCaskie, Stallcup, and De Benedictis, 1967). Scott (1888), "... a very considerable migration, as the birds are much more common in the spring and during breeding season..." Brown (1901), "... as a whole, they go south bodily on the first fall storm of wind or rain... The return migration is more gradual." McCaskie (1975), "The only Bendire's thrasher on the coast was one in San Diego November 27." Peterson (1961), "Winters from southern Arizona south." Bent (1948), "... there seems to be a very considerable migration."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Flat desert floor where scatteringly grown to clumps of cholla cactus, yucca of one species or another, and bushes of various kinds." Phillips, Marshall, and Monson (1964), "Found especially where stretches of open ground meet tall dense bushes and/or cholla cacti." Johnson, Bryant, and Miller (1948), "... were on nearly level terrain among scattered Joshua trees." Peterson (1961), "Desert, farmland, cholla, thorny bushes."

B. Altitudinal range

Grinnell and Miller (1944) noted found to 4700 feet at Rock Spring, San Bernardino County. Bailey (1923), "... in the mesquite and catsclaw a little below 4000 feet." Jewett (1940), "... at an altitude of about 5500 feet in the Joshua tree belt" (first state record). Bent (1948), "... up to 4000 or even 6500 feet in the mountains." Sightings indicate that these thrashers breed to at least 6500 feet elevation in Arizona and New Mexico (Jenks, 1937).

C. Territory requirements

Perch sites - Bailey (1928), "... nesting near houses, on which it perches to sing."

Toxostoma bendirei (con't.)

Nest sites - Miller and Stebbins (1964), "It occurs in the Joshua tree belt, nesting often in cholla cactuses." Brandt (1951), "Its nest was in the upright fork of a palo verde bush, about three feet from the ground... a nest two feet up among the daggers of a bushy Spanish bayonet... (yucca)." Brown (1901) reported of 50 nests taken, 34 were in tasajias (yucca), 11 in chollas, 3 in tesota bushes, 1 in mesquite tree, and 1 in a willow tree. Nest heights = 6 inches to 20 feet. Ligon (1961), "the nest was in a hackberry bush that grew in association with desert willow, catclaw, and Apache-plume (Fallugia paradoxa)."

"... a nest... in a dense, isolated cholla (Opuntia ramosissima) at the edge of a clearing in the Joshua tree forest. (Two photographs of nest and nest site are included).. a nest... was found 3½ feet above ground in a cholla" (Johnson, Bryant, and Miller, 1948). Bailey (1928), "Nest - in bushes, mesquite, mistletoe, palo verde, catsclaw, or cactus." Reed (1965), "nest 3 feet up in a cholla cactus." Gilman (1915a) notes Bendire's thrasher nesting in a deserted flicker nest. Gilman (1909), "Of the thirty-nine nests, 13 were in Lycium bushes; 3 in mistletoe, in mesquite and catsclaw (Acacia greggii); 3 in palo verde, 2 in catsclaw, 2 in Sarcobatus, 1 in screw-bean, and 1 in a saltbush. The average height was 5 feet" (range = 3-10 feet). Pierce (1921) reported nest near Victorville, California, was four feet up in cholla cactus.

V FOOD

A. Food preferences

Brandt (1951), "One of the fledglings... fed an entire, large, rough, coarse grasshopper." Engels (1940), "... was found to be carrying small, green, wormlike larvae... from a cultivated field." Woodbury (1939), "... where berries were available, but they appeared to be feeding largely upon small green moth caterpillars." Bent (1948), "... lives largely on insects, such as beetles, caterpillars, and other larvae and pupae."

B. Foraging areas

Small (1974), "The wide avenues among the desert shrubs are suitable pathways for escape and foraging for such strong runners as... Bendire's" - this statement given for Le Conte's and crissal, also.

C. Foraging strategies

Wetmore (1964), "... probes the ground with his bill to dig out morsels of food." Engels (1940), "... occasionally jumping up into the air as if catching insects... the feet are not used for scratching... peck and probe with the bill or poke around in litter, sometimes hammering the bill straight into the ground... bendirei have relatively straight, short bills and have never been observed to dig."

VI REPRODUCTION

A. Courtship and mating behavior

Bent (1948), "... arrive early in March, and begin mating and nesting almost at once." Scott (1888) noted singing begins upon arrival of the birds in early March.

Toxostoma bendirei (con't.)

B. Nesting phenology

Brandt (1951), "... this thrasher is a rather late nester; our earliest record for fresh eggs is April 26. The peak of the season is about May 15; while June 3 is my latest record." Also reported earliest nesting (fresh eggs) is about March 15; height of season is during the last third of April; latest record is July 11; an extended (nesting) season of about 4 months. Visher (1910), "... do not seem to adapt their nesting period to the rainy seasons" - states that broods are usually brought off by mid-April. Brown (1901), "The first week in March will frequently find them nesting, and the middle of April... second broods." Reed (1965), "... laying their first sets in March and early April and usually raising two broods a season." Bent (1948), "... two broods in a season seems to be the rule, with sometimes a third brood. Egg dates - Arizona: 143 records, February 24 to August 1; 76 records, March 16 to April 15, indicating the height of the season." Gilman (1915), "... hatched three young, these leaving the nest about the first of May." Gilman (1909), "... first nest and egg being March 7... latest date was June 10." An adult male collected on 27 June had "greatly enlarged (testes), probably indicating that it was breeding" (Jenks, 1937). Dawson (1923), "nesting season: April - June; one brood."

C. Length of incubation period

Bent (1948), "no one seems to have determined the period of incubation ... probably does not differ materially from other desert thrashers."

D. Length of nestling period

Bent (1948), "no one seems to have determined... the length of time that the young remain in the nest."

E. Post-breeding behavior

Scott (1888) noted young tend to flock after fledging; were seen associated with T. curvirostris and T. dorsale.

VII POPULATION PARAMETERS

A. Clutch size

Peterson (1961), "eggs (3-4) pale greenish, spotted." Reed (1965) noted lay 3 or 4 eggs; size 1.00 x 0.72 inches.

B. Mortality rates per age class

Johnson, Bryant, and Miller (1948), "... the fourth (young) was a runt, and was nearly dead."

C. Seasonal abundance

Bent (1948), "... as the birds are much more common in the spring and during the breeding season than during the late fall and winter months" (see seasonal variation in Distribution - ed.).

Toxostoma bendirei (con't.)

D. Habitat density figures

Bent (1948), "... it is not very common anywhere." Emlen (1974) noted density of Bendire's thrashers in desert as 0.2 birds/100 acres and in urban area 0.0 birds/100 acres.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Friedmann (1963) reported one record (3 April 1885 from Arizona) of 1 brown-headed cowbird egg in a nest with 3 Bendire's thrasher eggs.

B. Competition

Engels (1940), "The fact of ecological segregation of species over a common geographical area leads one to infer the presence of distinctive adaptations in each species to the special requirements of its preferred habitat" - discussing Toxostoma. Gilman (1915), "The 15th of May the female began fighting the kingbird for the nesting site... kingbirds drove her away."

IX STATUS

A. Past population trends

Grinnell (1915) reported only three records before 1912: Agua Caliente, Palm Springs; Warrens Wells, Mohave desert; and Los Angeles. Willett (1933), "Apparently rather uncommon resident east of mountains. One record for Pacific slope (10 September 1912)." Fisher (1903), "... has extended its range... by a route along the Colorado and Little Colorado Rivers and their tributary valleys." Collected an adult male on 7 May 1916 near Victorville, California; did not believe that the species nested in the area (Pierce, 1919).

B. Present population status

Grinnell and Miller (1944), "Summer resident; at least, our records to present time, are for spring and summer. Population for scattered and aggregate numbers small." Phillips, Marshall, and Monson (1964), "It is favored by man's clearing and agricultural activities, and is probably much commoner now than originally." McCaskie (1974) reported more than the average number of breeding thrashers were noted in the southern California deserts. McCaskie, Stallcup, and De Benedictis (1967), "... breeds in small numbers on the deserts of southeastern California."

C. Environmental quality: adverse impacts

Emlen (1974), "The absence of... Bendire's thrasher... from the urban area is probably also attributable to... human activities."

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LE CONTE'S THRASHER
Toxostoma lecontei

I TAXONOMY

A. Type description

Toxostoma lecontei - AOU (1957) Lawrence, Ann. Lyc. Hist. New York, 5, no. 4, September 1851. California near the junction of the Gila and Colorado Rivers = Fort Yuma, California.

B. Current systematic treatments

Grinnell (1933), "... there is only a faint average relative darkness of the San Joaquin population... as indicating result of its isolation there - but not sufficient for recognition nomenclaturally."

Sheppard (1970) lists 3 subspecies: T. l. lecontei; T. l. arenicola; and T. l. macmillanorum.

Hellmayr (1934) recognizes 2 races of Toxostoma lecontei, including lecontei, whose range includes the lower deserts of southeastern California, southern Nevada, southwest Utah, Arizona, and northeastern Baja California south to San Felipe Bay; also southern San Joaquin Valley from Onyx and Buena Vista Lakes, to near Huron, Fresno County, and southwestern Sonora.

Mayr and Greenway (1960) lists 2 races, lecontei and arenicola, the latter of which occurs only in Baja California.

Synonymies - Grinnell and Miller (1944), Toxostoma lecontei; Harporhynchos lecontii; H. lecontei; H. redivivus lecontei; H. redivivus lecontii. Le Conte mocking bird; Le Conte thrasher; Leconte mock-thrush; Leconte mocking thrush; Le Conte thrush; Yuma thrasher.

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "A very pale thrasher of the desert with a dark tail and dark eyes." Sheppard (1970), "... identified by its moderately de-curved bill, medium size (9.5 inches), and plain gray-brown colors." Ridgway (1907) of adults in autumn and winter - Similar to the spring and summer but upper parts deeper and grayer. Adult female - length 237-260 (250) mm; wing 93-97.5 (95.4) mm; tail 114.5-127 (118.7) mm; exposed culmen 30-35.5 (32.7) mm; tarsus 30.5-32 (31.3) mm; middle toe 21-22.5 (21.5) mm. Adult male - length 240-266 (255) mm; wing 95-101 (98.1) mm; tail 114-126.5 (121.7) mm; exposed culmen 30-34.5 (32.8) mm; tarsus 28.5-32 (31) mm; middle toe 20-22 (21.1) mm.

B. External morphology of subadult age classes

Bent (1948) reported juvenal plumage is similar to the adult plumage but slightly paler, especially on the rump. Ridgway (1907) reported

Toxostoma lecontei (con't.)

young - similar to spring and summer adult plumage but slightly paler.

C. Distinguishing characteristics

Interspecific - Peterson (1961), "Similar species: crissal and California thrashers are much darker; curve-billed thrasher has lightly spotted breast." Robbins, Bruun, and Zim (1966), "The dark bill and black eye line contrasting with the pale gray body distinguish it from the darker California and crissal thrashers." Engels (1940) gives a diagrammatic representation of the variation in length and curvature of the bill in the various members of Toxostoma, including lecontei.

Intraspecific - Miller and Stebbins (1964), "Iris dark in adults." Mearns (1886) lists measurements and plumages of age classes. Sheppard (1970), "... no sexual dimorphism."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species.

AOU (1957) in describing T. lecontei, "Semi-arid and desert regions of central California, southern Nevada, southwestern Utah, and western and central Arizona south to central Baja California and northwestern Sonora."

AOU (1957) in describing T. l. lecontei, "Resident from central California east of the coast ranges (Arroyo de los Gatos, Coalinga, eight miles northeast of Bakersfield, Little Owens Lake, Benton), southern Nevada (Table Mountain, Ash Meadows, Virgin Valley), southwestern Utah, and western and central Arizona (edge of the plateau escarpment in the extreme northwest, Fort Mohave, Phoenix, Casa Grande) south to northeastern Baja California (Colorado desert, Laguna Salada, San Felipe Bay) and northwestern Sonora (Punta Penascosa)."

Ridgway (1907) reported desert (lower Sonoran zone) of southwestern Utah (west of Beaverdam Mountains), southern California (Inyo, Kern, San Bernardino, eastern Riverside, and eastern San Diego Counties), Arizona, and northwestern Sonora (south to Cape Lobos). Mayr and Greenway (1960) noted California (west and south San Joaquin Valley, Colorado, Mohave, and Inyo districts), southern Nevada, southwest Utah, and central southern Arizona, and south in Mexico to northeastern Baja California and northwestern Sonora. Peterson (1961), "Sparse resident from southern California, southern Nevada, southwestern Utah, western and central Arizona to northwestern Mexico."

B. California distribution of the species

Dawson (1923), "Of fairly common occurrence in suitable cover in southeastern deserts, west regularly to Banning and Antelope Valley, north casually to Benton; also irregularly and locally distributed in the Tulare basin; thus, colonies at Buena Vista Lake, Onyx, Bakersfield, McKittrick, and northwest of Tulare Lake between Huron and Arroyo Los

Toxostoma lecontei (con't.)

Gatos. Casual near Julian, San Diego County." Grinnell (1933), "... population of Toxostoma lecontei occupying portions of the San Joaquin Valley is completely cut off from the main range of the species, which covers the Mohave and Colorado deserts." Bent (1948), "There are two northward extensions of the breeding range... in California, in Owens Valley and in the San Joaquin Valley." Grinnell and Miller (1944) lists numerous site and specimen records throughout the bird's Californian range. Peterson (1961), "... southeastern deserts, western and southern sides of San Joaquin Valley..." Goldman (1908), "Not previously recorded in the San Joaquin Valley from north of Buena Vista Lake." Sheppard (1970), "Persons looking for this species should investigate the Taft-Maricopa area of the San Joaquin Valley, the areas around Mojave and Cima, California."

C. California desert distribution

Sheppard (1970), "... inhabits some of the hottest and driest portions of the American southwest (Death Valley, Bennett's Well, Panamint Mountains, Harrisburg Flats)." Grinnell (1933) gives a figure of occurrence of Le Conte's thrashers in the San Joaquin Valley and along the western edge of the Mohave desert. Mailliard and Grinnell (1905) notes wintering Le Conte's thrashers. Johnson, Bryant, and Miller (1948), "We found them (in the Providence Mountains) only in the summer." Miller and Stebbins (1964), "Rains in the desert are spotty and local, and a Le Conte thrasher 'colony' could move a few miles to a new site... We suspect that this kind of shifting goes on..."

IV HABITAT

A. Biotopic affinities

Small (1974), "Le Conte's thrashers occur sparingly among the creosote bushes, preferring denser stands of saltbushes, palo verde trees, and mesquite." Bent (1948), "... lives mainly in the lowest, barrenest, and hottest desert plains and valleys of southwestern Arizona and southeastern California." Miller and Stebbins (1964), "... occur in flat open desert or in large washes where large shrubs or chollas are widely scattered. The creosote bush association is typically occupied..." Grinnell and Miller (1944), "Desert washes and flats with bushes far scattered and with large areas of open, usually sandy or alkaline terrain, prevailing of light color. The creosote-bush association not infrequently presents conditions suitable for this thrasher." Phillips, Marshall, and Monson (1964), "The habitat there (Arizona) is sandy drainageways with occasional chollas and mesquites (the latter for nests) within the bleak creosote desert." Johnson, Bryant, and Miller (1948), "... these thrashers stayed along the washes where there were clumps of desert willow and unusually large creosote bushes." Engels (1940), "... prefers somewhat more open country... with sandy soil and scattered bush. Were found concentrated along deep draws and washes, where the salt-bush (Atriplex)... was much more dense... Occur only in the lower Sonoran life zone." Jaeger (1947) reported used creosote bush for shelter and

Toxostoma lecontei (con't.)

shade. Peterson (1961), "Desert flats with sparse bushes, Atriplex." Robbins, Bruun, and Zim (1966), "Common in certain sagebrush and very open cactus deserts." Sheppard (1970), "... prefers an open desert scrub habitat (Atriplex, Opuntia)."

B. Altitudinal range

Miller and Stebbins (1964), "Altitude as such seems to be no barrier if the terrain is fairly flat and open." Grinnell and Miller (1944), "Altitudes of occurrence from -250 feet in Death Valley up to 5000 feet in Walker Pass, Kern County." Johnson, Bryant, and Miller (1948), "... were all in the creosote bush belt at elevations between 2100 and 3500 feet." Grinnell (1933), "... over the Walker and Kelso passes (of altitude 5248 and 5300 feet, respectively)... down to about 2500 feet, in the vicinity of Isabella." Sheppard (1970), "... from -280 feet... to about 5250 feet."

C. Territory requirements

Sheppard (1970), "utilize about 100 acres over a year's period. Very territorial species through much of the year. Defense of the territory seems to reach a peak from early December to early February..."

Perch sites - Mearns (1886), "Perched upon a mesquite - top... sing so loudly."

Nest sites - Bent (1948), "The birds seemed to select the densest, most thickly branched chollas... and the nests averaged about 3 feet above ground. Found occupied nests in ocotillo, cholla cactus, fruitea, smoke bush, and ironwood." Grinnell and Miller (1944), "Protection, but not necessarily concealment, for the large bulky nests is provided by cholla cactus; other thorny plant types resorted to are mesquite, palo verde, and Atriplex." Reed (1965), "... (nest) 4 feet from the ground in a small shrub." Peterson (1961) reported nest: a bulky bowl of twigs in cholla, thorny bush." Pemberton (1916) noted three nests were examined in Riverside County, California - nest sites: 2.5 feet up in a cholla cactus; 5 feet up in a yucca; in the center of a cholla cactus (2 photos, of nest sites and nest and eggs, are included). Gilman (1909), "... nest was found in a palo verde... Two old nests were found in chollas." Willett (1917) notes nesting of Le Conte's thrasher in Kern County; nest sites in Atriplex bushes. Grinnell (1933), "The nest bush was one of a row of large-sized Atriplex bushes growing irregularly along the edges of... a gully." Hanna (1933), "... found a typical nest in the center of a cholla cactus on the open desert." Hanna (1933a), "Probably ninety-nine per cent of the large deep nests of the Le Conte thrasher... have been in cacti." Mearns (1886), "... in a mesquite, at a height of six or eight feet." Sheppard (1970), "nesting sites... only occasionally exceeds 4.5 feet."

D. Special habitat requirements

Miller and Stebbins (1964), "Stout, dense bushes are required for holding and protecting their bulky nests... and in a few places the absence of

Toxostoma lecontei (con't.)

such bushes may render the locality unsuitable for them." Engels (1940), "... are greatly restricted... to open areas with scattered bush and with loose, sandy soil."

E. Seasonal changes in habitat requirements

Bent (1948), "Climatic variations in the seasons appear to have an effect on the numbers of the birds."

V FOOD

A. Food preferences

Bent (1948), "The stomach of a specimen... contained a small species of katydid and some ants." Small (1974), "Those birds which feed on fallen seeds include... Le Conte's thrasher." Sheppard (1970), "consists almost wholly of arthropods. Scorpions, spiders, beetles, grasshoppers, and Lepidoptera larvae... plant seeds and a small lizard (Uta)."

B. Foraging areas

Small (1974), "The wide avenues among the desert shrubs are suitable pathways for escape and foraging for such strong runners as... Le Conte's" - this statement given for Bendire's and crissal, also. Miller and Stebbins (1964), "... the scanty litter of leaves under this plant (creosote) and about the more diversified low shrubs of washes constitute the foraging ground where they whisk and dig into the soil." Grinnell and Miller (1944), "The scanty leaf litter in the lee of bushes as also comparatively barren sandy soil is whisked apart and dug into for plant and insect food."

C. Foraging strategies

Engels (1940), "... the feet are not used for scratching... (use) the bill like a pick, or as a tool with which to whisk litter from side to side." Sheppard (1970), "food is obtained on the ground or by digging 2-3 inches into the substrate."

D. Feeding phenology

Miller and Stebbins (1964), "In periods of lush annual flowers and attendant insect abundance, these thrashers take caterpillars. Thus in April of 1960 in Pinto Basin, a male was collected which had a large sphinx moth caterpillar in the stomach."

E. Energy requirements

Sheppard (1970), "activity is curbed as the temperature reaches 95°-100° F. Little or no feeding takes place during this time."

VI REPRODUCTION

A. Territorial behavior

Sheppard (1970) reported several nests are made per pair per year, with 6-10 old nests in a territory; need about 15 acres/pair for nesting territories.

B. Courtship and mating behavior

Sheppard (1970), "probably mate for life." Wetmore (1964), "Male and female join in building the bulky nest..."

C. Nesting phenology

Bent (1948), "The breeding season is a long one, and at least two broods are ordinarily raised in a season. Egg dates - Arizona: 9 records, February 21 to June 24; - California: 124 records, January 22 to June 11; 41 records, March 18 to April 11; 30 records, February 10 to 28." Dawson (1923), "Nesting begins in February on the Colorado desert, through early April is the best average... sometimes a second brood is brought off in May or June..." Sheppard (1970) reported nesting season extends from late January to early June. Three broods are often attempted. Willett (1933), "nests containing eggs... from February 17 (1899) until June; most common in late March and early April." Van Rossem (1936) noted nest found on 11 October 1931. Miller and Stebbins (1964), "The breeding season is early, perhaps triggered by the light and erratic winter rains and the subsequent rapid appearance of annual green plants. Nesting dates listed: 21 March (no eggs); 15 April (young); 11 April (new nest). Replacement nests or second-brood efforts have been noted, and are variable from year to year." In an anonymous citation, "O. W. Howard ... reports a set of Le Conte's thrasher (eggs) taken January 30 at Indio, California." Grinnell (1933), "... obtained a breeding male... the morning of February 21. Completion of nest-building the last week of January." Hanna (1933), "... the nest must have contained eggs during late January... an early record." Arnold (1937), "Le Conte thrasher... fairly common in Atriplex and Artemisia, nesting from February to June. Completed nest, February 23, 1935; nest and eggs, June 1, 1934." Huey (1936) noted a female Le Conte's collected on 8 February "showed signs of incubating". Stephens (1884), "... at least five month's range of nesting."

D. Length of incubation period

Bent (1948) noted incubation period unknown; both sexes share in nest building and incubation. Sheppard (1970), "incubation (by both sexes) requires 14-20 days, hatching of four eggs takes 20-36 hours."

E. Length of nestling period

Bent (1948), "... we apparently do not know just how long the young remain in the nest." Sheppard (1970), "fledging from the nest starts after ... 14-18 days."

Toxostoma lecontei (con't.)

F. Post-breeding behavior

Sheppard (1970), "young leave their parent's territory at about 4 weeks of age."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1948), "Two to four eggs constitute a full set." Peterson (1961), "Eggs (2-4) pale blue-green, speckled." Reed (1965) noted lay 3-4 eggs. Sheppard (1970) reported 3-4 eggs usually laid.

B. Nesting success

Guillion, Pulich, and Evendon (1959), "... an adult with six young south of Searchlight..."

C. Habitat density figures

Bent (1948), "... considered one of the rarest and most elusive of the desert birds." Grinnell (1933), "... estimated the population of Le Conte's thrashers in the favorable belt of territory lying two to six miles east of McKittrick at six pairs of adult birds per square mile." Engels (1940), "... is found concentrated along the draws where Atriplex grows most thickly..." Sheppard (1970) reported Maricopa, California = 10 pairs/square mile and throughout range = 0-5 pairs/square mile. Linehan (1968) noted saltbush scrub desert (Kern County, California) Le Conte's thrasher = 2 territorial males on 50 acre study site (4 males per 100 acres).

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Bent (1948), "... overlaps somewhat with the California thrasher and more so with the crissal thrasher... The haunts and behavior of all three are different." Engels (1940), "... has been able to take over the mesquite habitat because there is no rival thrasher there. The fact of ecological segregation of species over a common geographical area leads one to infer the presence of distinctive adaptations in each species to the special requirements of its preferred habitat" - discussing Toxostoma.

B. Parasitism

Friedmann (1963) reported one record (from Arizona) of a bronzed cowbird egg in the nest of a Le Conte's thrasher. These two species are largely ecologically allopatric.

IX STATUS

A. Past population trends

Brewster (1882), "... rather common in the desert between Fort Mohave and the San Bernardino Mountains, California."

B. Present population status

Grinnell and Miller (1944) reported permanently resident. Fairly common under suitable conditions, but these are localized and occur only scatteringly over general range.

C. Population limiting factors

Grinnell (1933), "luxuriant growth of Atriplex... and the general climatic conditions of high temperature and low humidity, appears to form the final requirement controlling the presence and relative numbers of the Le Conte thrasher in the San Joaquin Valley." Sheppard (1970), "most common in areas with 5-6 in/year" (of rainfall). Miller and Stebbins (1964), "We believe that species such as the Le Conte's thrasher, which exist close to the level of tolerance even for desert species, have to move out at times" - note: such movements due to limitation of water.

D. Environmental quality: adverse impacts

Phillips, Marshall, and Monson (1964), "Intolerant of man and his activities, it has retreated from the newly farmed areas..."

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CRISSAL THRASHER
Toxostoma dorsale

I TAXONOMY

A. Type description

Toxostoma dorsale coloradense - AOU (1957) Van Rossem, Condor, 48, no. 2, April 2, 1946. Brawley, Imperial County, California, altitude -113 feet.

Van Rossem (1946), "Type - adult female, no. 10826 Dickey Collection, taken at Brawley, Imperial County, California, altitude -113 feet, December 25, 1910."

First description of the crissal thrasher (Henry, 1858).

B. Current systematic treatments

Hellmayr (1934) recognizes 2 races of Toxostoma dorsale, including dorsale and trinitatis. Included coloradense within dorsale.

Mayr and Greenway (1960) lists 4 subspecies, dorsale coloradense, trinitatis, and dumosum. Both coloradense and dorsale occur in California.

Hubbard (1976) reported original species name intended to be Toxostoma crissalis... overturning crissale for dorsale seems unnecessary.

Synonymies - Grinnell and Miller (1944), Harporhynchus crissalis; H. crissales; Toxostoma crissalis; T. crissale; T. dorsale. Oberholser (1920), "We must therefore call the crissal thrasher Toxostoma dorsalis." Grinnell and Miller (1944), mocking thrush; Henry thrush; Henry mock-thrush; red-vented thrasher; Arizona crissal thrasher.

II DESCRIPTION

A. External morphology of adults

Ridgway (1907) reported of adults in autumn and winter - Similar to the spring and summer plumage, but coloration slightly darker and grayer. Adult male - length 273-297 (284) mm; wing 96-105 (100.3) mm; tail 133-150.5 (140.1) mm; exposed culmen 32-38.5 (35.3) mm; tarsus 31.5-34.5 (32.8) mm; middle toe 21.5-22.5 (21.9) mm. Adult female - length 252-311 (279) mm; wing 93.5-102.5 (99) mm; tail 123-145 (136.3) mm; exposed culmen 33.5-37.5 (35.1) mm; tarsus 30.5-34.5 (32.8) mm; middle toe 19-23 (21) mm. Phillips, Marshall and Monson (1964), "A patch of deep rusty under the tail (on the crissum) gives it the name of crissal thrasher" and in referring to T. dorsale coloradense "Birds along the Colorado and Big Sandy Rivers are paler than the typical race." Peterson (1961), "A rather dark desert thrasher with a deeply curved bill. Note the dark chestnut under tail patch darker than in other thrashers. No breast spots. Yellowish eyes."

Toxostoma dorsale (con't.)

B. External morphology of subadult age classes

Ridgway (1907) noted young - similar in coloration to spring and summer adults, but cinnamon-rufous of underparts, etc., slightly paler and duller, upper tail-coverts browner. Bent (1948) reported juvenal plumage very similar to the adults but browner throughout. Bailey (1928), "Young: like adults but slightly paler below."

C. Distinguishing characteristics

Van Rossem (1946), "Subspecific characters - Paler than T. d. dorsale. Upper parts grayish drab brown; under parts paler and more buffy gray."

Interspecific - Phillips, Marshall and Monson (1964), "The crissal thrasher is the longest and slimmest of the thrashers..." Engels (1940) gives a diagrammatic representation of the variation in length and curvature of the bill in the various members of Toxostoma, including dorsale. Peterson (1961), "Similar species: 1) curve-billed thrasher is grayer, has faint spotting, lacks rufous crissum; 2) Le Conte's is extremely pale; and 3) California thrasher has paler crissum." Robbins, Bruun, and Zim (1966), "The only other thrasher with rusty undertail coverts, the Californian, does not overlap crissal's range. Crissal lacks the buffy eye stripe." Brandt (1951), "... may be distinguished from other thrashers by its slender, deeply curved bill, and its egg by the plain greenish-blue color." Mearns (1886) gives measurements (and ratios of dimensions to entire length) of several species of thrashers.

Intraspecific - Ligon (1961), "Color pattern of sexes alike." Bent (1948), "The sexes are practically alike in all plumages." Mearns (1886) gives extensive lists of adult and juvenal measurements and plumages.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

T. d. coloradense - AOU (1957), "Resident from southeastern California (Palm Springs, Coachella Valley, Needles), southern Nevada (Cottonwood Springs, Logandale, Bunkerville), and southwestern Utah (St. George) south to extreme northern Baja California (Mexicali, Cocopah Mountains, Laguna Salada) and through western Arizona (mouth of Diamond Creek) to northwestern Sonora (Colorado River)."

T. dorsale - AOU (1957), "Southeastern California, southern Nevada, southwestern Utah, northern Arizona, southern New Mexico, and central western Texas south to northeastern Baja California and northwestern and south-central Mexico."

Ridgway (1907) reported deserts of western Texas, New Mexico, Arizona, southern Utah, southeastern Nevada, southern California (San Bernardino, eastern Riverside, and eastern San Diego Counties), northern lower California, and northern Sonora. Mayr and Greenway (1960) noted lower Colorado River Valley of California and Arizona, the Colorado desert of

Toxostoma dorsale (con't.)

California, and Mexico in northeastern Baja California and northwestern Sonora. Peterson (1961), "Resident from southeastern California, southern Nevada, southwestern Utah, northern Arizona, southern New Mexico, western Texas (Trans-Pecos) south to central Mexico."

B. California distribution of the species

Dawson (1923), "Resident in the mesquite association in the bed of the Colorado desert west to Palm Springs, and in the Colorado River Valley north at least to Needles." Scott and Sams (1959) gives first record of crissal thrasher from eastern San Diego County.

C. California desert distribution

Small (1974), "Crissal thrashers... occur on the fringes of and occasionally within this desert (Sonoran) but in California are more attached to the riparian association. The Sonoran desert is effectively isolated from the Colorado desert in the Salton Basin... but crissal thrashers... have been able to disperse westward." Grinnell and Miller (1944), "Colorado River Valley from Fort Yuma north to Nevada boundary; west through Imperial and Coachella Valleys to Palm Springs, and east slope of Providence Mountains." Grinnell (1904) notes crissal thrashers nesting near Palm Springs, calling this location the "westernmost limit of the bird's range."

D. Seasonal variations in distribution

Bailey (1928), "In winter it is more numerous in the lower levels." Engels (1940), "... are sedentary birds, but there is evidence of seasonal vertical movements in some populations. The exodus takes place about the end of February..." Phillips and Amadon (1952), "... T. d. coloradense... a fourth female from Rancho Carrizal... taken October 26, is perhaps a vagrant."

IV HABITAT

A. Biotopic affinities

Small (1974), "The dense patches of mesquite and saltbush... are the population centers for... the crissal thrasher in California." Brandt (1951), "... are occasional dense thickets which furnish cover sufficient for... understory birds, such as the crissal thrasher." Grinnell and Miller (1944), "Dense thickets of bushes or low trees which screen the ground where in loose sandy or alluvial soil and in the ground litter nearly all foraging is done. Cover is provided most frequently by mesquite and screw-bean and by thicker growths of ironwood and catclaw; also by arrowweed and, locally, dense willows... dense tall Artemisia brush and, in places, other dense bushes in the juniper belt. Life zone - lower Sonoran." Engels (1940), "... occur only in the lower Sonoran life zone." Ligon (1961), "Its favorite habitat is stream-bottom borders with thick brush, such as Condalia, mesquite, and tornillo." Johnson, Bryant, and

Toxostoma dorsale (con't.)

Miller (1948), "Crissal thrashers were found in... fairly dense brush immediately below the pinon belt." Oberholser (1974), "... in two habitats - mesquite or willow thickets beside desert rivers... and juniper-pinyon-oak hill slopes." Peterson (1961), "Dense brush along desert streams, mesquite thickets." Robbins, Bruun, and Zim (1966), "Found in fertile valleys and densely vegetated canyons." Bent (1948), "... prefers the more fertile valleys, canyons, and hillsides, where it can hide among the more abundant vegetation and in the dense thickets, often in the vicinity of water." Gilman (1902), "... found in dense thickets of mesquite and screw-bean..." Brewster (1882), "... fond of well-shaded undergrowth." Scott (1888), "... at home on the rough hill-sides where there is a low dense growth of... juniper and some mesquite."

B. Altitudinal range

Grinnell and Miller (1944), "Breeds chiefly below 500 feet; nesting records extend from 190 feet below sea level up to 4500 feet, and probably as high as 5400 feet." Bent (1948), "... altitudinal migrations in spring and fall, up to about 5000 feet in summer and fall and down to the warmer valleys in winter." Johnson, Bryant, and Miller (1948), "... at altitudes from 4500 feet to 5400 feet." Brandt (1951), "... on the outwash plain at around 5000 feet elevation, I found a nest... Hilly, rocky region, at an elevation of 5700 feet." Bailey (1928), "... ranging up over the hot slopes along with Yucca radiosa and other lower Sonoran plants to about 5100 feet." Oberholser (1974), "... from about 1900 to 5600 feet."

C. Home range size

Guillion, Pulich, and Evendon (1959), "Banding records... suggest that these birds ranged over only a few hundred feet of mesquite bosque during a year's time."

D. Territory requirements

Perch sites - Oberholser (1974), "... (it sings) atop a bush or small tree. Rather infrequently, however, it sings while standing on the ground." Bailey (1928), "This bird often sings from the ground instead of always perching on top of a bush." Engels (1940), "... thorny trees, working their way up towards the tops, the favored singing posts." Gilman (1902), "... sings (from) the cover of branch and leaf."

Courtship and mating sites - Mearns (1886), "... (sings) from the top of the tallest bushes, where it perches."

Nest sites - Brandt (1951), "It was a small affair, up nine feet on a flat mesquite crotch... three unmarked blue eggs. In an open mesquite grove. It was placed in full view eight feet above the ground, straddling a long horizontal limb. Nest three feet up in a small bushy juniper. Eight feet up against the trunk of a juniper treelet. - Nesting association = streamside thicket." Linsdale (1936), "... the nest..."

Toxostoma dorsale (con't.)

was placed partly on one of the large branches of a desert willow (Chilopsis saligna) and partly on top of an Atriplex canescens bush growing under it." Bailey (1928), "nest - in mesquites, tornillos, and bushes, as squawberry and greasewood." Reed (1965), "... (nest) in a chaparral bush 2 feet from the ground." Bent (1948), "... about 8 feet above ground in a vine-covered willow in a row of these trees growing along an irrigation ditch. The other nest... was placed 3 feet from the ground in a dense sagebush. Does not usually nest in cactus." Gilman (1902) reported nest heights: $\bar{x}$ = 3.5 feet; range = 2.5-6.0 feet; nest sites: mesquite. Gilman (1909), "... nesting sites: twenty-seven were in mesquites. Eleven were in squaw-berry bushes, four in greasewood, one in palo verde, one in a mistletoe and one in a low brush fence. The average height... was three feet ten inches with a range = 2-8 feet." Stephens (1903) notes nest site near 6000 feet in a pinyon and juniper belt in the Hualapai Mountains. Hanna (1933), "... nests of the crissal thrasher are almost invariably placed in mesquite trees or saltbushes... never seen one in a cactus."

E. Special habitat requirements

Brandt (1951), "... is an obligate of the streamside thickets." Oberholser (1974), "... the bird prefers the riverside thickets." Engels (1940), "... are greatly restricted... to the mesquite thickets."

V FOOD

A. Food preferences

Oberholser (1974) noted prey includes caterpillar, beetles, grasshoppers, bugs, and scorpions; wild grapes and other berries are also utilized. Ligon (1961), "Its long bill is well adapted for probing hard soil for insects and grubs." Small (1974), "Those birds which feed on fallen seeds include... crissal thrashers." Bailey (1928), "Gizzards of some summer specimens showed quantities of ants with bits of some vegetation." Swarth (1904), "... grubbing up a species of small black beetle..." Bent (1948), "It feeds largely upon berries and wild grapes - insects and a small lizard were found in a collected bird." Raitt and Pimm (1976) reported most important food source fed to young crissal thrashers was grasshoppers. Mearns (1886), "It feeds largely upon berries and wild grapes." Brewster (1882), "stomach contained insects and a small lizard."

B. Foraging areas

Small (1974), "The wide avenues among the desert shrubs are suitable pathways for escape and foraging by such strong runners as... crissal's" - this statement also given for Bendire's and Le Conte's.

C. Foraging strategies

Oberholser (1974), "On the ground it digs with its bill (for prey)." Engels (1940), "... the feet are not used for scratching... dig, using

Toxostoma dorsale (con't.)

the bill like a pick, or as a tool with which to whisk litter from side to side." Grue (1977) noted crissal thrashers are members of the ground feeding guild, and feed on seeds during the breeding season in Arizona.

D. Feeding phenology

Bent (1948), "Insects constitute an important article in their diet at all seasons." Mearns (1886), "Insects constitute an important article of their diet at all seasons."

E. Energy requirements

Bartholomew and Cade (1956) reported the mean water consumption for T. dorsale (20-23° C) was about 5% of body weight per 24 hours.

VI REPRODUCTION

A. Nesting phenology

Bent (1948), "The long breeding season, from February to June or July, indicates that at least two broods are reared in a season. Egg dates - Arizona: 88 records, February 18 to July 3; 44 records, April 2 to May 21, indicating the height of the season; - California: 56 records, February 10 to June 10; 28 records, March 11 to April 6; - Baja California: 6 records, May 8 to June 10. Indicates a long nesting season for the crissal thrasher and the probability of its rearing more than one brood per season." Gilman (1909), "... protracted breeding season: five months, February to June inclusive. Of the 45 nests noted, one was in February, 27 in March, six in April, ten in May, and one... June 10." Hanna (1933), "The eggs... deposited in January and constitute an early nesting date for California." Engels (1940), "... middle of March... are settled and occupied with domestic (nesting) affairs."

B. Length of incubation period

Bent (1948), "Both sexes share the duties of incubation and care of the young." Incubation period of about 14 days.

C. Length of nestling period

Bent (1948) noted nestling period of 11 or 12 (16) days.

D. Growth rates

Gilman (1909), "The short time from egg to leaving nest - 30 days - probably allows the raising of more than one brood." Dawson (1923), "... young crissal thrashers are covered at an incredibly early age with a heavy blackish down..."

E. Post-breeding behavior

Bailey (1928), "By the first of July the young are fully fledged and in early morning on the mesa one can see whole families... together..."

Toxostoma dorsale (con't.)

calling and feeding..." Oberholser (1974), "... toward the end of breeding and in autumn, small groups, apparently family parties, congregate."

VII POPULATION PARAMETERS

A. Clutch size

Peterson (1961), "Eggs (2-4) pale blue-green, unmarked." Reed (1965) reported lay 2-4 eggs; size: 1.10 x 0.75 inches. Hanna (1933), "Clutch size = 2 or 3 eggs - the number in a complete clutch seems to vary from year to year."

B. Habitat density figures

Miller (1955) noted four pairs were taken in a wash (mesquite, desert willow) in a section one mile in length on 27 April - referring to T. d. dorsale. Grue (1977) gives projected density of 0.5 birds per 40 ha for breeding crissal thrashers within the desert grassland of Arizona. Raitt and Maze (1968) reported density of crissal thrashers in creosote-bush: 0.2-0.6 pairs/100 acres. Balda (1970) noted density of crissal thrasher: oak woodland = 1.0 pair/100 acres and oak-juniper-pine = 0.0 pair/100 acres. Austin (1970) reported density of crissal thrashers: dunes = 2.0-3.5 pairs/100 acres; bosque = 1.0-2.0 pairs/100 acres; and TOTAL = 3.0-5.5 pairs/100 acres. Ryder and Ryder (1976) noted catclaw - rabbitbrush desert wash (San Bernardino County, California): crissal thrasher = 2 birds on 44.0 acres study site.

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Bent (1948), "... its haunts and habits are quite different (from other thrashers), and they seldom overlap to any extent." Engels (1940), "The fact of ecological segregation of species over a common geographical area leads one to infer the presence of distinctive adaptations in each species to the special requirements of its preferred habitat" discussing Toxostoma.

B. Parasitism

Friedmann (1963) noted no record of cowbird parasitism of crissal thrasher is listed.

IX STATUS

Grinnell and Miller (1944) reported status - permanently resident. Numbers small at western periphery of range, but fairly common in mesquite association.

Gilman (1915), "This thrasher... apparently does not take kindly to clearing and farming operations."

Toxostoma dorsale (con't.)

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Peterson (1961), "Eggs (2-4) pale blue-green, unmarked." Reed (1965) reported lay 2-4 eggs; size: 1.10 x 0.75 inches. Hanna (1933), "Clutch size = 2 or 3 eggs - the number in a complete clutch seems to vary from year to year."

B. Habitat density figures

Miller (1955) noted four pairs were taken in a wash (mesquite, desert willow) in a section one mile in length on 27 April - referring to T. d. dorsale. Grue (1977) gives projected density of 0.5 birds per 40 ha for breeding crissal thrashers within the desert grassland of Arizona. Raitt and Maze (1968) reported density of crissal thrashers in creosote-bush: 0.2-0.6 pairs/100 acres. Balda (1970) noted density of crissal thrasher: oak woodland = 1.0 pair/100 acres and oak-juniper-pine = 0.0 pair/100 acres. Austin (1970) reported density of crissal thrashers: dunes = 2.0-3.5 pairs/100 acres; bosque = 1.0-2.0 pairs/100 acres; and TOTAL = 3.0-5.5 pairs/100 acres. Ryder and Ryder (1976) noted catclaw - rabbitbrush desert wash (San Bernardino County, California): crissal thrasher = 2 birds on 44.0 acres study site.

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Bent (1948), "... its haunts and habits are quite different (from other thrashers), and they seldom overlap to any extent." Engels (1940), "The fact of ecological segregation of species over a common geographical area leads one to infer the presence of distinctive adaptations in each species to the special requirements of its preferred habitat" discussing Toxostoma.

B. Parasitism

Friedmann (1963) noted no record of cowbird parasitism of crissal thrasher is listed.

IX STATUS

Grinnell and Miller (1944) reported status - permanently resident. Numbers small at western periphery of range, but fairly common in mesquite association.

Gilman (1915), "This thrasher... apparently does not take kindly to clearing and farming operations."

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HERMIT THRUSH

Catharus guttatus

I TAXONOMY

A. Type Description

Catharus guttatus guttatus, hermit thrush: Musicapa guttata Pallas, 1811, Zoogr. Rosso - Dsiat. 1:495 - Kodiak Island, Alaska (Peters 1964).

Synonomies - Turdus nana, Turdus minor, Turdus pallasii, Turdus guttatus, Turdus aonalaschkae, Hylocichla aonalaschkae, Hylocichia guttata guttata; dwarf hermit thrush, Audubon hermit thrush, Alaska hermit thrust (Grinnell and Miller 1944).

Catharus guttatus nanus, dwarf hermit thrush: Turdus nanus Audubon, 1839, Orn. Biog. 5:201 - Columbia River (Peters 1964).

Synonomies - Hylocichla guttata vaccina, Catharus guttatus munroi (Peters 1964), Turdus nanus, Turdus pallasii, Hylocichla unalascae, Turdus aonalaschkae, Hylocichla aonalaschkae, Hylocichla guttata nana; dwarf thrush, coast hermit thrush (Grinnell and Miller 1944).

Catharus guttatus sequoiensis, Sierra hermit thrush: Hylocichla aonalaschkae slevini Grinnell, 1901, Auk 18:258 - vicinity of Point Sur, Monterey County, California.

Synonomies - Hylocichla guttata oromela, Catharus guttatus jewetti (Peters 1964), Turdus pallasii auduboni, Turdus Auduboni, Turdus aonalaschkae, Hylocichla aonalaschkae, Hylocichla guttata nana; dwarf thrush, coast hermit thrush, big tree thrush, Sierra thrush (Grinnell and Miller 1944).

Latharus guttatus polionotus, Great Basin hermit thrush: Hylocichla guttata polionota Grinnell 1918, Condor 20:89 - Wyman Creek, White Mountains, Inyo County, California.

Synonomies - Hylocichla guttata polionota, Turdus aonalaschkae auduboni, Hylocichla guttata sequoiensis; Audubon hermit thrush, White Mountain hermit thrush, Sierra hermit thrush, Mono hermit thrush (Grinnell and Miller 1944).

B. Current systematic treatments

Order Passeriformes, family Musicapidae, subfamily Turdinae, genus Catharus Bonaparte, 1851, Cons. Av. 1:278 (Peters 1964).

There are currently eight recognized subspecies of hermit thrush: guttatus, nanus, slevini, sequoiensis, polionotus, auduboni, faxonii, crymophilus (Peters 1964).

C. Recent taxonomic revisions

Dilger (1956b) recommended that Hylocichla fuscescens, H. guttata, H. ustulata and H. minima be placed in the genus Catharus, leaving H. mustelina alone in Hylocichla. In 1973, the Supplement to the AOU Checklist of North American Birds (1973) concurred and transferred fuscescens, guttata, ustulata and minima to Catharus. Hylocichla guttata is now Catharus guttatus.

II DESCRIPTION

A. External morphology of adults

The hermit thrush is "a slender (20-29 gram), long-legged thrush, brown or gray-brown above, the rump brighter rusty brown than back and tail; light eye ring; underparts spotted" (Miller and Stebbins 1964).

Bent's (1949) description disagrees somewhat with the above description, stating that "all western subspecies of the hermit thrush have the sides and flanks grayish or olivaceous, rather than brown or buffy brown."

B. External morphology of subadult age classes

The juveniles are sepia or olive-brown above, rump russet, everywhere spotted with white spots bordered with black (Gross 1949). The wings are darker, the tail burnt umber-brown. They are white below, tinged with buff and spotted with black (Gross 1949).

The first winter plumage is similar to the juvenile but without spots above and fewer spots below (Gross 1949). The first year birds retain buffy spots on the wing coverts during the first nuptial plumage, but otherwise resemble the adult. The first year birds are indistinguishable from adults after the first post-nuptial molt (Gross 1949).

C. Distinguishing characteristics

Interspecific - The reddish tail is unique to the hermit thrush. The wood thrush has a reddish head and the other thrushes are a uniform color above (Peterson 1961).

Intraspecific - C.g. guttatus is lighter than nanus, which is in turn darker and browner with larger spots on the chest (Bent 1949). C.g. polionotus is olive-brown on the top of the head and back, whereas sequoiensis dorsum is brown with slate-gray (Bent 1949).

D. Special morphological features

No information located.

III DISTRIBUTION

A. Overall distribution of the species

Six subspecies are found in the Rockies and west of the Rockies south to southwestern United States. The two other species are found in Newfoundland (crymophilus) and east of the Rockies from southern Canada to the mid-Atlantic states (faxoni; Peters 1964).

C.g. guttatus breeds from the "Alaskan peninsula and adjacent islands east to southwest Yukon and south to central British Columbia (Peters 1964).

C.g. nanus breeds in "coastal southeastern Alaska and western British Columbia" (Peters 1964).

C.g. sequoiensis breeds in Washington, Oregon and northern California south to Monterey County (Peters 1964).

C.g. polionotus breeds in "eastern Washington, eastern Oregon, Nevada, southwestern Utah, and east-central California" (Peters 1964).

B. California distribution of the species

C.g. guttatus is found the "entire length and breadth of state below levels of heavy snow, but only locally and in small numbers on southeastern deserts" (Grinnell and Miller 1944). It is a winter resident.

C.g. manus is found the "entire length of state west of the Cascade-Sierran axis; rarely on the deserts of southern California" (Grinnell and Miller 1944). It is a winter resident.

C.g. sequoiensis is a summer resident in Modoc County and the Lassen Peak region south along the Sierra Nevada through Tulare County. In southern California, it is found on Mount Pinos and in the San Bernardino Mountains (Grinnell and Miller 1944).

C.g. polionotus is a summer resident of the White Mountains of Mono and Inyo counties, Inyo and Panamint Mountains of Inyo County, and Clark Mountain in San Bernardino County (Grinnell and Miller 1944, Bent 1949).

C. California desert distribution

C.g. guttatus is found only locally in small numbers on southeastern deserts in winter (Grinnell and Miller 1944). It has been recorded in the Panamint, Argus, Providence Mountains and in the Colorado River Valley (Grinnell and Miller 1944). The guttatus subspecies occurs in Joshua Tree National Monument during the winter months (Miller and Stebbins 1964).

Catharus guttatus (Cont'd)

C.g. nanus has been recorded in Yermo, San Bernardino County and in Palm Springs, Riverside County (Grinnell and Miller 1944).

C.g. sequoiensis is found breeding on Mount Pinos and in the San Bernardino mountains (Grinnell and Miller 1944).

C.g. polionotus breeds in the White Mountains of Mono and Inyo Counties, in the Inyo and Panamint Mountains of Inyo County, and on Clark Mountain in San Bernardino County (Grinnell and Miller 1944, Bent 1949).

Hermit thrushes of unspecified subspecies have been observed breeding in the Panamint Mountains by Wauer (1964) and in winter in China Lake, Idylwild, Joshua Tree National Monument, South Salton Sea, the Parker, Arizona-Colorado River area, Yuma, Arizona (Seventy-seventh Audubon Christmas bird count 1977), and in Death Valley (Wauer 1962).

D. Seasonal variations in distribution

C.g. guttatus migrates in winter to Washington, Oregon, California, Colorado, Nevada, Texas, Baja California, and south to central Mexico (Peters 1964).

C.g. nanus winters from southern British Columbia south to southern Baja California and Sonora, and east as far as eastern California, Nevada, Arizona and New Mexico (Peters 1964).

C.g. sequoiensis winters in Baja California, Sonora and Sinaloa (Peters 1964).

C.g. polionotus migrates through Arizona, Oklahoma and Texas to winter in southeastern Arizona and central and northern Mexico (Peters 1964).

Therefore, southeastern California is visited by sequoiensis and polionotus in the summer and guttatus and nanus in the winter.

IV HABITAT

A. Biotopic affinities

The summer subspecies (sequoiensis and polionotus) are found in the Canadian Life Zone and also in the Transition and Hudsonian Life Zones (Grinnell and Miller 1944), and also in the pinon-juniper woodland (Wauer 1964). Their habitat is characterized by the presence of aspens, timber pine, lodgepole pine, mountain mahogany in dense and moderately open stands. The plant cover in general is arid, open, and strongly isolated.

The winter subspecies (guttatus and nanus) occur in chaparral, willow thickets, and forests which are open near the ground and lack tall

F. Seasonal changes in habitat requirements

C.g. guttatus and nanus migrate south from boreal, humid breeding areas to more open and arid wintering areas (Bent 1949, Peters 1964).

There was no specific information on the winter habitats of sequoiensis and polionotus.

G. Ecological physiology

Hermit thrushes arrive in Joshua Tree National Monument after the summer heat has dissipated, and they leave in the Spring before it begins to build up again. Their winter residence is not in the most arid areas, but is concentrated in the upper brush and woodland belt. Therefore, "severe drought and heat are largely avoided" (Miller and Stebbins 1964).

Holmes and Sawyer (1975) found that summer thrushes in New Hampshire had a lower critical ambient temperature of 25°C and an oxygen consumption at thermoneutrality of $3.02 \text{ cc O}_2/\text{g. hr.}$ Below 25°C , oxygen consumption increased linearly at a rate of $0.124 \text{ cc O}_2/\text{g.hr. }^{\circ}\text{C}$.

V. FOOD

A. Food preferences

Beal (1907) studied the stomach contents of hermit thrushes captured in California. He found that they consumed an average of 56% animal food and 44% vegetable food. The main components of the animal diet were Hymenoptera (24%), Coleoptera (11%), Lepidoptera (10%) and miscellaneous other animals (12%). The plant food was composed primarily of fruit (29%) and seeds (14%), the latter containing a large proportion of poison oad seeds.

Food brought to the nestlings consists primarily of insect larvae at first (Gross 1949). At later stages, the nestlings are also fed moths, grasshoppers, katydids, crickets, robber flies and berries (McClintock 1910; Perry and Perry 1918).

B. Foraging areas

The hermit thrush usually forages on the ground under the brush canopy in good litter (Grinnell and Miller 1944; Miller and Stebbins 1964). They frequently utilize forest edge areas, as well as the ground in the forest itself, and under scattered clumps of bushes in more open country, but are never far from cover (Bent 1949).

grass (Grinnell and Miller 1944). They are also found in residential areas of most cities and in the canyons of the foothills, avoiding "only the most open ground of meadows, fields and hillsides" (Bent 1949; see also Miller and Stebbins 1964). Bent (1949) remarked that ranus is often found "in willows along ditches... in the gloomiest shady clumps of large trees."

B. Altitudinal affinities

C.g. guttatus and nanus are found up to 7500 feet in California (Grinnell and Miller 1944). Since these are winter subspecies, the upper altitude is probably limited by the snow line.

C.g. sequoiensis and polionotus nest up to 10,000 feet, with sequoiensis ranging down to 3700 feet and polionotus to 7100 feet (Grinnell and Miller 1944).

Wauer (1964) and Linsdale (1938) both found hermit thrushes of unspecified subspecies common above 8000 feet in the Panamint Mountains and mountains of Nevada, respectively.

C. Home range size

No information located for desert areas.

D. Territory requirements

Perchsite - Hermit thrushes frequently use exposed perches on the tops of trees and shrubs in arid areas and higher elevations (Grinnell and Miller 1944). In denser, taller forests, they utilize the lower branches of pine trees, usually about 40 feet from the nest (Gross 1949).

Courtship and mating sites - No specific information located.

Nest site - Hermit thrushes nest most frequently in small trees or saplings, or between two closely growing saplings (Linsdale 1938; Bent 1949). Aspen, willow, pine, sagebrush are all used. Bent (1949) describes a typical sequoiensis nest as being "three feet above the ground near the top of a diminutive fir tree growing a yard from the stream... composed largely of pine needles and weathered grass stems."

The nests are usually placed lower than six feet, but rarely up to 15 feet (Linsdale 1938; Bent 1949). Closeness to water is another obvious characteristic of the nest site.

E. Special habitat requirements

No specific information located.

Catharus guttatus (Cont'd)

During the nesting season, food is gathered within a short distance of the nest. McClintock (1910) reported that this distance was seldom more than 50 feet.

C. Foraging strategies

The hermit thrushes characteristically forage by flipping over leaves on the ground in search for insects (Miller and Stebbins 1964). They always use the bill to flip the leaves (Bent 1949). The foraging sequence consists of a few hops followed by scanning the litter and flicking over a few leaves (Bent 1949).

The twinkling of the wings is a characteristic behavior of hermit thrushes. It is often accompanied by a compensatory tail flick and a soft "chuck" note and occurs incessantly while foraging (Bent 1949).

D. Feeding phenology

No information located.

E. Energy requirements

Hermit thrushes have an oxygen consumption value of 3.02 cc O₂/g.hr. in the thermoneutral zone which extends down to 25°C (Holmes and Sawyer 1975).

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

Hermit thrushes use song to advertise the presence of a territorial male and for species recognition purposes (Dilger 1956a). When two males confront each other, they use an upward posture and a horizontal stretch with gaping. Attack intention movements include wing flicking and thrusting the head forward while in the horizontal stretch posture.

Tail raising is a unique behavior to the hermit thrush. It accompanies every major shift in position, and the flash of the red tail probably serves as advertisement (Dilger 1956a). The frequency and height of tail raising increase as motivations for attack and escape increase. The behavior is not as strong as an upward posture and not as weak as foot quivering (Dilger 1956a).

The hostile call notes are mainly a harsh "chuck" and a hoarse "seeeeep" (rising inflection): "seeeeep" corresponds to low motivation, "chuck" to higher motivation and "eeeeee" to strong attack motivation (Dilger 1956a). The advertising calls are long flute-like phrases of five to 12 notes with rather long pauses. The notes are sweet, clear and musical, although the hermit thrush is less musical than the other congeners (Dilger 1956a).

C. Courtship and mating behavior

The sexes are monomorphic, and sexual recognition is presumably by behavioral means (Dilger 1956a). The initial contact is hostile as the females invade male territories. Females persist in the territory, whereas intruding males flee. At first, mutual hostile displays occur and the male song output increases. The male chases the female in repeated circular flights within the territory. These circular chases become more leisurely as tolerance develops over three to four days. However, individual distance is overcome only during copulation, when the sex drive overwhelms the attack and escape drives (Dilger 1956a).

The male helps build the nest and incubate the eggs (Verner and Willson 1969), but his primary function is to sing and guard the nest from intruders and enemies (Gross 1949). Both sexes feed the nestlings (Gross 1949; Verner and Willson 1969), although Perry and Perry (1918) reported that one bird (called the female) fed the young much more than the other.

D. Nesting phenology

Bent (1949) reported the following egg dates for California: 65 records, May 13 to July 22; 35 records, June 3 to June 21, indicating the height of the season.

E. Length of incubation period

Gross (1949) reported that the incubation period was 12 days ($n = 2$ nests).

F. Length of nestling period

The nestling period has been reported to be at least 11-12 days (McClintock 1910), 12 days (Perry and Perry 1918), and 12 days (Gross 1949). Perry and Perry (1918) reported that the young could not fly at the time they left the nest.

G. Growth rates

Gross (1949) reported the average weights of three nestlings from day 1 to day 12: 4.12g, 4.93g, 7.21g, 10.12g, 14.76g, 16.98g, 19.21g, 22.32g, 24.6g, 25.13g, 25.61g, 24.81g. The peak weight occurred on day 10-11 and the growth rate for the first eight days was approximately 2.8g/day.

Catharus guttatus (Cont'd)

The peak values reported by Gross agree well with those observed by Perry and Perry (1918). The three nestlings they weighed reached peak weights of 25.95g, 26.6g and 29.77g on days 9, 11 and 9 respectively, and had average growth rates of 2.62g/day, 2.14g/day and 2.98g/day. Perry and Perry observed that the third nestling received fewer feedings late in the nestling period and therefore lost more weight before fledging than did the others (fledging weights were 23.62g, 26.6g, and 23.94g respective to the order of data given above).

H. Post-breeding behavior

The adults feed the young for a while after they fledge (McClintock 1910) and then flock up for fall migration. Fall migration extends from September 7 into October with the return in spring occurring between March 21 and April 30 (Miller and Stebbins 1964).

In winter, hermit thrushes occur solitarily and are spaced out in places with good leaf litter, partly under brush canopy (Miller and Stebbins 1964).

VIII POPULATION PARAMETERS

A. Clutch size

In general, hermit thrushes lay three to five eggs, but usually four (McClintock 1910; Perry and Perry 1918; Linsdale 1938). Bent (1949) reported the following clutch sizes for each subspecies: guttatus (3-5, usually 4 eggs), nanus (usually 4 eggs), sequoiensis (3-5, usually 4 eggs), polionotus (3-4, usually 4 eggs).

B. Nesting success

Stanwood (1910) found only 19 of 47 eggs fledged from 14 nests, representing 1.4 young per nest and 40% fledging success.

C. Mortality rates per age class

No information located.

D. Longevity

One hermit thrush holds a longevity record of at least six and one-half years. It was banded as an adult and recaptured, alive, five and one-half years later (Bent 1949). Bent (1949) reported that banding returns indicate survivals after banding of nine months, two years and one and one-half years in three cases.

E. Seasonal abundance

No specific information located. Seasonal migration will cause fluctuations in local numbers of hermit thrushes.

Catharus guttatus (Cont'd)

F. Habitat density figures

No information located.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Hermit thrushes are preyed on by snakes, foxes, weasels, skunks, and occasionally hawks and owls (Gross 1949). McClintock (1910) reported that thrushes harrassed chipmunks and flickers, but not chickadees, purple finches or ravens.

B. Competition

No information located.

C. Parasitism

Gross (1949) reported that thrushes are known hosts to three species of lice, two species of bird flies, two tick species, and one mite species. They are also infrequent cowbird hosts.

Bennett and Cameron (1975) observed parasitism by leucocytozoon fringillinarum and L. dubreuili, the latter bring particularly partial to Turdidae hosts.

X STATUS

A. Past population trends

No information located.

B. Present population status

The Seventy-seventh Audubon Christmas bird count (1977) recorded hermit thrushes in 17 out of 21 desert or near desert censusing areas. The areas (and numbers of hermit thrushes observed) were as follows: Bakersfield (11), Butterbread Springs (4), Carrizo Plains (3), China Lake (13), Claremont (33), Idylwild (11), Joshua Tree National Monument (1), Orange County NE (315), Pasadena (44), Redlands (25), Salton Sea S. (3), San Bernardino Valley (23), San Fernando Valley (7), Sespe Wildlife Area (61), Springville (14), Thousand Oaks (108), Parker, Arizona-Colorado River (6), Yuma, Arizona (3).

C. Population limiting factors

No information located.

Catharus guttatus (Cont'd)

D. Environmental quality: adverse impact

No information located.

E. Potential for endangered status

No information located.

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Mountains, California. Condor 66:287-301.

BLUE-GRAY GNATCATCHER

Polioptera caerula

I TAXONOMY

A. Type description of desert subspecies

Polioptila caerula amoenissima, western blue-gray gnatcatcher:

Polioptila caerula amoenissima Grinnell, 1926, Proc. Calif. Acad. Sci, Ser 4, 15:494 - Pleasant Valley, 600 feet, Mariposa County, California (Peters 1964).

Synonomies - Culicivora caerula, Polioptila caerula obscura, Polioptila plumbea; blue-gray flycatcher, plumbeous gnat catcher, western gnatcatcher (Grinnell and Miller 1944).

B. Current systematic treatments

Order Passeriformes, family Muscicapidae, subfamily Polioptilinae, genus Polioptila Sclater, 1855, Proc. Zool. Soc. Lond. 23:11 (Peters 1964).

There are currently seven recognized subspecies of Polioptila caerula: caerula, amoenissima, obscura, gracilis, deppei, cozumelae, nelsoni (Peters 1964).

C. Recent taxonomic revisions

The Supplement to the AOU Checklist of North American Birds (1973 Auk 90:411-419) indicates that there have been no changes in Polioptera systematics since the 5th edition of the Check-list (1957).

II DESCRIPTION

A. External morphology of adults

The blue-gray gnatcatcher is a very small bird (5g) which is "blue-gray above and white to very pale gray below; tail black centrally, the outer tail feather white, next to outer with terminal third white, and adjacent feather medially with tip white. Males in spring plumage with black frontal area extending back as narrow line above eye" (Miller and Stebbins 1964; see also Root 1967, Phillips et al 1973).

B. External morphology of subadult age classes

"The young gnatcatcher in juvenile plumage is much like the adult female, both sexes being alike and lacking the black forehead" (Bent 1949).

C. Distinguishing characteristics

Interspecific - P. caerula amoenissima is "distinguished from other California gnatcatchers by having the outer tail feathers white for their entire length"

Polioptera caerula (Cont'd)

(Bent 1949). There is less white in the tail feathers of P. melanura melanura and almost no white on the tails of P. melanura Californica.

Intraspecific - P.c. amoenissima is similar to obscura, but the wing and tail are longer, the median lower surface is less white, imbued with pale gray (Grinnell 1926).

D. Special morphological features

The gnatcatcher possesses a sharp bill tip for gleaning insects from foliage and a compressed bill for aerial foraging (Root 1967).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

The blue-gray gnatcatcher breeds from south of the U.S.-Canadian border south to southern Mexico. Of the two U.S. subspecies, caerula is located in central and eastern states and amoenissima breeds in the western states (Peters 1964).

P. caerula amoenissima "breeds from northern California, central Nevada, southern Utah, and Colorado south to northernmost Baja California, northern Sonora, Chihuahua, Coahuila, and Nuevo Leon" (Peters 1964).

B. California distribution of the species

P. caerula amoenissima breeds in the "foothills and low mountains surrounding Sacramento and San Joaquin Valleys and locally in river bottoms of valleys, interior coastal ranges, and mountains and coastal plain of southern California south to Mexican boundary, desert mountain ranges from Providence Mountains north to White Mountains" (Grinnell and Miller 1944).

C. California desert distribution

P. caerula amoenissima breeds in desert mountains from the Providence Mountains to the White Mountains (Grinnell and Miller 1944). In winter, the gnatcatchers are found on the southeastern deserts north to Death Valley, Inyo County (Grinnell and Miller 1944; Wauer 1962).

D. Seasonal variation in distribution

The U.S. subspecies winter in southern U.S. south to central Mexico; the other subspecies are resident (Peters 1964).

P. caerula amoenissima "winters from southern California, southern Nevada, central Arizona, southern New Mexico, western Texas, Chihuahua, Nuevo Leon, Tamaulipas, south to central Baja California, Colima, Michoacan, Morelos, Puebla" (Peters 1964). In California, this gnatcatcher winters on the southeastern deserts north to Death Valley, Inyo County (Grinnell and Miller 1944). Only the northern populations migrate; the southern birds are year-round residents (Root 1967).

IV HABITAT

A. Biotopic affinities

P. caerula amoenissima breeds preferentially in the Upper Sonoran Life Zone (Grinnell and Miller 1944, Wauer 1964, Phillips et al 1973). In general, the breeding habitat is in "arid, well-isolated, park-like tree growths of low or moderate stature, and broken chaparral," especially on blue-oak covered hill slopes and chaparral edges where oaks and arroyo-edge cover intermingle (Grinnell and Miller 1944).

In desert mountains, the gnatcatcher is found in pinon-juniper woodland as well (Grinnell and Miller 1944, Miller and Stebbins 1964, Wauer 1964). In the Panamint Mountains, the upper canyons which are also inhabited by the gnatcatcher, support a desert scrub vegetation (Wauer 1964).

B. Altitudinal range

Grinnell and Miller (1944) reported that amoenissima bred from seal level to 7500 feet. Bent (1949) reported finding this bird mainly between 500 and 6000 feet in desert mountains, but "never out on the lower plains or at higher elevations... among the coniferous forests." In the Panamint Mountains, gnatcatchers occur from 300 to 4000 feet and from 5500 to 7000 feet (Wauer 1964).

C. Home range size

Breeding territories in California average 4.6 acres, ranging from 2.2 to 7.4 acres (n = 9 territories, Root 1969). Grinnell and Storer (1924) reported a defended area with a radius of 100 yards about the nest.

D. Territory requirements

"Differences in the food supply of the habitats in which gnatcatchers occur during the period of territory establishment appears to be the principal variable that can account for the differences in the attractiveness of the habitats" (Root 1967). Chaparral or live oak woodland is preferred early in the season, deciduous oak woodland is occupied after foliation occurs later in the spring.

Perch site - Turgs (< 1cm diameter) and branches (1 - 4 cm diameter) were used during 98.5% of the observations made by Root (1967). The gnatcatchers usually used horizontal turgs, and they also used fallen branches when foraging in the herb layer.

Courtship and mating sites - no specific information located.

Nest sites - Grinnell and Storer (1924) reported that a typical nest in blue oak was "situated about 10 feet above the ground near the periphery of the tree, and small twigs and branchlets, and rested directly on a horizontal branch."

Root (1967) found that the height of the nest was related to the height of the nest tree. In chaparral, the nest was near the top of the shrub; in oaks, it was at least three feet from the top ($n = 7$ nests, 11 to 26 feet). Over 90% of the nests were located in oaks ($n = 64$, Root 1967).

The nests are not necessarily built under protective foliage; rather concealment is by resemblance of nest exterior to bark surfaces, since gnatcatchers frequently use spider silk to stick lichens onto the outside of their nests (Root 1969). The nests are placed in forks that present enough surface to support the nest and have 2 or 3 elements for the attachment of nest walls (Root 1967). Root (1967) found 28/64 nests placed in vertical forks against the trunk or vertical limb, 24/64 in y-shaped forks at branch bifurcations, 10/64 between adjacent upright branches, and 2/64 nests in dense twig tangles where two branch systems met.

E. Special habitat requirements

No information located.

F. Seasonal changes in habitat requirements

During the breeding season, the gnatcatchers shift territories from the chaparral and live oak woodland to the deciduous oak woodland, as the latter leaves out and insect prey become abundant there (Root 1967). By early August, the gnatcatchers move back into chaparral and live oak woodland.

The wintering habitat in Arizona includes screwbean woodland with arrowweed as a dense understory near the Colorado River, and saguaro-palo verde associations on rocky slopes of sonoran desert scrub near Tucson (Root 1967). Winter occurrence has also been documented in mesquite habitats with creosote bushes or graythorns (Miller and Stebbins 1964, Root 1967).

G. Physiological ecology

No information located.

V FOOD

A. Food preferences

The blue-gray gnatcatcher consumes only 2% vegetable matter yearly, the remainder being primarily insectivorous food (Beal 1907). Annual consumption percentages of insect foods were as follows: Hemiptera (64%), Hymenoptera (16%), Coleoptera (7%), miscellaneous (6%). Root (1967) found similar results.

Root (1967) observed adults feeding nestlings. He found that grasshoppers were fed to the young on 20% of 704 feeding trips, whereas grasshoppers were rarely found in adult stomachs.

Poliioptila caerula (Cont'd)

B. Foraging areas

Root (1967) studied the foraging utilization of different (micro) habitats throughout the breeding season. His results are presented in the following table:

<u>Date</u>	<u>Percent of foraging time</u>				
	<u>Deciduous oak</u>		<u>Live oak</u>		<u>Herb layer</u>
	<u>foliage</u>	<u>subcanopy</u>	<u>foliage</u>	<u>subcanopy</u>	
March-April	64.9%	12.5%	20.7%	1.2%	0.7%
mid-May to mid-June	78.6%	6.5%	10.7%	4.2%	0.0%
	(71.6%)*	(7.3%)	(8.3%)	(0.0%)	(12.8%)
mid-June to mid-July	87.9%	6.5%	2.8%	0.0%	2.8%
	(58.1%)	(6.1%)	(18.8%)	(2.1%)	(14.9%)

*Values in parentheses are for adults who are feeding young.

There were two major findings: 1) a shift from live oak early in the season to deciduous oak areas later in the season, 2) an increasing utilization of the herb layer by adults feeding young.

In the winter, gnatcatchers use the shrub and "tree" forms of the southwestern deserts (eg., mesquite, palo verde, screw bean, bur-sage, catclaw, willows, cottonwoods, Root 1967). They were never observed foraging in cacti.

C. Foraging strategies

Gnatcatchers enter every tree in their path, remaining for differing periods depending on food availability (Root 1967). Most of the foraging occurs in the foliage, but it is not restricted to any one foliage layer or level.

Foraging movements consisted of rhythmic hops from perch to perch, the gnatcatcher remaining only momentarily in one location (i.e., 1-2 seconds; Root 1967). Gnatcatchers moved tangentially or vertically when searching the sides of trees, radially when searching the canopy. The tail-flicking that occurred when adults were foraging with fledglings might serve to flush insects (Root 1967). Gnatcatchers also used hawking movements to capture airborne prey and hovering to search the outermost foliage (Root 1967).

When feeding nestlings, adult gnatcatchers make several adjustments in foraging strategies to meet the energy demands of the nestlings (Root 1967): 1) they spent more time in foraging; 2) they increased foraging intensity (more attacks

Polioptila caerula (Cont'd)

per unit time); 3) they increased the diversity of the foraging substrate and prey capture methods by adding the herby layer; 4) they captured larger insects. Foraging area was also restricted to the territory within 200 feet of the nest (Root 1969). Myres (1907) found that the adults visited the nests an average of 30.4 times per hour in the morning, with feeding being more intense for the early hours (46 and 35 feedings per hour from 0630 to 0830). Older nestlings were fed 52.5 times per hour, whereas younger nestlings were fed only 28 times per hour (Myres 1907).

D. Feeding phenology

Root (1967) found that over 70 species of arthropods were consumed throughout the year, most between the size of 1 and 10 mm in length. Different arthropod groups were utilized maximally at different times of the year: Homoptera (June to August), Heteroptera (March to May), Coleoptera (December to January), Lepidoptera (March to May), Diptera (June to August), Hymenoptera (June to August), Aranae (winter and summer). In the December to January period when the gnatcatchers were observed in Arizona, Coleoptera, Aranae and Homoptera were best represented in the diet. During the spring (March to May) after returning to the breeding grounds, Coleoptera, Homoptera, Lepidoptera, and Hymenoptera formed much of the diet. In the summer months (June to August), most gnatcatcher stomachs contained Homoptera, Coleoptera, and Hymenoptera.

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

The gnatcatcher establishes a territory that contains food, shelter, and nest sites for the pair and the young (Root 1967). The boundaries extend to include evergreen areas for foraging with fledglings who require more protection from predation. The male defends the area against all conspecifics, the female occasionally assisting him (Root 1969). The male patrols the boundary regularly until incubation begins, often accompanied by the female. Once nesting begins, the active defense area becomes compressed to the area around the nest (Root 1967), and the patrolling is usually restricted to a period of 1/2 hour after sunrise (Root 1969). The lack of breeding synchrony among neighboring pairs thus leads to a fluid territorial organization as individual territories expand and contract with breeding stages (Root 1967).

Polioptila caerula (Cont'd)

The advertising song of the male is given frequently on patrol (Grinnell and Storer 1924, Miller and Stebbins, 1964, Root 1969), and consists of 3 to 8 short sibilant phrases (Root 1969). Male-male interaction involves 1) intense vocalization and posturing, 2) aerial chase and combat if the boundary is heavily disputed. Over 50% of the early season encounters may result in combat, but boundaries are respected once they are established so that territorial disputes decrease starting in May (Root 1969).

C. Courtship and mating behavior

Weston (1949) reported that there was no well-marked courtship ritual, although males sang ceaselessly throughout the pre-incubation period. Root (1969) observed courtship and mating only within the boundaries of a territory. He found that the male perched in an upright posture and sang an elaborate whispered song. Subsequently, the female followed the male to a few nest sites and the female occasionally visited several territories. Begging by the female and head flagging displays were also observed during courtship (Root 1969).

Once the pair is formed, both sexes participate in nest building, although females may do more of the work (Nice 1932, Bent 1949, Root 1969). Frequently, several nests are built before egg laying begins. If so, the old nests are usually torn down and the nest material reused for the next nest (Bent 1949, Root 1969). Both sexes incubate the eggs and feed the nestlings and fledglings (Nice 1932, Root 1969).

D. Nesting phenology

Gnatchatchers arrive on breeding grounds in California from late February to late March (Root 1969). They establish territories from March to mid-April and nest from May through August. The first brood is produced between May and mid-July, the second brood from mid-June through August (Root 1969). The birds migrate south by early October (Root 1967).

Bent (1949) lists the following egg dates for California: 108 records, April 5 to July 12; 58 records, May 16 to June 12, indicating the height of the season.

E. Length of incubation period

Incubation has been reported as lasting 13 days (Western 1949) and 15 days (n = 2 nests; Root 1969).

F. Length of nestling period

The nestling period has been observed to be between 10 and 12 days (Weston 1949) and between 12 and 13 days (n = 2 nests, Root 1969).

G. Growth rates

Root (1969) observed the following course of change in external morphological and behavior traits:

day 2 (flight feathers show),
day 3 (pinfeather tracts show),
day 5 (eyes open to slits),
day 6-7 (feathers erupt),
day 8 (eyes open most of time),
day 10-11 (nestlings stand up, stretch, and preen),
day 12 (nestlings climb on nest rim and branches).

H. Post-breeding behavior

The adults feed the young for 2 to 3 weeks after fledging (Root 1969). The young can glean insects by the 9th day post-fledging and perform all adult foraging maneuvers by day 13 post-fledging. The young continue to get the bulk of their food from the adults until day 16 and are fed occasionally until the 19th day post-fledging (Root 1969).

On the wintering grounds, gnatcatchers remain on undefended home ranges, sometimes foraging in "pairs" (Root 1969). They are frequently seen in the company of verdins, black-tailed gnatcatchers, and ruby-crowned kinglets (Root 1969).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1949) reported a clutch size of 4 to 5 eggs, and this figure has been confirmed by Root (1969). Root observed a mean clutch size of 4.3 eggs (n = 20 nests),, 2 nests of 3 eggs, 11 nests of 4 eggs, and 7 nests of 5 eggs. Both Root (1969) and Weston (1949) reported that gnatcatchers lay 2 broods each year, although Weston indicated that this behavior was uncommon.

B. Nesting success

Root (1969) reported a high rate of desertion and nest predation. Young fledged from 24.4% of the nests (n = 45), which includes data from 12 pairs since most pairs built more than one nest: 5 pairs were unsuccessful, 3 pairs raised one brood, 4 pairs raised two broods. Losses during egg-laying and incubation accounted for 63.4% of the total loss, 26.7% occurring during the nestling period.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

Polioptila caerula (Cont'd)

E. Seasonal abundance

Gnatcatchers migrate south from higher latitudes (Grinnell and Miller 1944, Peters 1964) and downslope from higher elevations (Miller and Stebbins 1964).

F. Habitat density figures

Cody (1974) reported that 66% of the oak-woodland habitat he observed was occupied by gnatcatchers, as was 5% of the north slope chaparral, and 6% of the south slope chaparral. These figures are for the breeding season.

Grinnell and Storer (1924) observed a density of 64 pairs per square mile in the Sierra foothills near Coulterville.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1949) reported that California jays destroyed nests and robbed them of eggs and young and indicated that the shrike might also prey on gnatcatchers. Root (1969) observed harassment of the following potential predators: screech owl, horned owl, barn owl, pygmy owl, Cooper's hawk, scrub jay, yellow-billed magpie, and rattlesnake.

B. Competition

Phillips et al (1973) stated that "the breeding preferences of P. caerula and P. melanura... are distinct and nonoverlapping. P. caerula is found in the Upper Sonoran Life Zone... whereas P. melanura is restricted entirely to the arid parts of the Lower Sonoran Life Zone." Miller and Stebbins (1964) however, found that caerula does range down into melanura breeding habitat in Joshua Tree National Monument providing potential competition. Root (1969) observed no competition between caerula and melanura on the wintering grounds in Arizona, although the two species frequently foraged in close proximity.

The gnatcatcher competes potentially with all members of the foliage-gleaning guild (eg., warbling vireo, Hutton's vireo, orange-crowned warbler, plain titmouse, occasionally bushtit, yellow warbler, house wren, Bewick's wren, junco, chipping sparrow; Root 1967). However, guild members vary in the degree to which they are restricted to the oak foliage zone for foraging. The gnatcatcher overlaps most with the warbling vireo and orange-crowned warbler, since both of these spend 90% of their time in the same habitat as the gnatcatcher (Root 1967). The gnatcatcher diet overlaps primarily with the orange-crowned warbler, Hutton's vireo and the plain titmouse (Root 1967).

The gnatcatcher responds aggressively to any vertebrate that approaches its nest (Root 1969). At least 4 species are known to supplant the gnatcatcher from its nest: western flycatcher, western wood peewee, plain titmouse, western bluebird.

C. Parasitism

Cowbirds parasitize gnatcatchers (Friedmann 1929), and Root (1969) found that 6 of 22 gnatcatcher nests with young contained only a single cowbird nestling. Two of these cowbirds weighed 28 g each which compares to 29.3 g for a normal brood of 5 gnatcatcher nestlings.

The mite (Ornithonyssus sylvarium) occurs in gnatcatcher nests and was the cause of mortality in one brood (Root 1969).

IX STATUS

A. Past population trends

No information located.

B. Present population status

The Seventy-seventh Audubon Christmas bird count (1977) recorded blue-gray gnatcatchers in 12 out of 22 desert or near desert sites that were censused. The sites (and numbers of gnatcatchers observed) were: Claremont (2), Granite-woody-Glennville (3), Butterbread Springs (1), Joshua Tree National Monument (1), Pasadena (11), Orange County NE (51), Salton Sea N (9), Salton Sea S (42), San Bernardino Valley (20), Sespe Wildlife Area (3), Parker, Arizona - Colorado River (46), Yuma, Arizona (41).

C. Population limiting factors

No information located.

D. Environmental quality: adverse impact

No information located.

E. Potential of endangered status

No information located.

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BLACK-TAILED GNATCATCHER

Polioptila melanura

I TAXONOMY

A. Type description of desert subspecies

Polioptila melanura californica, California black-tailed gnatcatcher: Polioptila californica Brewster, 1881, Bull. Nuttall Ornith. Club. 6:03 - Riverside, Riverside County, California (Peters 1964).

Synonomies - Culicivora atricapilla, Culicivora mexicana, Polioptila californica; black-headed gnatcatcher, black-tailed flycatcher, black-capped gnatcatcher, California black-capped gnatcatcher (Grinnell and Miller 1944).

Polioptila melanura lucida, Sonora black-tailed gnatcatcher: Poliptila melanura lucida van Rossem, 1931, Condor 33:36 - Guaymas, Sonora Mexico (Peters 1964).

Synonomies - Polioptila plumbea, Polioptila melanura melanura; black-head gnatcatcher plumbeous gnatcatcher, lead-color flycatcher, black-capped gnatcatcher (Grinnell and Miller 1944).

B. Current systematic treatments

Order Passeriformes, family Musicapidae, subfamily Polioptilinae, genus Polioptila Sclater, 1855, Proc. Zool. Soc. Lond. 23:11 (Peters 1967).

There are currently 6 recognized subspecies of Polioptila melanura: californica, lucida, melanura, pontilis, margaritae, curtata (Peters 1964).

C. Recent taxonomic revisions

The Supplement to the AOU Check-list of North American Birds (1973 Auk 90: 411-419) indicates that there have been no revisions in gnatcatcher systematics since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The black-tailed gnatcatcher is a very small bird (5 grams) which is "plumbeous gray above and light gray... to white below; tail black, the outer pair of feathers with white lateral web and white tip. Male in spring plumage with lores, top of head, and post ocular region black, but the eye ring white" (Miller and Stebbins 1964; see also Phillips et al 1973).

The males have black caps in spring and summer which are replaced by gray in the fall and winter (Woods 1921). The black disappears over a 1-1/2 month period, and only the black streak above the eye is permanent.

Poliioptila melanura (Con't)

B. External morphology of subadult age classes

The juveniles resemble the females and have a greater amount of white on the outer tail feathers (Woods 1921).

C. Distinguishing characteristics

Interspecific - P. melanura is darker in coloration than P. caerula and has narrower white tail edgings (Woods 1949). Psaltiparis minimus (the bush-tit) lacks white tail markings entirely (Woods 1949).

Intraspecific - The subspecies californica is generally darker than the subspecies melanura (Woods 1949). The subspecies lucida is smaller in all dimensions than melanura. It is decidedly paler below, and the flanks are paler and less extensively gray (van Rossem 1931).

D. Special morphological features

No information located (but see Root 1967, Ecol. Monogr. 37:317-350, on blue-gray gnatcatcher).

III DISTRIBUTION

A. Overall distribution of the species

The black-tailed gnatcatcher breeds from the southwestern U.S. south to Baja California and central Mexico (Peters 1964). Three subspecies are restricted to Baja California (pontilis, margaritae, curtata) and the other three occur in the rest of the range (melanura, lucida, californica).

P.m. californica breeds in desert areas from southeastern California, southernmost Nevada, and central Arizona southward in northeastern Baja California to latitude 31°N, and in Sonora, Chihuahua, and northwestern Durango (Peters 1964).

B. California distribution of the species

P.m. californica is found on "coastal southern California from the Mexican line northwest to lower Santa Clara Valley, Ventura County, and eastward to San Gregario Pass" (Grinnell and Miller 1944).

P.m. lucida occurs on the "Colorado desert west to eastern San Diego County and northwest to Palm Springs, Riverside County, along the valley of the Colorado River from Mexican boundary to Nevada line; occurs locally on the Mohave Desert" (Grinnell and Miller 1944).

C. California desert distribution

See California distribution (IIIB.). In addition, an unspecified subspecies (probably lucida) occurs and may breed in Death Valley (Wauer 1962).

D. Seasonal variations in distribution

The black-tailed gnatcatcher is a year-round resident in its breeding range (Grinnell and Miller 1944).

IV HABITAT

A. Biotopic affinities

The black-tailed gnatcatcher typically breeds in the Lower Sonoran Life Zone (Grinnell and Miller 1944) described as "semidesert valleys and lower slopes covered with a low and often scattered growth of shrubs" (Woods 1949). The shrubs are those of typical desert scrub: creosote bush, mesquite, tar bush, ironwood, smoke tree, screwbean, cat claw (Grinnell and Miller 1944, Raitt and Pimm 1976). Although this gnatcatcher is rigidly confined to the Lower Sonoran Life Zone (Woods 1949), it will follow the catclaw upward to where it interdigitates with pinon pines (Miller and Stebbins 1964, Wauer 1964). In New Mexico, this species is also found in Yucca-grassland habitats where Yucca, black grama, and mesa dropseed and/or tobasa grass predominate (Raitt and Pimm 1976).

B. Altitudinal range

P.m. ludica is found from -240 feet to 3000 feet, although it breeds chiefly below 1000 feet (Grinnell and Miller 1944).

P.m. californica occurs from sea level to 2500 feet (Grinnell and Miller 1944).

An unspecified subspecies (probably lucida) breeds at 4000 feet in the Panamint Mountains (Wauer 1964).

C. Home range size

Emlen (1974) reported that the territory size of the species was large and included foraging areas. Woods (1921) commented that "black-tailed gnatcatchers do not wander much during the ... year, and ordinarily it is possible to locate a pair at almost any time within an area of a few acres." Raitt and Maze (1968) found between 0.5 and 2 pairs per 100 acres in New Mexico.

D. Territory requirements

Perch site - no information located.

Courtship and mating sites - no information located.

Nest sites - The black-tailed gnatcatcher nests in dense foliage for concealment and protection from the sun, as for example, in mistletoe clumps on catclaw (Miller and Stebbins 1964). Other nest sites include sumac, graythorn, buckthorn, cactus and weed clumps (Woods 1921, 1928; Raitt and Maze 1968). The nests are usually located between 2 and 3 feet above the ground (Woods 1921, 1928; Raitt and Maze 1968).

E. Special habitat requirements

"Probably no other California bird is so strictly confined to the brushlands as is this. The cactus wren shares the same territory, but often comes about houses..., while the black-tailed gnatcatcher almost invariably turns back when it reaches the limits of the natural vegetation" (Woods 1928). This situation is in contrast to the wide-ranging habits and distribution of its congener, the blue-gray gnatcatcher.

F. Seasonal changes in habitat requirements

This gnatcatcher is a year-round resident.

G. Physiological ecology

The black-tailed gnatcatcher sometimes retreats to mistletoe clumps on catclaw to avoid the heat of midday (Miller and Stebbins 1964).

V FOOD

A. Food preferences

The food preferences are essentially the same as those of the blue-gray gnatcatcher: Hemiptera (64% of the total food consumed), Hymenoptera (16%), Coleoptera (7%), miscellaneous arthropods (6%), vegetable matter (2%) (Beal 1907).

Small insects and spiders are usually brought to the nestlings (Woods 1921). If larger insects are provided, the adults first beat them against a branch to break them up and then feed them to the nestlings.

B. Foraging areas

The gnatcatchers forage in the shrubs and trees located on their territories (Emlen 1974).

C. Foraging strategies

The black-tailed gnatcatcher is not as aerial in its foraging habits as is its congener, the blue-gray gnatcatcher (Woods 1949). It does not use hawking or hovering except rarely and searches systematically through the branches of shrubs for small arthropods.

D. Feeding phenology

No information located.

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

No information located.

B. Territorial behavior

This gnatcatcher defends the area around its nest vigorously from conspecifics and from other species such as the bushtit and even larger birds (Woods 1928). The area of primary defense is within a 50-foot radius of the nest (Woods 1949).

C. Courtship and mating behavior

Black-tailed gnatcatchers form permanent pair bonds (Woods 1949). No information was located on the specifics of pair formation and mating. Both sexes build the nest, incubate the eggs, and feed the nestlings and fledglings (Woods 1921, Verner and Willson 1969).

D. Nesting phenology

The first brood is raised between March and early June, and the second brood is reared from June to early August (Woods 1921, 1928).

E. Length of incubation period

Woods (1921, 1928) reported incubation periods for three nests of at least 12 days, at least 14 days, and 14 days.

F. Length of nestling period

Woods (1921, 1928) reported nestling periods for three nests of 9 days, 10 or 11 days, and 14 or 15 days.

G. Growth rates

No information located.

H. Post-breeding behavior

The young are fed for at least two weeks after they fledge (Woods 1921). However, young from the first brood are not permitted to loiter around the second brood nesting area. The second brood young leave the nesting area in early August (Woods 1921).

VII POPULATION PARAMETERS

A. Clutch size

Woods (1921, 1928) reported clutch sizes of 3 eggs (2 nests) and 4 eggs (4 nests).

Polioptila melanura (Cont'd)

B. Nesting success

No information located.

C. Mortality rates per age class

No information located.

D. Longevity

No information located.

E. Seasonal abundance

The black-tailed gnatcatchers are year-round residents.

F. Habitat density figures

Emlen (1974) reported a density of 1.6 birds per 100 acres of desert habitat in Arizona. Raitt and Maze (1968) found 0.5 to 2.0 pairs per 100 acres in a creosote bush community in New Mexico.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Woods (1928) found an alligator lizard waiting beside a nest and also observed that 3 nestlings disappeared from another nest when a shrike was known to be in the vicinity.

B. Competition

P. melanura and P. caerula come into contact where catclaw and pinon pine interdigitate and when P. caerula migrates into Lower Sonoran areas for the winter (Miller and Stebbins 1964). However, Root (1969) has observed P. caerula and P. melanura foraging in close proximity in winter and concluded that there was no overt competition occurring.

C. Parasitism

Three breeding pairs of gnatcatchers were parasitized by dwarf cowbirds in a study by Taylor (1966). One pair built a total of 4 nests, 2 of which were destroyed, and 2 of which contained cowbird eggs and were subsequently destroyed or deserted. One pair successfully raised one cowbird young and no gnatcatcher young, and the third pair was observed incubating 3 gnatcatcher eggs and 2 cowbird eggs.

Polioptila melanura

IX STATUS

A. Past population trends

No information located.

B. Present population status

The Seventy-seventh Audubon Christmas bird count (1977) found black-tailed gnatcatchers in 3 out of 21 desert or near desert areas sampled. The areas (and numbers of gnatcatchers seen) are as follows: Salton Sea N (3), Salton Sea S (1), Parker, Arizona-Colorado River (66).

C. Population limiting factors

The black-tailed gnatcatcher may be limited by the amount of desert brushland available, since it does not appear to extend into agricultural or suburban vegetation (Woods 1928).

D. Environmental quality: adverse impact

No information located.

E. Potential for endangered status

No information located.

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Ecol. Monogr. 37:317-350.

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These two references provide detailed information on the closely related congener of the black-tailed gnatcatcher.

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PHAINOPEPLA
Phainopepla nitens

I TAXONOMY

A. Type description

Phainopepla nitens lepida - AOU (1957) Van Tyne, Occ. Pap. Boston Soc. Nat. Hist., 5, May 22, 1925. Riverside, California.

B. Current systematic treatments

Sibley (1973) noted protein electrophoretic studies clarifying taxonomic position.

Synonomies - Wheelock (1904) noted called "black mockingbird" in some localities. Coues (1878) reported called "crested shining-black white-winged flysnapper". Everman (1882), "black crested flycatcher".

II DESCRIPTION

A. External morphology of adults

Ridgway (1904) gives detailed descriptions of plumages and measurements of adults and nestlings.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "From central California, southern Nevada, southern Utah, southwestern New Mexico, and western Texas south to Baja California, Sonora, and the Mexican plateau to Puebla and Vera Cruz. Breeds from California (north to the San Francisco Bay region and the head of Sacramento Valley), southern Nevada, southern Utah, southwestern New Mexico, and western (except Brewster County) and southern Texas south through Baja California and Sonora."

B. California distribution of the species

Grinnell and Miller (1944) noted geographic range - north from Mexican boundary over Colorado and Mojave deserts east of Sierra Nevada as far as "Morans" (= Benton Station), Mono County; west, at least in summer, to include coastal slope of southern California, and northwest along inner coast ranges as far as Alameda, Contra Costa and Solano Counties; north, sparingly, through Great Valley to its head, in Tehama and Shasta Counties. "Status - resident within state, southerly. Locally common to abundant. In winter, population concentrates chiefly in portions of Colorado and Mojave deserts, spreads thence westward to coast of San Diegan district, and northward, less commonly, to San Francisco Bay region and head of Sacramento Valley. However, seasonal and yearly occurrence anywhere is irregular, unpredictable; there are winter records for occurrences nearly as far to northward as northmost summer ones." Dawson

Phainopepla nitens (con't.)

(1923), "Abundant winter resident and fairly common summer resident in suitable sections of the deserts, Mojave and Colorado, north to Owens and Panamint Valleys; common summer resident in the San Diegan district and north." Hoffman (1933) reported female observed at 5500 feet at Barley Flats, north of Mount Wilson, Los Angeles County, California on December 20.

C. California desert distribution

Gilman (1935) noted a female was seen in the mesquites on Furnace Creek Ranch, May 6. Wauer (1964) reported nested at Wildrose; on May 18, using a Joshua Tree. Nest located in the high canyon area just below the pinon-juniper woodlands. A well-watered area. Crouch (1943), "In the lower Sonoran desert regions breeding occurs wherever nesting sites and sufficient food are available." Bent (1950) reported some birds winter in the southern deserts of California and Arizona.

D. Seasonal variations in distribution

AOU (1957), "winters in breeding range, chiefly from the Mojave and Colorado deserts southward; recorded from February to May in Brewster County, Texas." Small (1974), "seasonal status - resident in southeastern portion of state; elsewhere is a transient and summer visitor as major portion of California population withdraws to southeast in winter... Range in California - in winter, found in the southeastern deserts; summer birds range north to head of Central Valley and coastally to about San Francisco from San Diego County." Crouch (1943) reported common year round residents in the deserts of southeastern California, probably less common in summer. "... records point to a northward migration in spring and a southward migration in the fall. This migration seems to be complicated by a movement of birds from the deserts of southeastern California presumably into cooler climates to the north and west. This exodus of the birds from the deserts, when it occurs, follows the breeding season along in late April or May. All individuals do not leave, and in some areas apparently none."

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "breeding life zones east of desert divides, lower Sonoran; west of desert and Sierran divides, both lower and upper Sonoran but chiefly the latter." Crouch (1948), "The most important factor in the environment of the phainopeplas is vegetation for it furnishes them with food, shelter, and a place to raise their young." Crouch (1943), "Breeding occurs in both the upper and lower Sonoran life zones, more commonly in the latter. West of the mountains, quite a different association of plants is frequented by the phainopeplas, No one plant is as influential as the mistletoe of the deserts. Willow, sycamore and oak associations seem to be favored. Phainopeplas have become common in many agricultural areas. Deserts - mesquite and mistletoe; foothills - live oaks, sycamores, sumachs." Wheelock (1904) reported California

Phainopepla nitens (con't.)

breeding range: arid lower Sonoran zone. Bent (1950), "East of the principal mountain ranges of southern California the phainopepla occurs mainly in the mesquite association."

B. Altitudinal range

Grinnell and Miller (1944) reported altitudinal records in summer: -200 (near Salton Sea) up to 6600 feet (west of Lone Pine, Inyo County). Stevenson (1933) noted species found at 6200 feet flying about in, and perching in yellow pines, on June 12.

C. Territory requirements

Nest sites - Bent (1950) reported in the desert, nests have been found in mesquites, cottonwoods, hackberries, and willows. On the coast, sycamores, oaks, orange trees and many other tall trees and shrubs are used. Phainopeplas will nest in the middle of a clump of mistletoe, parasitizing a mesquite. Hensley (1959) noted nests in palo verde, catsclaw, condalia, and mesquite. Nests placed in trees without mistletoe, but always adjacent to ones with the parasite. Bent (1950) cited nests placed mostly between 6 and 12 feet above the ground, though some much higher. Bancroft (1930), "nest ordinarily placed eight to twelve feet above the ground, though some were much higher." Gilman (1915), "They nest most frequently in the old growth of mesquites that have much mistletoe growing in them." Bancroft (1932), "In California we expect to find the nests resting against the larger limbs of trees. In the San Ignacio region nearly all were placed in mistletoe or suspended beneath it." Woods (1932), "nest abundantly in orange groves and orchards." Dawson (1923) reported nest height: 5-60 feet; 15 feet average for those placed in mesquite and elderberry. Everman (1886) noted nests in live-oaks.

V FOOD

A. Food preferences

Grinnell and Miller (1944), "During the breeding period, a need for insect food seems to dim the berry requirement." Dawson (1923) noted insects important food source in summer, but berries are their chief food at all times of the year. Bent (1950) reported phainopeplas eat various kinds of berries and winged insects. Tiny insects and berries form most of the diet of young phainopeplas as noted in Myers, 1908. Phainopeplas eat mistletoe berries, buckthorn berries; juniper, elder and Rhus berries, berries of the peppertree (Schinus molle), petals of the Paraguay guava (Feijoa selowiana) and other small fruits and berries, also wild grapes. Everman (1882) noted the species eating berries of the "chokecherry". Crouch (1943) reported in side canyons, west of the mountains phainopeplas ate: elderberry (Sambucus), red-berry (Rhamnus) and pepper berries (Schinus). Coues (1878), "... though insects form much of its food, it seems berries form still more." Myers (1909) noted phainopeplas will eat "nightshade berries". Woods (1932) reported phainopeplas eat buckthorn (Rhamnus crocea) berries, and the petals of the Paraguay guava (Feijoa sellowiana).

Phainopepla nitens (con't.)

B. Foraging strategies

Bent (1950), "It is noticeable that the hunting of winged insects always is conducted at a considerable height and never in low swoops over the ground as is often the case with flycatchers." Phainopeplas, particularly males, will often "carry on flycatching activities from high perches, sometimes by sallies in regular flycatcher fashion, but frequently by hovering and fluttering about in the air in a seemingly aimless and befuddled manner". Coues (1878) noted a dozen P. nitens "pitching about the topmost branches (of oaks) in active pursuit of their insect prey". Merriam (1896) observed hovering before a bunch of berries, feeding. "... Made short sallies into the air as if for insects." Carter (1937) noted they fly up from the tops of the mesquites to catch insects.

C. Energy requirements

Walsberg (1975), "The bird's stomach is highly adapted for processing mistletoe berries. The gizzard is reduced in size and does not grind the mistletoe berries. It extrudes the berries seed and pulp and passes them into the intestine while the exocarp is temporarily retained in the gizzard. Phainopeplas pass berries through the digestive tract in 12-45 minutes." "Individual phainopeplas ate an average of 264 berries per day." Average daily energy expenditure calculated at 10.9 kcal/bird/day.

VI REPRODUCTION

A. Territorial behavior

Hensley (1959) noted female, primarily, chased away intruders. Rand and Rand (1943), "... male phainopeplas established territories and advertised themselves visually instead of singing. During incubation, territory defense and display flights were lacking, but appeared again after the young were hatched." Territorial defense weakens during incubation period. Myers (1908) reported phainopeplas guard the nest tree, the male and female taking turns.

B. Courtship and mating behavior

Wheelock (1904), "... usually remain mated for life..."

C. Nesting phenology

Dawson (1923), breeding season: "Varies with local conditions: March - April on the deserts; May - July, but chiefly June elsewhere." Bent (1950) noted in the deserts, nesting begins 2 to 3 months earlier than on the coastal slope... Begins in late February and most of the young are hatched in March and April, west of the mountains nesting begins in late May, continues into June, with the young hatching and fledging by the end of July. Wheelock (1904) reported breeding season: May to July. Myers (1909) noted both birds work at nest building but the male does the majority of the work. Everman (1882) reported both male and female worked at nest

building. Hensley (1959) noted male builds nest. Merriam (1896) reported males did almost all the nest building. Myers (1907) cited sketchy description of nest building, brooding behavior. Myers (1909) reported phainopepla nest composed of a gray, stringy, woolly plant material with a resemblance to papier mache. Myers (1909) reported nest building takes about one week. Hensley (1959) cited first nest under way by March 10 and last young left a nest after May 30. Rand and Rand (1943) reported incubation started with the first egg, both male and female incubated, at early part of incubation the male incubated more of the time than the female. Female spent the night on the nest. Male and female usually took equal part in feeding, sanitation, and brooding. Merriam (1896) noted both male and female brooded eggs. Bent (1950) reported phainopeplas may raise more than one brood a year.

D. Length of incubation period

Hensley (1959) noted incubation period 14 days. Woods (1927) reported incubation period = 16 days. Bent (1950) cited incubation period has been given as: 16 days - F.L. Burns, 1915; 15 days - F.F. Gander, 1927; and 14 days - A.C. Bent. Dawson (1923), "The young are hatched upon the fourteenth day after the deposition of the last egg."

E. Length of nestling period

Burns (1921) noted nestling period = 20 days. Myers (1908) reported the young leave the nest for the first time after 19 days. Hensley (1959) noted young remained in one nest for 17 days, in the other for 19 days. Bent (1950) cited the young remain in the nest about 19 days. The shortest time reported = 18 days. Dawson (1923), "... the birds first leave the nest in about nineteen days. They do not, however, leave it for keeps, as most birds do, but will make it headquarters for a day or so..."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1950) reported a set of eggs may be often two, usually three and rarely four. Wheelock (1904) noted clutch size: 2 or 3 eggs. Coues (1878) cited clutch size - two eggs. Everman (1886) found nest containing 3 eggs near the mouth of Santa Paula Canyon, May 4, 1879. Six other nests were found in Santa Paula Canyon; all but one had 3 eggs. Dawson (1923) reported three egg clutches may predominate in certain favorable seasons, G.F. Moroom. Bancroft (1932), "The number of eggs in a set is either two or three, the latter being more common..."

B. Habitat density figures

Van Velzen (1977) reported catclaw - rabbitbrush desert wash; location: San Bernardino County, California. Sixteen territorial males or females:

Phainopepla nitens (con't.)

90 territorial males or females/km²; 36 territorial males or females/100 acres. Desert riparian; location: San Bernardino County, California. Twelve territorial males or females/16-26 acres: 182 territorial males or females/km²; 74 territorial males or females/100 acres. Three nests were found. Austin (1970) noted breeding bird density (pairs) - Dunes: 1968 = 3.0, 1969 = 4.0; Bosque: 1968 = 1.5, 1969 (-); Total: 1968 = 4.5, 1969 = 4.0.

VIII INTERSPECIFIC INTERACTIONS

Bancroft (1930), "... gregarious to the extent of perhaps a dozen pairs in especially favored spots where the mesquite is at its best and food supply is exceptional."

A. Parasitism

Friedmann (1931) noted parasitized by Molothrus ater obscurus.

IX STATUS

no information located

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LOGGERHEAD SHRIKE

Lanius ludovicianus

I TAXONOMY

A. Type description of desert subspecies

Lanius ludovicianus gambeli, California loggerhead shrike: Lanius ludovicianus gambeli Ridgeway, 1887, Man. No. Amer. Birds., p. 467 - California, especially coast district (Peters 1960).

Synonomies - Lanius degans, Lanius excubitoroides, Collyrio excubitoroides, Collurio ludovicianus, C. l. excubitoroids, Lanius ludovicianus excubitoroides, L. l. robustus, L. l. excubitoroides; white winged shrike, American gray shrike, white-rumped shrike, western loggerhead shrike, California shrike, long-billed shrike, Gambel shrike, butcher-bird (Grinnell and Miller 1944).

Lanius ludarcianus sonoriensis, Sonora loggerhead shrike: Lanius ludovicianus sonoriensis Miller, 1930, Condor 32, p. 155 - Chiricahua Mountains, Cochise County, Arizona (Peters 1960).

Synonomies - Lanius excubitoroides, Collyrio excubitoroides, Collurio ludovicianus excubitoroides, Lanius ludovicianus excubitoroides; American gray shrike, western loggerhead shrike, white rumped shrike, Sonora shrike.

B. Current systematic treatments

Order Passeriformes, family Laniidae, subfamily Laniinae, genus Lanius Linnaeus, 1758, Syst. Nat., 10th ed., 1:93 (Peters 1960).

There are currently eleven recognized subspecies of loggerhead shrike: gambeli, excubitoroides, migrans, ludovicianus, miamensis, mexicanus, sonoriensis, grinelli, redsoni, anthonyi, mearnsi (Peters 1960).

C. Recent taxonomic revisions

The Supplement to the AOU "Check-list of North American birds" (1973, Auk 90: 411-419) indicates that there have been no revisions in shrike taxonomy since the 5th edition of the Checklist (1957).

II DESCRIPTION

A. External morphology of adults

"A stocky, large-headed species, 8½ inches long. Above light gray, the scapulars and rump whitish; a black mask extends from bill through eye to ear area; below white; wings black with white 'windows' at bases of primaries; secondaries tipped with white. Tail black with white tips on all but central pair, the white areas progressively larger laterally; tail distinctly graduated" (Miller and Grinnell 1964).

Lanius ludovicianus (Cont'd)

B. External morphology of subadult age classes

In juvenile plumage, the back is olive gray; rump and upper tail coverts light drab or clay color, chin and throat white; breast, sides and flanks light smoke gray; belly white with dusky spots; wings dull black; tail dull black (Miller 1950).

C. Distinguishing characteristics

Interspecific - The loggerhead shrike is a chunkier bird than the mockingbird and the gray color is much lighter in shade. The large head is noticeable as is the black line through the eye, which is almost a mask (Sprunt 1950). Unlike the larger northern shrike, there is no barring on the breast (Sprunt 1950).

Intraspecific - The subspecies sonoriensis "differs from L.l. gambeli as follows: anterior part of forehead with larger zone of pallid neutral gray; remainder of pileum, hind neck, back, and upper rump lighter gray; scapulars with more white laterally; lower rump and upper tail coverts usually lighter...; breast and flanks much lighter" (Miller 1931). L.l. sonoriensis intergrades with gambeli on the eastern margin of the mountains of San Diego County and at San Gregorio Pass, Riverside County (Miller 1931).

D. Special morphological features

No information located.

III DISTRIBUTION

A. Overall distribution of the species

The loggerhead shrike breeds from southern Canada south to central Mexico (Sprunt 1950, Peters 1960). The general ranges for each subspecies are as follows:

gambeli: western North America
excubitoroides: Great Plains region of North America
migrans: eastern North America
ludovicianus: southeastern United States
miamensis: southern Florida
mexicanus: central Mexico
sonoriensis: southwestern United States and northwestern Mexico
grinnelli: northern Baja California
nelsoni: southern Baja California
anthonyi: Santa Barbara Island group
mearnsi: San Clemente Island, California

Lanius ludovicianus gambeli breeds from interior southern British Columbia and eastern Washington south through the Great Basin to California (San Diego County and Mohave Desert); east to southwestern Montana and northwestern New Mexico (Peters 1960).

Lanius ludovicianus (Cont'd)

Lanius ludovicianus sonoriensis breeds in the southwestern United States and northwestern Mexico, from southwestern New Mexico, and Western Texas, central Arizona, extreme southern Nevada, southern California, and northeastern Baja California south to northern Durango and southern Sinaloa (Peters 1960).

B. California distribution of the species

L.1. gambeli breeds in the Great Basin plateau, Sacramento and San Joaquin Valleys, coastal districts from Sonoma south to Mexican border (Grinnell and Miller 1944).

L.1. sonoriensis is a permanent resident of the Colorado Desert in eastern Riverside, Imperial and San Diego Counties (Grinnell and Miller 1944).

L.1. anthonyi is restricted to the Santa Barbara Island group, especially Santa Cruz Island.

L.1. mearnsi is found only on San Clemente Island.

C. California desert distribution

The subspecies sonoriensis breeds in the Colorado Desert (Grinnell and Miller 1944) and is also found in Joshua Tree National Monument (Miller and Stebbins 1964). The subspecies gambeli joins sonoriensis on the Colorado desert in the winter (Miller 1950) and is also found in the Mohave Desert (Grinnell and Miller (Grinnell and Miller 1944). Unspecified subspecies occur in Death Valley (Wauer 1962), the Panamint Mountains (Wauer 1964) and the San Jacinto Mountains (Smyth and Coulombe 1971).

D. Seasonal variations in distribution

L.1. gambeli is migratory north of California, but a permanent resident south of Latitude 40° N (Miller 1950). L.1. gambeli winters southward through western Mexico south to Baja California, Muchoacan and Morelos (Peters 1960), residing on the Colorado and Mohave Deserts in California during the winter months (Grinnell and Miller 1944). The other northern subspecies, excubitoroides and migrans, also migrate south as far as Mexico, central Mexico and north-eastern Mexico respectively.

IV HABITAT

A. Biotopis affinities

L.1. sonoriensis is a resident of the Lower Sonoran Life Zone, whereas L.1. gambeli is found in the Upper and Lower Sonoran Life Zones (Grinnell and Miller 1944). The Lower Sonoran Life Zone is composed of such vegetation as clumps of mesquite, desert willow, palo verde, smoke-bush, ironwood, cat-claw and ocotillo (Miller 1931, Grinnell and Miller 1944). The Upper Sonoran is characterized by sagebrush and juniper associations (Grinnell and Miller

Lanius ludovicianus (Cont'd)

1944, Wauer 1964). In both life zones, the loggerhead shrike frequents dry washes, arroyos and arid flats and mesas (Miller 1931, Grinnell and Miller 1944).

In the Panamint Mountains, the loggerhead shrike moves up from lower altitudes to breed in the pinon-juniper woodland (Wauer 1964). In Colorado and New Mexico it is found on grassland associations: short-grass associations of blue grama, buffalo grass, saltbush and prickly pear in Colorado (Porter et al 1975); yucca, black grama, mesa dropseed and/or tobasa grass in New Mexico (Raitt and Pimm 1976).

B. Altitudinal range

L.1. sonoriensis occurs primarily below 1000 feet, although it is found up to 4000 feet in the desert mountains of Riverside County (Grinnell and Miller 1944).

L.1. gambeli is found from sea level to 5600 feet (Grinnell and Miller 1944).

An unspecified subspecies breeds at 6000 feet in the Panamint Mountains (Wauer 1964).

C. Home range size

The size of the loggerhead shrike territory in California varies with the terrain. In grassy hills with scattered trees, the territory covered 11 to 14 or 15 acres, whereas in semidesert with widely spaced bushes and few trees, it reached 25 to 40 acres (Miller 1931, Miller 1950). In Colorado, Porter et al (1975) found that nests were located at least 400m apart, although the territory was much smaller.

D. Territory requirements

Perch sites - The loggerhead shrike uses any bush or tree over 2 feet in height as a lookout perch (Grinnell and Miller 1944). Joshua trees are especially favored as perches from which to forage (Miller and Stebbins 1964). The shrikes are also observed frequently on fence posts and power lines (Miller 1950). "Within the occupied territory, the highest perches available were likely to be the ones most often used" (Linsdale 1938).

Courtship and mating sites - No special site indicated.

Nest site - The loggerhead shrike will use any bush or tree with a screen of overhanging limbs as a roost or nest site (Miller 1950). The following trees and shrubs have been observed as nesting sites: graythorn, creosote bush, catclaw, Krameria (Raitt and Maze 1968), elms, willows, cottonwoods, Russian olives, saltbush (Porter et al 1975), mesquite, screw bean, palo verde, smoke-bush, live oak, sumac, acacia (Miller 1931, 1950).

Porter et al (1975) found that 70% of the nests were found in trees (willow, cottonwood, elm, Russian olive) in Colorado and 10% were found in saltbush. They concluded that the amount of cover and not the plant species was the determining factor in nest site selection. Thorny trees were used first. The mean height of the nests found in trees was 2.23m (range, 0.92 to 7.52m); the mean height of nests in bushes was 0.76m (range, 0.43 to 0.94m; Porter et al (1975).

Miller (1931, 1950) characterized the nest site as being in dense bushes or thickly grown trees (eg., mesquite, screwbean, smoke bush, live oak, cypress, sumac, acacia). He also found nests in mistletoe clumps on mesquite (Miller 1931). Miller (1950) observed nests between 3 and 25 feet from the ground, frequently hidden below the crown on sturdy limbs. The nest itself is built of twigs with a lining of hair, feathers and bark.

E. Special habitat requirements

The loggerhead shrike requires open terrain with well spaced lookout posts at least 2 feet high (Grinnell and Miller 1944, Miller 1950). The terrain may be flat land, canyon walls or mountain slopes, as long as the ground is free of dense cover (Miller and Stebbins 1964). In Joshua Tree National Monument, Joshua tree "forests" are especially favorable, since they provide scattered perches for foraging (Miller and Stebbins 1964).

F. Seasonal changes in habitat requirements

L.l. gambeli is found primarily in sagebrush-juniper associations during the breeding season, but migrates south or downslope to winter in the Lower Sonoran with L.l. sonoriensis (Miller 1931, Wauer 1964).

G. Physiological ecology

The loggerhead shrike has not been observed drinking in desert areas, although it is frequently seen around open water (Miller and Stebbins 1964). The animal food probably supplies the shrike with sufficient moisture. In addition, shrikes seek shady perches to escape the extreme heat of the desert (Miller and Stebbins 1964). Respiratory water loss is quite low, averaging 5.8% of body weight over 24 hours (Battholomew and Dawson 1953).

V FOOD

A. Food preferences

"Shrikes possess an almost indiscriminate taste for animal matter; if it is within the shrike's power to attain it, few kinds of animals are rejected" (Miller 1950).

Vertebrate food contributes up to 76% of the diet in winter, although only 28% yearly (Judd 1898). L.l. gambeli is reported to take fewer birds and

mammals than other subspecies (Miller 1950; 12% Beal and McAtee 1912). Small birds usually make up no more than 15% of the total food consumed, reptiles account for 7-8% if they are available, and small rodents are a common food in late summer, but account for only 3% of the yearly food intake (Miller 1931, 1950). Among the vertebrate food eaten are the following species: quail young, blue-gray gnatcatchers, sparrows, rattlesnake, pocket mice, green tree frogs, spring peepers.

Ground dwelling large insects are the principal food items (especially orthopterans (Miller and Stebbins 1964). Orthopterans account for 30 to 75% of the yearly total food intake with Coleoptera providing an additional 20% (Carabidae, 7%; Miller 1950). Beal and McAtee (1912) reported values of prey consumption as follows: Orthoptera (43%), Hymenoptera (11%), Lepidoptera (4 to 7%).

B. Foraging areas

The loggerhead shrike hunts from lookout posts throughout the habitats it lives in (Miller 1931, Grinnell and Miller 1944, Miller 1950, Miller and Stebbins 1964). All foraging occurs on territories in winter and summer (Miller 1950). "Presence of plants was necessary if there was to be insect food, but too much cover would tend to conceal the prey" (Linsdale 1938).

C. Foraging strategies

Loggerhead shrikes hunt by watching from fixed positions and require long unobstructed views from these look out posts (Miller 1950). Prey is taken on the ground after it is seen from above with the shrike moving from one perch to another if prey is not sighted within 1 to 2 minutes (Miller 1950). This active mode of hunting is most frequent early in the morning. While the morning kills are being digested, and if there are no nestlings to be fed, the shrikes engage in passive hunting. This involves remaining at one post and pursuing prey as they wander into range (Miller 1950).

The killing mechanism is a quick cut or snip of the bill (Miller 1950). Prey is often impaled on thorny shrubs, barbed wire, or broken branches. "The impaling habit of shrikes is the result of a lack of sufficiently powerful feet to hold the prey while it is being torn to pieces, thorns or crotches being used in order to hold the food while it is being eaten (Miller 1950). Laboratory experiments indicate that impaling occurs with greater frequency as hunger decreases (Wemmer 1969).

Prey selection experiments indicated that 83.5% of the mice captured were under 8.6 g (Slack 1975). The mean weight of the mouse prey selected was 7.15 g.

D. Feeding phenology

Judd (1898) found that vertebrates supplied up to 76% of the shrike diet in winter, although this figure is probably not as high for western subspecies.

Lanius ludovicianus (Cont'd)

Judd (1898) indicated a yearly vertebrate composition of 28% for his eastern birds, whereas Beal and McAtee (1912) found that vertebrate food accounted for only 12% of the yearly diet in western subspecies.

E. Energy requirements

No information located.

VI REPRODUCTION

A. Age of first breeding

Miller and Stebbins (1964) implied that loggerhead shrikes breed in their first year.

B. Territorial behavior

Loggerhead shrikes are territorial throughout the year (Miller 1931, 1950). In the winter males and females maintain separate feeding territories. The winter territories are actively defended when the birds are residents, but not as vigorously when the birds migrate and are winter visitors (Miller 1931).

The ready visibility of perches and the contrasting markings on the bird serve to advertise the territory (Miller 1931, 1950). Song is also used, and it consists of 4 to 12 screeches of diminishing intensity (Miller 1950, Miller and Stebbins 1964). All parts of the territory are not used equally, but all are defended (Miller 1950).

The territory used in the breeding season is usually one of the territories held by the parents in winter (Miller 1950). Once a pair is established on a territory "much of the territorial behavior seen... consisted simply of loud songs and 'bzeek' notes... If the invader remained, the resident chased it briefly" (Smith 1973). This was the usual pattern observed against territorial encroachment by neighbors. When strangers appeared, the shrikes gave flutter displays in which the wings were drooped and fluttered, the tail spread, the feathers raised (Smith 1973). The amount of tail spread indicated the intensity of aggression. Sometimes the shrikes uttered a harsh rising note (Smith 1973).

C. Courtship and mating behavior

Pair formation occurs when sexual excitement overcomes the impulse to defend the feeding territory (Miller 1950). Given this context, courtship involves trial chases and begging notes to identify sex and/or reduce aggression. Early in the season, courtship consists primarily of mock pursuit and erratic, zigzag hovering accompanied by metallic screeches (Miller 1950). Later in the season, the shrikes use a lot of courtship feeding, in which the male feeds the begging female who imitates juvenile begging (Miller 1950, Smith 1973).

The female builds the nest and incubates the young (Miller 1931). The male feeds the female while she is incubating and brooding, supplying her with 80% of her food. Both sexes feed the young (Miller 1931, 1950).

D. Nesting phenology

In resident populations, pairing occurs from November through March (Miller 1950). Laying occurs from March to early April and the brood fledges in April and May (Miller 1931, 1950; Miller and Stebbins 1964). The young are driven off the territory in July, the pair bond dissolves, and the birds set up their solitary winter territories (Miller 1931).

Migratory populations arrive at northern locations or higher elevations in late March or early April (Miller 1931, 1950, Porter et al 1975). Eggs are laid mid April to May.

E. Length of incubation period

The incubation period has been reported to be 16 days (Miller 1950, Porter et al 1975).

F. Length of nestling period

Miller (1950) reported that 20 days elapsed before the young left the nest. Porter et al (1975) found the nestling period to be only 17 days.

G. Growth rates

Porter et al (1975) weighed nestlings from the first to the seventeenth day. Nestling loggerhead shrikes weighed 4.1g on the first day. They gained weight at a rate of 3.1g/day until the 12th day when they have reached 89% of their fledging weight. The young weigh 42.1g on the 17th day.

Miller (1950) observed external growth in shrike nestlings. He found that they couldn't stand on the 12th day, but were well-feathered by the 15th day and fledged on the 20th day. The parents continued to feed the young from the time of fledging to the 35th day as the young learn to forage for themselves.

Miller (1931) reported that song, impaling and bathing instincts appeared between day 30 and day 40. Busbee (1976) first observed a successful kill at 41 days in hand-reared shrikes. He reported that 5 to 7 days of experience was then required before the fledglings reached adult proficiency.

H. Post-breeding behavior

The adults feed the young at least through day 36 (Miller 1931). The young are ultimately driven off the territory in July, the pair bond dissolves, and winter territories are established by solitary residents (Miller 1931). Migratory populations leave for more southern areas or lower elevations.

VII POPULATION PARAMETERS

A. Clutch size

Loggerhead shrikes lay between 4 and 7 eggs. Miller (1950) found the most common clutches were 6 eggs in the San Francisco area, 5 eggs in the San Diego County region. Johnson (1964) found a modal value of 5.0 eggs and a mean of 5.3 eggs in Kansas (n = 32 nests). Porter et al (1975) reported a modal value of 7 eggs and a mean value of 6.4 eggs for Colorado (n = 77 eggs) and found some nests with 8 eggs. Linsdale (1938) found clutches of 4 to 6 eggs in Nevada, the mean being 5.3 eggs (n = 6 nests).

Miller (1950) felt that loggerhead shrikes might lay 2 clutches. However, Porter et al (1975) observed no second broods, although renesting was common if the first nest was destroyed. Usually this replacement clutch was smaller than the first clutch.

B. Nesting success

Porter et al (1975) observed the outcome of 77 nests over 4 years in Colorado. They found that 79.5% of the eggs hatched (330/415 eggs), and 55.9% of the eggs fledged (232/415 eggs). These percentages are comparable to figures of 5.1 young hatched per nest (5.7 young per successful nest) and 3.6 young fledged per nest (5.4 young per successful nest).

Porter et al (1975) found that the nesting and fledging percentages showed significant year to year fluctuations (range 47.8 to 82.4%, and 35.8 to 71.0%, respectively; PL .005; nesting success was percent of nests fledging at least one young). Hatching success showed no such fluctuations (range 69.7 to 87.2%; PL .25).

Porter et al (1975) found that adverse weather (eg., thunderstorms with hail) accounted for the loss of 9/23 unsuccessful nests. Predators destroyed the other 12 nests.

C. Mortality rates per age class

Miller (1931) observed that the principal mortality occurs among juveniles. First year birds composed 50% of the winter and spring populations and on this basis Miller (1931) estimated that the annual mortality was 50%. By this reckoning, if 2 adults and 6 young were present in the spring, then by winter 1 adult and 5 offspring would have perished (Miller 1931, 1950).

D. Longevity

Miller (1931) estimated that longevity after the first as 2 to 3 years.

Lanius ludovicianus (Cont'd)

E. Seasonal abundance

Seasonal abundance would fluctuate in those areas supporting migratory populations of shrikes. No specific information located.

F. Habitat density figures

There have been two studies that documented densities of loggerhead shrikes in Arizona. Raitt and Maze (1968) found values of 0 to 0.2 pairs per 100 acres, and Emlen (1974) observed a value of 0.1 birds per 100 acres of desert terrain.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Loggerhead shrike remains have been found in horned owl nests, and hawks, owls, cats and dogs evoke frantic screeches from shrikes when they are exposed to these potential predators (Miller 1950).

Porter et al (1975) suspected that magpies were a primary source of nest destruction. They occurred in areas where shrike nests were predated and also were observed harrassing adult shrikes that nested in close proximity to the magpies.

B. Competition

No information located.

C. Parasitism

Shrikes are parasitized by Mallophaga and round worms (Miller 1931). The nematode Acuaria occurred in 18% of 34 birds captured, but was probably not a common source of mortality (Miller 1931). Porter et al (1975) reported one instance of nest failure caused by bot fly larvae (Oestridae).

IX STATUS

A. Past population trends

This species "has adjusted itself to cultivated lands in the Imperial Valley and probably has increased in numbers there in the last twenty years" (Grinnell and Miller 1944).

B. Present population status

Loggerhead shrikes were observed in 21 out of 22 desert and near desert areas censused in the Seventy-seventh Audubon Christmas Bird Count (1977). The areas (and numbers sighted) were: Bakersfield (5), Big Bear Lake (3),

Lanius ludovicianus (Cont'd)

Butterbread Springs (present), Carrizo Plains (12), China Lake (6), Claremont (26), Granite-Woody-Glennville (16), Death Valley (present), Idylwild (8), Joshua Tree National Monument (14), Pasadena (15), Parker, Arizona-Colorado River (58), Redlands (12), Salton Sea N (38), Salton Sea S (52), San Bernardino Valley (71), San Fernando Valley (8), Sespe Wildlife Area (14), Springville (29), Thousand Oaks (26), Yuma (53).

C. Population limiting factors

Linsdale (1938) made the following comment regarding the presence of logger-head shrikes in the Great Basin area of Nevada: "Apparently in this region abundance of food was significant among the factors controlling the presence and numbers of shrikes."

D. Environmental quality: adverse impact

No information located.

E. Potential for endangered status

No information located.

X ADDITIONAL REFERENCES

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STARLING
Sturnus vulgaris

I TAXONOMY

A. Type description

Sturnus vulgaris vulgaris, starling: Sturnus vulgaris vulgaris Linnaeus, 1758, Syst. Nat., ed. 10, 1:167- Sweden (Peters, 1962).

Synonomies- Sturnus rithenus, Sturnus sophiae, Sturnus vulgaris granti, Sturnus vulgaris jitkowi, Sturnus vulgaris graecus, Sturnus vulgaris ferdinandi, Sturnus balcanicus, Sturnus vulgaris britannicus (Peters, 1962; no information located on synonyms for common name).

B. Current systematic treatment

Order Passeriformes, family Sturnidae, subfamily Sturninae, genus Sturnus Linnaeus, 1758, Syst. Nat., 10th ed, 1:167 (Peters, 1962).

There are currently 11 recognized subspecies occurring throughout Europe and Asia. S. v. vulgaris is the only North American subspecies (Peters, 1962).

C. Recent taxonomic revisions

The supplement to the AOU checklist of North American birds (1973 Auk 90: 411-419) indicates that there have been no changes in starling taxonomy since the 5th edition of the checklist (1957).

II DESCRIPTION

A. External morphology of adults

The starling is a trim, compact bird with a short tail and a long, bright yellow bill (Bent, 1950). It has greenish and purplish reflective coloration and whitish or buffy dots in the fall. The sexes are similar.

B. External morphology of subadult age classes

In juvenile plumage, the starling is plainly colored, brownish mouse gray above with the underparts slightly paler and fading out to whitish on the throat and chin (Bent, 1950). In first winter plumage, the starling obtains the bottle or purplish green of the adults. However, the first year birds have cinnamon spots above, white spots below, and retain the whitish chin coloration (Bent, 1950).

C. Distinguishing characteristics

Interspecific- Starlings look like short-tailed "blackbirds". However, the grackles tail is long and the red-wing, rusty, and Brewer's blackbird tails are medium in length compared to the starling (Peterson, 1961).

Sturnus vulgaris (con't.)

D. Special morphological features

no information located

III DISTRIBUTION

A. Overall distribution of the species

The starling breeds on the British Isles and Azores and in Europe east to Urals except extreme north; south to south central France, northern Italy and latitude 48° N in Russia (Peters, 1962). It was introduced to the United States in 1890 (Bent, 1950) and has spread through the country since then.

B. California distribution of the species

The starling was present in all 64 localities sampled by the Seventy-fifth Audubon Christmas bird count (1975), and breeds throughout the state (Planck, 1967).

C. California desert distributions

According to the Audubon Christmas bird count in 1974 and 1976, starlings were present in all desert and near desert areas sampled. However, the numbers were generally low relative to those observed close to populated areas. Starlings were observed specifically in Big Bear Lake, Butterfield Spring, China Lake, Death Valley, Idylwild, Joshua Tree National Monument, Salton Sea North and South, and Parker, Arizona- Colorado River area, Yuma, Arizona. Wauer (1962) also noted the starling as an increasingly common winter visitor in Death Valley.

D. Seasonal variations in distribution

Many of the starlings (in Europe and North America) remain stationary in winter (Bent, 1950; Peters, 1962). Some make short flights to other areas. An increasing number are migrating in association with blackbirds and grackles, especially from the more northern latitudes (Bent, 1950).

IV HABITAT

A. Biotopic affinities

The starling is primarily found in urban and agricultural areas in all parts of the United States (Bent, 1950; Royall, 1966; Johnson and Cowan, 1974). In Arizona, the starlings frequent agricultural lands, orchards and feed lots for forage and roost in cattail marshes, oleander hedgerows, citrus groves, mesquite thickets, and sorghum fields (Royall, 1966).

B. Altitudinal range

no specific information located- The Audubon Christmas bird count (1975) indicates the starling occurs in the San Bernardino Mountains and the Sierra Nevada.

Sturnus vulgaris (con't.)

C. Home range size

Bray et al (1975) monitored winter movements of starlings in Oregon and found that the mean distance from roost to activity area was 18.0 km. The mean distance between activity areas on two successive days was 4.8 km and the mean daily activity area had a radius of 0.8 km. The entire home range is approximately 39.6 square km.

D. Territory requirements

Perch sites- no specific information located

Courtship and mating sites- no specific information located

Nest sites- The starling is not very particular about its nest site and will breed in almost any hole or cavity with an entrance diameter greater than $1\frac{1}{2}$ inches (Bent, 1950). It has been found in woodpecker holes, nest boxes, natural cavities in trees, under eaves, in or on barns, in schools and towers among others. In California, Planck (1967) reported starlings nesting in palm trees and cottonwoods. He stated that these sites may be used throughout the year. In Arizona, Royall (1966) found starling nests in cottonwood, chinaberry, peppertree, Chinese elm, saguaro, and palms.

E. Special habitat requirements

no information located

F. Seasonal changes in habitat requirements

Since a large proportion of the starlings do not migrate in the winter (Bent, 1950; Planck, 1967), there is probably no change in habitat between summer and winter.

G. Physiological ecology

Starlings are tolerant of high ambient temperatures and can withstand ambient temperatures of 40°C for over 3 hours (Johnson and Cowan, 1975). Panting occurs at temperatures over 30°C . The lower critical ambient temperature is 15°C , but the starlings don't shiver visibly until ambient temperature is below 0°C . The slope of the heat production curve below the lower critical temperature is approximately $-1.5 \text{ cal/g}^{0.724}\cdot\text{hr}$. Conductance is $0.21 \pm 0.012 \text{ cal/cm}^2\cdot^{\circ}\text{C}$.

Johnson and Cowan (1974) also found that starling nestlings were ectothermal until they became feathered at 13-15 days. Nestlings which weighed 40-50 g showed an increased heat production to lowered ambient temperatures, but still experienced a drop in body temperature. Body temperature was maintained in a cold environment at a weight of 60-70 g. The starling nestlings are very tolerant of cold weather and hypothermia (Johnson and Cowan, 1974).

V FOOD

A. Food preferences

Starlings are omnivorous, exploitative birds. Over the course of a year they consumed 57% animal food and 43% vegetable food in a study by Kalmbach and Gabrielson (1921). The animal food was primarily insectivorous (41.6%), and the main constituents were Coleoptera (19.6% of total food consumption) and Orthoptera (12.4%). The plant foods consumed included cherries (2.7%) and wild fruits (23.9%). Starlings also eat grain, corn, hay, weed seeds and garbage (Killpack and Crittenden, 1952).

B. Foraging area

Starlings are also not particular about the foraging areas (Bent, 1950). They forage in pasture, fruit and nut orchards, tree groves, planted and stubble grain fields, fallow fields, flooded areas, dumps (Bray et al, 1975) and feed lots (Bailey, 1966). Kessel (1957) observed that foraging areas were usually within 1/2 to 3/4 mile from the nest site and that the feeding area was not defended.

C. Foraging strategies

The starlings are primarily ground gleaners (Bent, 1950; Emlen, 1974) although they forage in trees and bushes for fruit (Bent, 1950). Starlings usually forage in flocks (Bent, 1950; Williamson and Gray, 1975), with the flocks increasing in size from summer to fall and decreasing again from winter to spring (Williamson and Gray, 1975). The flocks may consist entirely of starlings or they may include blackbirds (Williamson and Gray, 1975). The most active feeding periods are in the morning, late afternoon and early evening (Kessel, 1957). Planck (1967) found that starlings fed their nestlings most frequently from 0500 to 0800 and from 1300 to 1800.

Williamson and Gray (1975) studied the flock exploitation patterns at feeding sites in Maryland. They observed the following characteristic behaviors:

- 1). foraging in lines moving as a unit across a field by "leap frogging" or in circles which moved outward radially;
- 2). consistent movement direction across a field;
- 3). close individual distances;
- 4). constant, rapid rates of foraging;
- 5). formation of active foraging swarm when startled.

D. Feeding phenology

Kalmbach and Gabrielson (1921) found that animal food consumption peaked in April (91% of total monthly food) and May (95%) during the breeding season and reached a low of 28% in February, although insect consumption reached its peak in October (58%). Plant food was consumed in the highest proportions in July (53%) with wild fruit intake peaking in August (41%).

Sturnus vulgaris (con't.)

These findings are confirmed in general by two subsequent studies. Killpack and Crittenden (1952) observed a very low winter consumption of animal food (4% of the total) in Utah and found that garbage (22%) and plant food (74%) were most heavily utilized. Among the plants, Russian olives (36%) and grain (23%) were most frequently consumed. Corn silage (12%), alfalfa hay (2%), and weed seeds (<1%) were also eaten. Coleopterans (3%) provided most of the food.

A summer study by Johnson and Cowan (1974) showed that animal matter contributed more before July 1 (69%) than afterwards (61%). Fruit consumption followed the opposite trend, rising from 29% early in the summer to 38% late in the summer.

E. Energy requirements

Johnson and Cowan (1975) found the resting metabolic rate of the starling to be 12.6 cal/g·hr at 20° C with an R. Q. of .74 and a digestion efficiency of 40%. They estimated that the gross energy intake per day was 114 kcal, the daily excretory energy was 59 kcal and the daily metabolizable energy was 56 kcal.

A study of energy balance in nestlings revealed a gross energy efficiency of 14% and a net growth efficiency of 22% (Westerterp, 1973). Johnson and Cowan (1974) observed an energy intake of 1.45 kcal per nestling hour (26.1 kcal per nestling day) at hatching time which increased to values of 4.64 kcal per hour and 82.5 kcal per day at the age of 10 to 12 days. They found that the average food sample brought to the nestlings contained 5.18 ± 0.09 kcal/g and that each feeding weighed 0.112 ± 0.02 g. There were 2.5 to 3.0 feedings per nestling-hour for 18 hours per day at the age of 10 to 12 days.

VI REPRODUCTION

A. Age at first breeding

Kessel (1957) stated that more females than males nest in their first year.

B. Territorial behavior

Starlings nest near other species with relatively little antagonism once established (Bent, 1950). They tend to choose nest sites close to the ones they used the previous year (Kessel, 1957). When a male has chosen a nest site, he begins to discourage intrusion by other male starlings, defending an area with a radius of 10 to 20 inches around the nest hole. The male chases intruders away, sings a great deal, and may resort to severe fighting on occasion (Kessel, 1957).

C. Courtship and mating behavior

Planck (1967) reported that the "cheerio" call is heard in August, early spring and during nesting. It is given by unestablished males who have not yet selected a nest site or paired.

Sturnus vulgaris (con't.)

Kessel (1957) reported that females choose the nest site and then paired with the resident male. Courtship consisted mostly of intensified nesting activity. The female always pecked the male in the neck or shoulder region which acted as a "releaser" for the male which mounted immediately. The male displayed pre-copulatory behavior only part of the time.

The male and female both incubate by day but the female incubates alone at night (Johnson and Cowan, 1974). The male roosts nearby alone or elsewhere with other males.

D. Nesting phenology

Pairs may form as early as October or November (Kessel, 1957; Planck, 1967). Hole exploration shows an increase in February and March, although it does occur year round (Planck, 1967). Kessel (1957) found that a mean daily temperature of 40° to 43° F was necessary if light was to stimulate gonadal growth in the later stages. Therefore annual differences in laying dates could be due to differences in spring temperature profiles.

Egg laying begins in early to mid March in central Arizona (Royall, 1966) and is definitely underway by April in central California (Planck, 1967). Kessel (1957) reported that the second brood followed the first brood by 40 to 50 days.

E. Length of incubation period

The incubation period has been reported as being 11 to 14 days (Bent, 1950), 12 days (Kessel, 1957), 12 days (Royall, 1966), and 10 to 13 days (Johnson and Cowan, 1974).

F. Length of nestling period

The nestling period has been reported to be 2 to 3 weeks (Bent, 1950), 21 days (Kessel, 1957), and 22 days (Planck, 1967).

G. Growth rates

Starling nestling growth curves are sigmoidal for the first 10 to 12 days as they reach adult weight. Then they level off and fluctuate as plumage development proceeds (Kessel, 1957). The first brood nestling weights increased from a mean hatching weight of 6.4 g to 71.4 g on day 11; the peak weight was 78.8 g on day 18; and weight recessed to 70.9 g on day 22 (Kessel, 1957). The second brood weights were somewhat lower: 6.5 g to 61.4 g for days 1 to 14; the peak weight was 69.2 g on day 17 and recessed to 67.9 g on day 22. The growth curve was more erratic and fluctuated after day 10 (Kessel, 1957). Johnson and Cowan (1974) found similar results in Arizona: nestlings weighed 5.7 g on the first day and increased to a peak weight of 78.6 g, averaging 6.4 g weight gain per day.

Kessel observed that parental feeding increased during the first 7 to 12 days, leveled off until 17 days of age, then decreased until fledging.

Sturnus vulgaris (con't.)

By day 12, nestlings were consuming 6/7ths of their weight in food each day (see also Johnson and Cowan, 1974; and Section V E. above).

H. Post-breeding behavior

The parents are with the young a relatively short time after fledging (Kessel, 1957). The young birds flock up soon after fledging and the flocks grow rapidly as the second brood fledges and adults join the flocks after the molt in September (Bent, 1950). The number and size of flocks fluctuates greatly in the fall as migrants pass through (Bailey, 1966).

Roosting flocks of starlings are a common sight in winter. They swarm and fly together in a highly coordinated fashion before settling for the night (Bent, 1950). Overcast days produce earlier roosting, with birds at a greater distance from the roost moving toward the roost site earlier than the others (Bray et al, 1975).

Starlings frequently roost in nest boxes through the winter period (Kessel, 1957). "During the three months or more that the starlings are roosting in the boxes at night, a given bird may change its roosting site and shift its partner several times" (Kessel, 1957). Starlings may also use nest boxes in association with other species, eg. house sparrows (Stewart, 1977).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1950) reported that starlings usually laid 4 to 5 eggs, often 6, rarely 7. There were usually two broods and sometimes three. These findings are supported by subsequent studies.

Kessel (1957) found a mean clutch size of 5.5 eggs for 199 first broods and a mean clutch size of 4.1 eggs for 110 second broods. Replacement broods averaged 5.0 eggs. The overall seasonal average clutch size for Ithaca, New York was therefore 4.9 eggs. Royall (1966) found an average clutch size of 4.4 eggs (n = 285 nests) in Arizona. Johnson and Cowan (1974) observed a first brood clutch of 5.45 eggs (n = 76 nests) and a second brood clutch of 4.73 eggs (n = 32 nests) in British Columbia. They found that 38% of the birds had second broods.

B. Nesting success

Several authors have accumulated data on nesting success and this is presented in the table below:

Study	First Broods		Second Broods	
	% Hatch	% Fledge	% Hatch	% Fledge
Johnson (1935)	90	90	48	28
Kessel (1957)	90	81	80	68
Royall (1966)		57		47
Johnson + Cowan (1974)	84	76	69	71

Sturnus vulgaris (con't.)

In general, second broods were less successful than first broods. Johnson (1935) attributed the sharp decline in success for his study to a persistent drought and his figures may therefore be lower than usual. Kessel's (1957) figures are somewhat inflated, since she excluded predated and deserted nests from her success calculations. Johnson and Cowan (1974) attributed their losses to egg infertility and desertion of eggs and young. Losses also occurred through predation, mites, wounds inflicted by parents, and invasion of the nest by older starling fledglings. Royall (1966) also found that there was a high proportion of infertile eggs (110 eggs/74 nests) and that an additional 57 eggs developed and didn't hatch. Coleman (1974) found that intraspecific competition for nest sites accounted for 9.7% of the egg and nestling losses in his New Zealand study area.

These success rates correspond to numbers of fledglings as follows: Johnson (1935; 4.3 young per first brood nest, 1.27 young per second brood nest); Royall (1966; 2.4 young fledged per nest).

C. Mortality rates per age class

During the first year, mortality is between 50 and 60% (Kessel, 1957). Much of this mortality may occur soon after fledging (Dunnett, 1956), and Lack (1948) found that fewer birds were recovered after fledging from large broods than were recovered from small broods. There may also be a differential mortality of females, at least during the first year. Kessel (1957) found more females than males at fledging, an equal sex ratio in the winter, and a preponderance of males in the breeding season. She cites several studies reporting populations of starlings with 52.7% to 71.1% males.

There is little adult mortality during the breeding season and most of it occurs in the fall and winter months (Dunnett, 1956). The second and third year birds apparently suffer a 50% mortality rate and after the third year, the mortality rate increases (Kessel, 1957).

D. Longevity

Kessel (1957) estimated that starlings which survive their first 6 months have a mean longevity of 15.6 months.

E. Seasonal abundance

Seasonal abundance would vary from location to location depending on the proportion of the population that migrates. No specific information located.

F. Habitat density figures

Bray et al (1975) observed a mean density of 8 birds per hectare in Oregon during the winter. Emlen (1974) found an average of 35 birds per 100 acres in an urban area in Arizona.

Davis (1950) analyzed the Christmas bird counts in New York, Massachusetts and Ohio from the first year of their appearance until the populations leveled off. It took 9 to 13 years for the fast rise in population to

Sturnus vulgaris (con't.)

level off and an additional 0 to 10 years to reach a stable level. These data represent population growth in a previously unexploited area which rises to an asymptote reflective of the carrying capacity of the environment.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1950) reported that cats and hawks (Coopers, sharp-shinned, duck) prey on starlings and that the starlings will mob hawks. Kessel (1957) also observed predation by Cooper's hawks. Ogden and Hornocker (1977) found starling remains in 3% of the prairie falcon eyries they sampled in Idaho. Royall (1966) reported that gila woodpeckers may occasionally kill starling young in attempts to take over nest sites.

Powell (1974) examined the social value of flocking in starlings and found that individual starlings in groups of 10 spent less time in surveillance than individuals in smaller groups. They responded more readily to hawk models as well. Surveillance was also decreased when a single starling was placed in a flock of tricolored blackbirds, indicating that flocking is of value whether or not the birds are all conspecifics.

B. Competition

Starlings compete with a large number of birds for nest sites. They are successful exploiters of most woodpecker nests, eg. flickers (Kessel, 1957) and acorn woodpeckers (Troetschler, 1976) and also steal bluebird nest sites (Kessel, 1957). They compete, sometimes unsuccessfully, with pigeons, screech owls, sparrow hawks, crested flycatchers, purple martins, tree swallows and house wrens as well (Bent, 1950).

Cooper and Crites (1976) observed a high degree of commonness of intestinal parasites among starlings, robins, redwing blackbirds, and common grackles. They concluded that this commonness reflected usage of the same food sources.

C. Parasitism

Helminthes are one of the main parasites of starlings. Infestation is particularly high in the spring to autumn period, and the starling's omnivorous diet may increase the parasite load (Hair and Forrester, 1970). Hair and Forrester (1970) reported finding 4 species of Trematodes, 5 species of Cestodes and 12 species of Nematodes. Their list was supplemented later by an additional 4 species of Trematodes, 10 species of Cestodes, 8 species of Nematodes, and 1 species of Acanthocephala (Cooper and Crites, 1976).

Cooper and Crites (1976) observed the various helminth parasites in the following proportions of starlings: Trematodes (6%), Cestodes (38 to 42%), Nematodes (18 to 46%), Acanthocephala (42%). Sommer (1937), observed the incidence of intestinal parasitism from September through December in Illinois. He found a 48% infestation in September, 31% in October, 41% in November, and 48% in December.

Sturnus vulgaris (con't.)

Red fowl mites (Dermanyssus) also infect the starling nests. Royall (1976) found that this infestation did not affect the success of brood rearing.

X STATUS

A. Past population trends

The starling was liberated in New York City in the winter of 1890-1891 (Bent, 1950). By 1900 it had spread to New York, New Jersey and Connecticut, 1908 (Massachusetts), 1910 (Pennsylvania). By 1916 it was found from southern Maine to Norfolk, Virginia, and by 1929-1930 it had also reached to Wisconsin, Iowa, Missouri, Kansas, Oklahoma, Texas and the Gulf States (Bent, 1950).

The western frontier of the starling dispersal was 103° W longitude in 1937, its greatest density was between 97° and 98° W longitude, and its breeding range had extended to the Mississippi River (Dickerson, 1938). Starlings were first observed in Utah in 1939 (Bailey, 1966), in Tucson, Arizona in 1946, and in California in 1942 (Tule Lake; Jewett, 1942).

The breeding range has lagged about 5 years behind the fall and winter range (Bent, 1950), but by now starlings breed throughout most of the United States. In California desert or near desert areas, first breedings were reported for 1958 in San Luis Obispo County (McMillan, 1959), San Joaquin Valley (Reuther, 1959), Los Angeles County and Imperial County (Rainey and van Hoose, 1959). The first nesting was recorded in San Francisco in 1964 (Tenaza and Tenaza, 1966).

Starlings require only 9 to 13 years to invade a new area plus an additional 0 to 10 years to stabilize their populations (Davis, 1950).

B. Present population status

Starlings were present in all 64 California localities sampled by the Seventy-fifth Audubon Christmas bird count (1975). In 1977, they were present in 21 out of 22 desert or near desert areas sampled. The areas (and numbers of starlings present) were as follows: Bakersfield (146), Big Bear Lake (310), Butterbread Springs (5), Carrizo Plains (228), China Lake (350), Claremont (140), Death Valley (1000), Granite-Woody-Glennville (471), Idylwild (25), Joshua Tree National Monument (237), Pasadena (791), Redlands (103), Salton Sea N (215), Salton Sea S (885), San Bernardino Valley (3162), San Fernando Valley (287), Sespe Wildlife Area (232), Springville (378), Thousand Oaks (686), Parker, Arizona- Colorado River (556), Yuma, Arizona (519).

C. Population limiting factors

no information located

D. Environmental quality: adverse impacts

no information located

Sturnus vulgaris (con't.)

E. Potential for endangered status

no information located

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BELL'S VIREO
Vireo bellii

I TAXONOMY

A. Type description

V. b. arizonae - Ridgway (1903) noted this form was described from a specimen taken at Tucson, Arizona.

V. b. pusillus - Coues (1866) reported this form was described from a specimen taken at Cape San Lucas, Baja California.

B. Current systematic treatments

AOU (1957) recognizes four races of this species in North America: the nominate, which occurs east of Colorado; medius, in southwestern Texas; arizonae in Nevada, Utah, Arizona, and (formerly) in southeastern California; and pusillus in central and western California and Baja California.

Paynter (1968) recognized four races: V. b. bellii, V. b. arizonae, V. b. medius, and V. b. pusillus.

Synonomies - V. b. arizonae - Grinnell and Miller (1944), "Vireo pusillus, part; Arizona least vireo."

V. b. pusillus - Grinnell and Miller (1944), "Vireo bellii; Vireo pusillus, part; Vireo pusillus albatus; Vireo bellii albatus; Bell vireo; little vireo; little greenlet; least vireo; California least vireo."

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "Western counterpart of white-eyed, but eye is always black. Note wingbars and light eye ring. Sexes are alike. Also similar to gray vireo (which has longer tail and obscure wingbar) and Hutton's (which has broad wingbars and dull gray throat and breast)." Peterson (1961), "A small grayish vireo with 1 or 2 light wing-bars and pale yellowish-washed sides; nondescript. Distinguished from warbling vireo by the wing-bar(s) and narrow eye-ring. Most 'wing-barred' vireos have more conspicuous eye-rings." Under similar species: "In desert mountains see gray vireo. In central Texas (close to 100°) dark-eyed young white-eyed vireos have been called Bell's vireos. See Texas field guide."

V. b. arizonae - Phillips, Marshall, and Monson (1964), "Freshly molted birds have tinges of yellow and green on the flanks and back, respectively, but worn summer birds and juveniles are essentially white and gray, with wing-bars. A faint pale line runs from the bill backwards over the eye and down around half of the eye, leaving the lores dark. But the head shows no really strong contrasts."

Vireo bellii (con't.)

B. External morphology of subadult age classes

V. b. arizonae - Ridgway (1904) noted the principal distinguishing characteristic of young is their pure white underparts, although the sides are faintly tinged with pale yellow.

V. b. pusillus - Ridgway (1904), "Young with upper parts decidedly paler and grayer, and under parts of body, with under tail-coverts, pure white throughout."

C. Distinguishing characteristics

Intraspecific - V. b. arizonae - Ridgway (1904) reported this race is similar to V. b. medius, but is paler and grayer, with the back and scapulars brownish gray, the sides and flanks faintly washed with grayish olive-yellow, and with the tail and tarsus longer than the eastern races.

V. b. pusillus - Ridgway (1904) noted similar to V. b. arizonae, but still grayer above and whiter beneath; the upper parts between olive-gray and mouse gray without distinct tinge of greenish olive except on rump and upper tail-coverts; underparts nearly pure white, including under tail coverts, only a trace of yellow on the sides and flanks which are washed with grayish olive, and the wing and tail average longer.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

V. bellii - AOU (1957), "Breeds from the Great Valley of California, southern Nevada, central Arizona, southwestern New Mexico, western Texas, eastern Colorado, central Nebraska, southeastern South Dakota, Iowa, southwestern Wisconsin, and northeastern Illinois south to southern Texas and northwestern Louisiana. In winter from southern Louisiana (one specimen), southern Sonora, and southern Baja California south to El Salvador and northern Nicaragua."

V. b. arizonae - AOU (1957), "Breeds from southern Nevada (Boulder City and opposite Fort Mohave, Arizona) and southwestern Utah (along Virgin River) to southeastern California (Colorado River Valley) and southern Sonora (Guayman, Tobari Bay, Chinobampo), east to central Arizona (Big Sandy River, Oak Creek, Salt River Refuge). Winters, so far as known, in the tropical zone of southern Sonora (Alamos; probably north to Ures)."

V. b. pusillus - AOU (1957), "Breeds in California in the Great Valley (Red Bluff), Owens Valley (Bishop), Death Valley, Mohave River Valley (Victorville, Camp Cady), and southwestern California (Santa Barbara, San Diego, Escondido) and the northwestern Baja California coastal area (Guadalupe, El Cajon, El Rosario, San Fernando). Winters in southern Baja California (Isla Santa Margarita, and La Paz to the Cape). Casual in central western California (San Mateo County) and southwestern Nevada (Ash Meadows)."

Vireo belli (con't.)

B. California distribution of the species

Remsen (1978) reported present localities where this species still breeds in California include the following: coastal slope of San Diego County; possibly a couple of Los Angeles County localities; Morongo Valley, San Bernardino County; San Timoteo Creek, San Bernardino County; Whitewater Canyon, Riverside County; Bautista Canyon, Riverside County; and Coyote Creek Canyon, San Diego County. McCaskie (1976), "A Bell's vireo near Imperial Beach, San Diego County, October 28 (JD) was exceptionally late and its bright coloration indicated it may have been V. b. bellii rather than one of the two western races occurring in California." Small (1974), "Seasonal status - summer visitor, late March to September;... range in California - breeds in coastal and interior southern California (west of the deserts) and north through Central Valley to Tehama County; also breeds in Owens Valley and Death Valley and lower Colorado River Valley." McCaskie (1968), "This species is a regular summer visitor between late March and late September in suitable habitat in southern California."

V. b. arizonae - Grinnell and Miller (1944), "Colorado River Valley from Nevada line south to Mexican boundary."

V. b. pusillus - Grinnell and Miller (1944) reported occurs in "coastal southern California, and on east slope in stream courses at the bases of the southern mountains; north in warmer coastal valleys to extreme southern Santa Clara County; north through San Joaquin and Sacramento Valleys to Tehama County; in the Inyo district occurs in Owens and Death Valleys." Lane (1976) noted localities mentioned for this species include Solvang (Alisal Creek), Ortega Highway (San Juan Creek), Oceanside (San Luis Rey River), San Diego (Mission Dam), San Gabriel Mountains (Mill Creek Canyon), Mojave River near Victorville, and San Timoteo Canyon, Riverside County. The bird is designated as a "fairly common summer resident".

C. California desert distribution

McCaskie (1968), "Richard Stallcup saw one at Ramer Lake, Imperial County, on 28 December 1963, and I saw the bird there on 8 February 1964. I saw one near Parker Dam, San Bernardino County, on 28 November 1964. It would now appear that this species occasionally winters in southern California." McCaskie (1976), "A singing male Bell's vireo at 6200 feet in the New York Mountains, May 18 (VR) was certainly out of habitat; one in Kelso April 24 (EAC), another at F.C.R. (Furnace Creek Ranch in Death Valley) during much of early May (WS et al.) and a third near Big Pine May 24 (TH) were all significant since few have been found in this area of California in recent years."

V. b. pusillus - Grinnell and Swarth (1913) noted abundant in suitable portions of the lower Sonoran zone in the San Jacinto Mountains. Specific localities include Little Paradise Valley, lower Palm Canyon, Murray Canyon, Snow Creek, Cabezon, Banning, and along the San Jacinto River road at 2000 feet.

Vireo bellii (con't.)

D. Seasonal variations in distribution

V. b. arizonae - Grinnell and Miller (1944), "Summer resident, arriving in early March." Bent (1950) noted the earliest date of spring arrival known to him was 21 March at Tucson, and the latest fall date for Arizona was 20 October at Tombstone.

V. b. pusillus - McCaskie and Banks (1964) reported on 4 January 1963 a male V. b. pusillus was collected in Mission Valley, San Diego, apparently representing only the second record of the species wintering in the United States (the other instance being of the nominate race in Louisiana). Bent (1950) noted the earliest date of spring arrival known to him was 7 March at Santa Barbara, and the latest date of fall departure was 3 October at Azusa. Grinnell and Miller (1944), "Summer resident, from latter part of March to end of August in southern California. Farther north arrives in early April."

IV HABITAT

A. Biotopic affinities

Nice (1929), "Vireo bellii bellii is preeminently a bird of shrubbery; it frequents the clumps of sand plums and young willows, and also adapts itself to civilization and nests in gardens." Pitelka and Koestner (1942) noted five nests studied in central Illinois were located in an area of grassland and scattered patches of shrubby fruit trees and several masses of shrubs. Nolan (1960) reported in Indiana this species was found to occur in dry open scrub, i.e., fairly open grassland with scattered low shrubs and vines, much less dense and scrubby than areas occupied by white-eyed vireos. Pitelka (1938) noted near Laredo, Texas this species occurred in patches of mesquite scattered over dry, open uplands. Small (1974), "habitat - dense riparian growth, especially tangles of shrubs and vines."

V. b. arizonae - Phillips, Marshall, and Monson (1964), "Common summer resident in dense low brush, especially mesquite associations along streams, up to the top of the lower Sonoran zone... like the verdin and other birds which like mesquites, this vireo has spread out from the river bottoms as mesquites came in through abuse of the land..." Grinnell (1914), "The bird foraged in all of the component associations, but was perhaps best represented in the willow association, especially where there was an undergrowth of guatemote (Baccharis glutinosa).\" Grinnell and Miller (1944) reported habitat is "Chiefly willow association with undergrowth of guatemote (Baccharis glutinosa).\" Bent (1950), "In Arizona, in 1922, we found this vireo only at the lower levels, in the valley of the San Pedro River, where it frequented the narrow strip of willows, small cottonwoods, and underbrush along the irrigation ditches, and in the extensive mesquite forest near Tucson."

V. b. pusillus - Grinnell and Miller (1944) reported occurs in lower Sonoran life zone. Occurs in "low riparian growth either in the vicinity of water or in dry parts of river bottoms... Less commonly live and valley oaks, wild grape, poison oak and sumac in the margins of water courses are visited and

Vireo bellii (con't.)

may be nested in. On the desert slopes mesquite and arrowweed in canyon locations may be occupied." Grinnell and Storer (1924), "The California least vireo dwells in the dense thickets of willows and other plants which grow along the lower courses of the Merced and Tuolumne Rivers, chiefly west of the foothills."

B. Altitudinal range

V. b. pusillus - Grinnell and Miller (1944) noted altitudinal range in California is from -175 feet (Death Valley) up to 4100 feet at Bishop, Inyo County.

C. Home range size

Nolan (1960) noted in Indiana home ranges occupied two or three acres. Barlow (1962) reported nine territories in Kansas varied in size from 0.26 acre to 3.1 acres, with an average size of 1.25 acres. This is smaller than that found in other areas and was believed to be due to the greater vertical range of available foraging area and the higher density of birds present. Pitelka and Koestner (1942) noted a pair in Illinois confined their activities to a grassy area of approximately three acres containing scattered patches of shrubby fruit trees and several masses of shrubs. Hensley (1950) noted the nesting territory of a pair of Bell's vireos in Illinois comprised 3.1 acres of grassland containing scattered trees and shrubs.

D. Territory requirements

Nest sites - Mumford (1952) noted thirteen nests in Indiana ranged from 20-40 inches in height with an average of 31 inches for eight nests. Overmire (1962) reported at Stillwater, Oklahoma 92 nests were located at a mean height of 36.9 inches with a range of 20-144 inches. Only one nest was located over 66 inches. Hensley (1950) reported a nest in Illinois was built in a blackberry patch, adjacent to a small intermittent stream, and bordered on one side by a small grove of willow trees. The briar patch was about 50 feet in diameter and was located in a relatively undisturbed area of forest-edge. Barlow (1962) noted in Kansas nest height averaged 27 inches off the ground. Nests are suspended from lateral or terminal forks of branches of small trees or bushes situated at the edge of a thicket or isolated from adjacent trees by several feet. Preference for open situations is characteristic of the species. Most nests are situated so that they are protected and concealed by the dense foliage of trees.

V. b. arizonae - Bent (1950) reported nests have been found in willows, mesquites, guatemote, and in other riparian plants.

V. b. pusillus - Grinnell and Storer (1924) reported a nest found near Lagrange, California on 8 May 1919 was located in deep shade under a thicket of willows and white alders which grew on the lower slope of a pile of gravel. The nest was fastened to a weed 19 inches off the ground.

Vireo bellii (con't.)

E. Special habitat requirements

Barlow (1962), "A critical feature of the habitat preferred by the Bell's vireo is the presence of water."

V FOOD

A. Food preferences

Chapin (1925) noted this species is the most insectivorous of the North American vireos studied. Fifty-two stomachs taken between May-August from various parts of the range indicated that animal food comprised 99.3% of the diet, while wild fruit comprised 0.7%. The animal matter was almost entirely insects. Barlow (1962) noted in Kansas this species was observed to feed almost entirely on insects, but on three occasions a bird was observed taking food of vegetable origin (wild cherries).

B. Foraging areas

Barlow (1962), "The Bell's vireo has been characterized as a thicket forager... but in my experience it is not restricted to low level strata; bird forages from the ground level upward, both in thickets and isolated trees ranging in height from 3 feet to 65 feet. The tendency to forage at higher levels is in part dictated by the presence of tall trees within the various territories." Hamilton (1962) noted this species is considered to be a member of the group of basically thicket-foraging vireos.

V. b. arizonae - Grinnell (1914), "The vireos worked a rather low zone of foliage, from the ground up to a height of six or eight feet." Grinnell and Miller (1944), "The sphere of activity is within about eight feet of the ground and includes open and sparsely foliated branch-work beneath or between the taller and denser trees and bushes."

V. b. pusillus - Grinnell and Miller (1944), "The center of activity is within a few feet of the ground, in the fairly open twigs canopied above by the foliage of willows and cottonwoods. Foraging cruises may take the birds higher into the trees but territorial interest, with song perches and nest sites, is in the lowest stratum of vegetation... Most typical plants frequented are willow, guatemote (Baccharis glutinosa), and wild blackberry." Grinnell and Storer (1924), "the least vireo differs from our other vireos in that it chooses a low zone of vegetation in which to search for its food and place its nest. An individual is rarely seen above 6 feet from the ground, and usually it keeps below four feet. Our impression is that all the other vireos habitually forage well above the six-foot level."

C. Foraging strategies

Barlow (1962), "Behavior in foraging in larger trees followed a routine pattern. Typically a pair alighted in a tree at a height of 15 feet. Then the female hopped to a perch a foot above the one upon which she landed.

Vireo bellii (con't.)

The male succeeded her to the perch she had previously occupied. The pair in effect spiralled around some large, essentially upright branch, in foraging. The birds usually reached higher perches in this manner rather than by flying upward 10 to 15 feet to them. Animal food, consisting primarily of insects and spiders, is actively sought along branches and under leaves. Often a foraging bird will leap to the underside of a branch and hover, mothlike, beneath a cluster of leaves while extracting some insect. Some individuals hung up-side-down on small branches, parid-like, while foraging. Occasionally, I have seen a Bell's vireo fly from a perch and capture an insect in the manner of a flycatcher."

V. b. pusillus - Grinnell and Storer (1924), "The female was foraging and she moved about rather rapidly, occasionally flying upward a short distance to get some particular insect on the leafage. Meanwhile the mate traveled along with less frequent change of position, keeping to perches fairly close to his mate..."

D. Feeding phenology

Chapin (1925) noted beginning in July vegetable matter represented 1.57 per cent of the bird's subsistence, and thereafter slightly more until fall migration.

VI REPRODUCTION

A. Territorial behavior

Barlow (1962), "The Bell's vireo exhibits 'classic' passerine territoriality. Within a specific area, a pair of this species carries out pair-formation, courtship activities, copulation, nesting, rearing the young, and foraging. With the cessation of reproductive activities, a pair continues to restrict its other daily activities to the same general area." In the initial period after arrival on the breeding grounds, the male becomes identified with a large area, but is soon restricted to a much smaller area by the encroachment of other males. Territorial disputes in this period often involve physical contact, as well as protracted sessions of high-intensity singing at rates exceeding three hundred song-phrases per hour. "Except in the early stages of nesting, territory is maintained primarily by song. In the period of incubation a male regularly patrols his territory between sessions of sitting on the eggs. He sings several songs from each of several perches." Nice (1929) noted earlier in the breeding cycle, singing occurs more frequently. Mumford (1952), "The existence of a territory is quickly perceived. As the observer approaches, the male begins to sing, often coming to meet the intruder. Males under observation sang at all times during the day." Nolan (1960) noted beginning with their arrival in Indiana, males sing from prominent perches about 15 times per minute until they acquire a mate, after which they fall relatively silent for a time.

B. Courtship and mating behavior

Barlow (1962), "Early courtship activities of the Bell's vireo are characteristically violent affairs, with the male directing strong aggressive

Vireo bellii (con't.)

attacks towards the female. Rapid, looping flights through the thickets occur, the female leading the male. Occasionally he deliberately collides with her in mid-air, but the pair quickly separates." After nest-building is initiated, sexual chases cease. The principal courtship displays and postures observed in a Kansas study included greeting ceremonies, pouncing, "leap-flutters", a pre-copulatory display, copulation, and a post-copulatory display.

C. Nesting phenology

Pitelka and Koestner (1942) noted eggs in Illinois have been recorded between 26 May to 4 July. Nolan (1960) reported adults arrived in Indiana in early May. First eggs were discovered between 22-26 May and first eggs for replacement nests were found between 10 and 16 or 17 June. Fledging occurred in mid-June. Second broods are sometimes raised. The birds depart from this area by the second week of September.

V. b. arizonae - Bent (1950) reported thirty-five egg records for Arizona fell between 24 April to 1 July, with 18 being between 19 April to 29 May.

V. b. pusillus - Bent (1950) noted 105 egg records occurred between 7 April to 27 June with 58 records falling between 11 May to 10 June.

D. Length of incubation period

Nolan (1960) noted incubation required 14 days. Barlow (1962) reported in Kansas incubation began when the second egg was laid and lasted fourteen days. Pitelka and Koestner (1942) reported incubation began on the day the first egg was laid and lasted for 14 days after the laying of the first and second egg. Nice (1929) reported incubation started with the third egg and lasted 14 days. Hensley (1950) noted incubation lasted 14 days from the laying of the second egg in an Illinois nest. Since four eggs comprised the clutch, this should mean that the incubation period was 12 days.

E. Length of nestling period

Pitelka and Koestner (1942) noted the nestling period in one Illinois nest was 11 days. Barlow (1962) reported in Kansas the nestling period lasted from nine to twelve days, with eleven days being the most common nestling period. Hensley (1950) noted the nestling period at an Illinois nest was 14 days. Nolan (1960) reported nestlings fledged in Indiana at age 10.5 to 12 days.

F. Growth rates

Barlow (1962) noted the principal events in nestling development are opening of the eyes on about the 5th day, feathers erupting on the 6th day, cowering (in response to a threat) on the 8th day, head scratching and preening and hopping to the rim of the nest on the 9th day, and actual fledging on about the 11th day.

Vireo bellii (con't.)

G. Post-breeding behavior

Nolan (1960) reported in Indiana broods remained intact and were fed by the parents until they were 40 days of age or a little older. The young then disappeared.

VII POPULATION PARAMETERS

A. Clutch size

Nice (1929) reported (in Oklahoma), "The typical set consists of four eggs. Bennett, Simmons, and Kirn report occasional instances of five eggs. If cowbird eggs are present the vireo quota is always less than four." Nolan (1960) noted for an Indiana population seven nests contained 4 eggs; an eighth nest held 3 vireo and 2 cowbird eggs. Barlow (1962), "The average clutch size of the Bell's vireo in Kansas, based on thirty-three records, is 3.39 eggs. Seasonally, the largest average clutches are produced in the middle of the breeding season."

V. b. arizonae - Bent (1950), "The set of eggs for the Arizona vireo seems to consist of either three or four eggs, perhaps most commonly three."

B. Nesting success

Overmire (1962) noted of 61 completed nests at Stillwater, Oklahoma whose histories were known, 29 (48%) hatched at least one egg, and 19 (31%) fledged at least one young bird. From a total of 173 eggs, 78 (45%) hatched and 47 (27%) produced fledglings. Barlow (1962) noted only four out of 35 nests in a Kansas study were successful. Nice (1929) noted (in Oklahoma), "Of the 17 nests found by us, the outcome of two was unknown, but 15 came to untimely ends." Nolan (1960) reported in Indiana of 28 eggs laid in seven nests, 23, or 82 per cent, hatched and 16 young, or 57 per cent, left the nest.

C. Mortality rates per age class

Barlow (1962) noted nesting failure in a Kansas study resulted from severe weather, predation (apparently by snakes), cowbird parasitism, and human interference. Pitelka and Koestner (1942) reported of 26 nests of this species known to the authors from their own studies and those of others, only five were successful, and 17 of the 21 failures were because of cowbird parasitism.

D. Habitat density figures

Barlow (1962) noted in a Kansas study area there were 40 pairs of Bell's vireo per 100 acres.

V. b. arizonae - Grinnell (1914) noted in linear willow habitat along the Bill Williams River on 14 March, each singing male occupied each 200 yards of habitat.

Vireo bellii (con't.)

V. b. pusillus - Grinnell and Storer (1924) reported near Snelling (California), eight least vireos were observed within a stretch of about 300 yards in low growths along the Merced River, and in approximately the same extent of streamside brush along the Tuolumne River southwest of Lagrange, three pairs were found.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Cink (1977) noted three instances of snake predation on Bell's vireo nests were observed in Douglas County, Kansas. Nice (1929) reported for 15 Oklahoma nests which failed, three were deserted following cowbird parasitism, cats destroyed six nests, and snakes or people may have been responsible for the other failures. Nolan (1960) noted snakes were believed to have taken up to three nests in Indiana. Bent (1950) reported cats are probably an important mortality source for this species since it builds so close to the ground.

B. Competition

Bunker (1910) reported a nest of a Bell's vireo was found in the same bush as that of a black-capped vireo. The former species builds on the outer edges of bushes, whereas the black-cap builds in the center of bushes. Nolan (1960) noted habitat selection seems to be related to the avoidance of contact with the congeneric white-eyed vireo.

C. Parasitism

Pitelka and Koestner (1942) noted when parasitized by cowbirds, this species may desert its nest, it may tolerate the added eggs and accept them if they appear before the host's first egg, but desert when an egg is removed, or they may even attend a nest containing only eggs of the cowbird. "Both incubating adults and young apparently suffer infestation by the northern fowl mite, Liponipsus sylviarum (Can. & Franz.)." Nolan (1960) noted only one out of eight nests studied held cowbird eggs (three of host, two of cowbirds). The vireos did not desert the nest. Overmire (1962) reported at Stillwater, Oklahoma, "Eighteen (30 percent) of the nests were parasitized by the brown-headed cowbird (Molothrus ater). Two of these nests fledged a total of three cowbirds." Mumford (1952) noted of 13 nests observed in Indiana, seven were parasitized, and in only one instance was a young cowbird raised. In most of the cases, the nest was deserted soon after the cowbird eggs were laid. Bennett (1917) reported in Iowa 12 nests were studied of which 7 were parasitized by cowbirds. Of these, all were unsuccessful. Lantz (1883) believed that this species always deserts its nest if parasitized by a cowbird. Friedmann (1929), Fide R.W. Quillin: "This species will sometimes build another layer, or, rather, add a layer of lining and cover up the eggs of the cowbird. They must often push the foreign eggs from the nest, as I have seen many, many eggs of the cowbird on the ground under a nest of this species. Yet the Bell's vireo will hatch the eggs in majority of cases." Friedmann (1963), "Bell's vireo is

Vireo bellii (con't.)

a frequent victim of the cowbird in an area that extends from Illinois, Wisconsin, Iowa, Nebraska, Kansas, Oklahoma, and Texas to Arizona and southern California. All four races of this bird recognized within the United States are known to be affected..."

V. b. pusillus - Rowley (1930) noted of four parasitized nests of the least vireo found in 1927 and 1929 in southern California, three had been deserted by the hosts. Friedmann, Kiff, and Rothstein (1977) reported twenty-four out of 120 sets (20.0%) of eggs in the Western Foundation of Vertebrate Zoology egg collection for V. b. pusillus contained eggs of Molothrus ater, the brown-headed cowbird.

IX STATUS

A. Past population trends

V. b. pusillus - Mans and Chase (1963) noted a bird reported from Merced National Wildlife Refuge on 15 April 1963 prompted the comment that it was "one of the few reported in our region in the last ten years. Although apparently formerly a common nester in the riparian habitat of the Central Valley, it is now almost unknown in northern California, though still common in parts of southern California." Grinnell and Miller (1944), "In last fifteen years a noticeable decline in numbers has occurred in parts of southern California and in the Sacramento-San Joaquin Valley, apparently coincident with increase of cowbirds which heavily parasitize this vireo."

B. Present population status

Hibbard and Kline (1971) noted the first nesting record of this species in North Dakota was discovered in 1954. Subsequent records elsewhere in the state and also in Minnesota and South Dakota suggest that the species is either spreading northward, or that it is just now being observed by ornithologists. Unitt (1977), "Bell's vireo is an uncommon and declining species since the dense willow habitat along the rivers which they require usually lies in areas doomed to development. The species is severely parasitized by cowbirds, and evidently does not occupy all the available habitat, as it is absent in the dense riparian woodland along the lower San Luis Rey River in Oceanside."

V. b. arizonae - In Remsen (1978), "The race arizonae once bred commonly along the entire length of the Colorado River Valley in California... By the 1950's, the population had virtually disappeared (Monson, 1960), and now is probably gone completely from the California side. In 1977, surveys detected birds at only four sites along the Colorado River, and all four were on the Arizona side (D. Gaines, pers. comm.)."

V. b. pusillus - Remsen and Gaines (1973) noted in the central valleys of central and northern California, this species was considered to be nearly extinct, "probably due to cowbird parasitism". Remsen (1978), "The Bell's vireo has nearly disappeared from California. The subspecies pusillus, virtually endemic to California, is nearly extinct..." Gaines (1974) noted this species was not found in numerous surveys of the Sacramento Valley riparian areas during the breeding season of 1973 and has apparently succumbed to cowbird parasitism.

Vireo bellii (con't.)

C. Population limiting factors

V. b. arizonae - Grinnell (1914), "It would appear that many nests meet with disaster from their being built, as they so often are, in openings between thickets. These openings serve as passageways for browsing cattle, which as they crowd through, force the supporting branches aside and demolish the nests. Evidence of a number of instances of this type of catastrophe came to notice."

V. b. pusillus - Friedmann et al. (1977), "There is a possibility that the high incidence of parasitism (by brown-headed cowbirds) on this bird in southern California, coupled with an accelerated rate of destruction of its habitat may be causing it locally to diminish critically in numbers."

D. Environmental quality: adverse impacts

V. b. pusillus - Remsen (1978) noted destruction of riparian habitat may be responsible for the species' decline in some areas (e.g., southern San Joaquin Valley), the present critical status of this species in California is almost certainly due to brood parasitism by the brown-headed cowbird." The rate of decline of this and other passerine species in California coincides with the spread of the cowbird. Habitat destruction may have reduced the population below levels capable of withstanding intense cowbird parasitism.

E. Potential for endangered status

Arbib (1972) noted the Bell's vireo was officially added to the National Audubon Society's Blue List. Arbib (1975), "There is increasing sentiment to delist this species, although those in favor of listing are still in a sizable majority. But the vast majority of those consulted expressed no opinion about the species, indicating a dearth of knowledge, a situation that should be remedied." Arbib (1976) reported the Bell's vireo was retained on the Blue List by a two-thirds majority of reporters. It has been on the list since its inception in 1971. Regional declines were noted mostly in the western portion of the range, while the northern and more eastern portions of the range apparently contain more stable populations.

V. b. pusillus - Remsen (1978) noted this species is considered to face immediate extirpation in California if current population trends continue and is placed in the list of first priority among species of special concern in the state. It is recommended that this species (i.e., the race pusillus) be placed immediately on the Federal and California endangered species lists. Further recommendations include initiating cowbird removal programs in areas where the species still breeds and the protection of critical habitat in several areas of the several areas of the state.

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GRAY VIREO
Vireo vicinior

I TAXONOMY

A. Type description

Coues (1866) noted the species was described from a male collected by Elliot Coues at Fort Whipple, Arizona on 24 May 1865.

B. Current systematic treatments

AOU (1957) reported the species is regarded as monotypic. Phillips, Marshall, and Monson (1964), "There is geographical variation in the gray vireo but it seems to be non-clinal, forming a mosaic, as in some of the other gray birds of the Great Basin and desert areas..." Grinnell and Swarth (1913) reported a comparison of Arizona and California skins indicated that the race californicus (Stephens) is not justified. Stephens (1890) suggested that the name Vireo vicinior californicus be applied to California individuals of this species on the basis of darker coloration and differences in nesting behavior.

Synonomies - Grinnell and Miller (1944) reported Vireo vicinior californicus; California gray vireo.

II DESCRIPTION

A. External morphology of adults

Phillips, Marshall, and Monson (1964), "This is a very plain gray and white vireo with one wing-bar. The white eye-ring is complete but narrow. The tail, as in Bell's, is rather long and expressive." Peterson (1961), "A plain, gray-backed vireo of arid mountains; has a narrow white eye-ring but differs from other vireos with eye-rings by having no wing-bars or one faint bar. Though drab, it has character, flopping its tail like a gnatcatcher." Under similar species: "Bell's vireo usually has two wing-bars (sometimes one); often has a faint wash of yellow on sides. Its habitat is different (low stream edges)." Robbins, Bruun, and Zim (1966), "Drabdest of the wing-barred spectacled vireos; the single wing-bar is faint. Easily confused with Bell's, but the rump is gray, as is the back; the tail is much longer;... This is the only vireo that nervously twitches its tail as a gnatcatcher does."

B. External morphology of subadult age classes

Bailey (1928), "Texture of plumage looser and much softer than in adults; gray of upperparts slightly more brownish, white of underparts purer, and wing and tail edgings tinged with olive."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from south-central California (Liebre Mountains, Bodfish, Walker Pass), southern Nevada (Grapevine Mountains, Oak Spring), southwestern Utah (Beaverdam and Pine Valley Mountains), northwestern Arizona (Mount Trumbull, Grand Canyon, northeastern slope of the San Francisco Mountains, southern edge of the Mogollon Plateau), and southwestern New Mexico (Carlisle) south to northwestern Baja California (Ojos Negros), and central Arizona (Kirkland, Santa Catalina Mountains, Graham Mountains, mountains above Fort Bowie), locally to central New Mexico (Montoya), western Oklahoma (Kenton), and western Texas (Guadalupe and Chisos Mountains). Winters in southern Sonora (Tiburon and San Sebastian Islands, Guaymas) and southern Baja California (San Jose del Cabo). Casual in central Utah (Salinas)." Johnson (1972) noted in Nevada this species occurs to the northern limits of the Mojave desert.

B. California distribution of the species

Grinnell and Miller (1944), "Summer resident, from late March through August. Common locally, and sharply restricted to arid chaparral habitats; in many parts of range to be rated as no more than fairly common." Small (1974), "Seasonal status - uncommon summer visitor, late March to August. Range in California - very few known current breeding 'colonies'; most frequently seen on north slope of San Bernardino Mountains and in the Mojave desert from the Providence Mountains north to the Grapevine Mountains; note - occasionally seen in dry chaparral of interior valleys." Grinnell (1922) reported this species was collected at Walker Pass, Kern County, California, which then represented the northernmost record for it in the state. Bent (1950) noted spring arrival was on 26 March at Mecca and the species departed from the San Jacinto Mountains on 27 August.

C. California desert distribution

Grinnell and Miller (1944) reported California desert localities mentioned include Horse Spring in the Kingston Range, Clark Mountain, Providence Mountains, Grapevine Mountains just over the state line in Nevada, San Jacinto Mountains, Julian and Campo in San Diego County, 10 miles east of Riverside, Riverside County, Cajon Pass and Cactus Flat on the north side of the San Bernardino Mountains. Lane (1976), "Rare and very localized, known from: Oak Springs, near Phelan; Providence Mountains near Kelso (Kelso-Cima Road, Butterbread Springs); Joshua Tree National Monument (rare); Pinyon Flats, San Jacinto Mountains; Rose Mine Road, San Bernardino Mountains; along base of Santa Rosa Mountains; Wrightwood, San Gabriel Mountains." Remsen (1978) noted localities where this species still occurs include Round Valley, eastern San Bernardino Mountains, south-facing slopes of the Laguna Mountains, Pinyon Flats in the Santa Rosa Mountains, Riverside County, Clark Mountain, Mid Hills, and the New York Mountains in San Bernardino County.

Vireo vicinior (con't.)

D. Seasonal variations in distribution

Phillips, Marshall, and Monson (1964), "The summer range is relatively small, from southern California to west Texas; and the winter range appears to be still smaller, concentrating in central to northwestern Sonora. It remains common in northwestern Arizona until about September 20; but the latest for the north is September 16... It arrives on its wintering grounds as early as August 25."

IV. HABITAT

A. Biotopic affinities

Johnson (1965), "We found this species in the Sheep Range among scattered pinon, juniper, and brush on slopes near the bottom of Hidden Forest Canyon from 6100 to 6500 feet." Phillips, Marshall, and Monson (1964), "Fairly common summer resident in junipers of the upper Sonoran Zone... Though characteristic of the upper Sonoran Zone, the exact habitat varies from place to place and includes mesquites along the northeast base of the Chiracahua Mountains, for instance. Gray vireos usually prefer large junipers or chaparral with scattered trees." Johnson (1972) reported in the Virgin Mountains, Nevada, this species occupied mountain-mahogany (Cercocarpus ledifolius), Gambel oak (Quercus gambelii), and Mexican manzanita (Arctostaphylos pungens). He concluded that here the species occupied essentially the same sort of association ("dry chaparral") as in California, but that the designation "arid scrub" or "arid lowlands" described by authors did not apply. Bent (1950) reported in southern California above the Mojave desert this species occurred in a locality with juniper and cholla as the most common forms of vegetation. Scott (1885), "The locality (in Arizona) where the species is most abundant is where the mesquites terminate and the oaks begin... I have found that the smooth flat mesas, and the broad open bottoms of the wider canyon are quite as much frequented by them as the rough and broken hillsides." Wauer (1964) noted this species was a breeding resident of the pinon-juniper woodlands of the Panamint Mountains. Small (1974), "habitat - dry chaparral particularly that associated with pinon-juniper woodland." Grinnell and Swarth (1913) reported in the San Jacinto Mountains this species occurred specifically within the Adenostoma minor association in chaparral in the upper Sonoran Zone. Grinnell and Miller (1944), "Most typical plant association west of the desert is that dominated by chamise (Adenostoma sparsifolium and A. fasciculatum). Other associations of more varied composition (Garrya, Purshia, Artemisia tridentata, Cercocarpus; and scrub oak, manzanita, and ceanothus) may be occupied. In the mountains of the Mohave desert, the juniper-Artemisia association is the normal habitat, with mixture of other shrubs and trees such as Ephedra, Lycium, Purshia, and pinon pine. These plants provide a less dense brush cover than the chaparral of the coastal mountains."

B. Altitudinal range

Wauer (1964) reported the altitudinal range for this species in the Panamint Mountains was given as approximately 6000-6400 feet. Johnson

Vireo vicinior (con't.)

(1972) noted in Nevada this species was found between elevations of 5400 to 7400 feet, mostly between 5400 to 6600 feet. Scott (1885) reported this species was found in Arizona from elevations of 2800 to 4000 feet, being most common between 3000 to 3500 feet. Grinnell and Swarth (1913) noted this species was found between 3000 to 6500 feet in the San Jacinto Mountains. Grinnell and Miller (1944), "Altitudes of nestling localities range from 2000 feet, as in Mint Canyon, Los Angeles County up to 6500 feet."

C. Home range size

Grinnell and Swarth (1913), "We estimated that there was a pair of gray vireos for every forty acres of suitable ground, thus giving an unusually large forage area for the individuals of this species."

D. Territory requirements

Nest sites - Hanna (1944) reported a nest that was six feet up from the ground near the end of a limb of a pinon tree and suspended from two twigs on separate branches of the limb. This was only the second nest he had seen in a pinyon - all others were located in various species of shrubs. In Bent (1950), Hanna reported, "My notes record 13 nests, and these have been between 2½ feet and 8 feet from the ground, averaging 4 feet. The host shrubs have been about equally divided between big sagebrush (Artemisia tridentata), antelope-brush (Purshia glandulosa), and greasewood chamise (Adenostoma fasciculatum), and a single nest each in mountain-mahogany (Cercocarpus betulaeifolius) and pinyon (Pinus monophylla).". Grinnell and Swarth (1913) reported two nests were found in the San Jacinto Mountains on 21 May, both in greasewood bushes (Adenostoma fasciculatum) 33 and 36 inches high, respectively. Bailey (1928) noted nest in thorny bushes or trees, 4-6 feet from ground, occasionally supported underneath or on sides. Scott (1885) reported three nests were found, two six feet high, and the other seven feet high. The nest is apparently less pensile than those of other vireos. One was built in a thorn bush.

E. Special habitat requirements

Grinnell and Miller (1944), "Dry chaparral, which forms a continuous zone of twig growth from one to five feet above the ground in which the birds forage, sing, and nest."

V FOOD

A. Food preferences

Chapin (1925) noted from two stomachs examined by the U.S. Biological Survey, the following insects were found: caterpillars, a small moth, a stink bug, a tree hopper, a tree cricket, two dobson flies, a small cicada, and a long-horned grasshopper and two beetles.

Vireo vicinior (con't.)

B. Foraging areas

Grinnell and Swarth (1913) reported this species is a brush forager on dry slopes. "The forage depth of this vireo is between one and five feet above the ground, rarely any higher." Hamilton (1962) noted the gray vireo is considered to belong to the group of vireos that basically forages in thickets.

C. Foraging strategies

Stephens (1878) reported this species is usually seen singly, never more than three together. They usually keep near the ground, searching one bush thoroughly before moving to the next. They are never observed feeding on the wing, but the author states that he observed them scratching like towhees.

VI REPRODUCTION

A. Territorial behavior

Wauer (1973), "Males vigorously defend their territories throughout the breeding season..."

B. Nesting phenology

Bent (1950) reported egg dates for California (12 records) are between 20 April to 4 July with 6 records between 21 May to 29 May, indicating the height of the season.

VII POPULATION PARAMETERS

A. Clutch size

Hanna (1944), "The number of eggs in clutches that I feel were not disturbed has ranged from three to four, with an average of 3.55."

B. Habitat density figures

Grinnell and Swarth (1913) estimated 16 pairs per square mile in the San Jacinto Mountains.

VIII INTERSPECIFIC INTERACTIONS

A. Competition

Barlow, James, and Williams (1970) noted habitat co-occupancy was found in Texas between the gray vireo and Bell's vireo and between the gray vireo and the solitary vireo. Behavioral and vocal differences help to separate Bell's and gray vireos, while only behavioral differences facilitate the association between solitary and gray vireos. Grinnell and Swarth (1913) noted gray vireos were confined to dry chaparral in the

Vireo vicinior (con't.)

San Jacinto Mountains, while Vireo gilvus and V. solitarius occurred in the alder-lined ravine bottoms and in golden or black oaks on cool slopes, respectively. Hutton vireos also occurred in golden oaks adjacent to the chaparral, while Bell's vireos occurred in more riparian situations than the gray vireo. Johnson (1972) reported observations of gray and solitary vireos in six Nevada mountain ranges indicated that the species occur in completely different habitats, although limited contact might occur where the chaparral and scattered woodland preferred by V. vicinior intermixes at its upper elevational edge with the lower border of the ponderosa pine forest or heavy pinon woodland inhabited by V. solitarius.

B. Parasitism

Hanna (1944) reported a nest of the gray vireo that was located on 28 May 1944 contained two vireo eggs and one cowbird egg on 4 June. It had apparently been deserted by the host. This is apparently the first record of cowbird parasitism on the species. Hanna speculated that the vireo's lack of care about concealing its nest might make it easier for cowbirds to parasitize them. Friedmann (1963) notes three records of parasitism on gray vireos in California by the brown-headed cowbird and refers to it as a "frequently imposed upon victim".

IX STATUS

A. Past population trends

Grinnell and Swarth (1913) reported on the basis of their estimate of 16 pairs of this species per square mile in suitable habitat, they believed that there were around 960 gray vireos in the San Jacinto Mountains.

B. Present population status

Remsen (1978) reported this species apparently occurs in few of the localities where it was once found. Therefore, it is placed in the "second priority" list for California birds, i.e., it is among species that are considered to be on the decline in a large portion of their range in California, but still with a population sufficiently large that extinction is not immediately imminent.

C. Environmental quality: adverse impacts

Remsen (1978) noted the reasons for the decline of this species are unknown, but are doubtfully habitat destruction. It is most probable that cowbird parasitism is responsible for its present scarcity in California.

D. Potential for endangered status

Arbib (1975) reported this species was removed from the Blue List, but the southwest and southern Pacific Coast regions recommended its rein-

Vireo vicinior (con't.)

statement. Arbib (1973) reported observers in the southwest region recommended removing the gray vireo from the Blue List, but the southern California region recommended retaining it. Arbib (1972) noted the gray vireo was retained on the National Audubon Society Blue List for 1973. Arbib (1971) reported the gray vireo was listed on the "Preliminary - Tentative" Blue List of the National Audubon Society.

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WARBLING VIREO
Vireo gilvus

I TAXONOMY

A. Type description

Vireo gilvus leucopolius - Oberholser (1932) noted this race was described from a specimen taken at 6400 feet in Barley Camp, Warner Mountains, 14 miles southwest of Adel, Oregon.

Vireo gilvus swainsonii - Baird, Cassin, and Lawrence (1858) reported this form was described (as an entirely new species) from a specimen from Petaluma, California.

B. Current systematic treatments

AOU (1957) noted four races are recognized by the current checklist: V. g. gilvus, swainsonii, leucopolius, and victoriae (confined to the Victoria Mountains of southern Baja California). This was the first edition of the AOU checklist which gave the race leucopolius recognition. Paynter (1968) recognizes seventeen races, including swainsonii; leucopolius, and the nominate race in the United States; and leucophrys and its allied forms in the neotropics (usually separated by most authors).

Synonomies - Vireo gilvus leucopolius - Vireo gilvus swainsoni, part; Vireosylva gilva swainsonii, part; Vireosylva gilva leucopolia. Western warbling vireo, part; Oregon warbling vireo (Grinnell and Miller, 1944).

Vireo gilvus swainsonii - Vireo gilvus; Vireo swainsonii; Vireosylva swainsoni; Vireosylva gilva swainsoni; Vireosylva gilva; Vireosylva gilva swainsonii, part. Warbling flycatcher; warbling vireo; Swainson warbling greenlet; western warbling greenlet; Swainson greenlet (Grinnell and Miller, 1944).

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "Of those warbling vireos that no distinct wing-bars or eye-rings are present, this is the most widespread. A pale-backed vireo; whitish below; head inconspicuously striped." Under similar species: "(1) Red-eyed vireo has a more contrastingly striped head and shows contrast between gray cap and olive back. (2) Philadelphia vireo (Canada) has yellowish underparts. (3) Gray and (4) Bell's vireos tend to have eye-rings." Robbins, Bruun, and Zim (1966) reported summer plumage is drab. Look for the vireo bill and broad white eye stripe, which is not outlined in black. This vireo is well concealed by foliage.

B. Distinguishing characteristics

Intraspecific - Sibley (1940) noted the race swainsonii has an olive-green back, while leucopolius has a more grayish and less olive back.

Vireo gilvus (con't.)

Swainsonii has a deep olive-green rump, and its underparts have considerable olive-yellow on the flanks and belly, while leucopolius has an olive-gray rump and underparts with some olive-yellow on the flanks.

V. g. swainsonii - Ridgway (1904), "Similar to V. g. gilva, but smaller, with relatively smaller bill; coloration darker, especially the plumage, which is perceptibly (often distinctly) darker than the back; the latter, together with sides and flanks, usually more strongly olivaceous."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from northern British Columbia, southern Mackenzie, central Saskatchewan, southern Manitoba, western Ontario, northern Minnesota, northern Michigan, southern Ontario, extreme southern Quebec, southern Maine, southern New Brunswick, and central Nova Scotia south to Baja California, central northern Mexico, central Texas, southern Louisiana, northern Alabama, western North Carolina, and the coastal plain of Virginia. Winters from southern Sonora and Veracruz to Guatemala and El Salvador."

V. g. leucopolius - AOU (1957), "Breeds in the Great Basin from eastern Washington (Spokane), eastern Oregon (Barley Camp, Adel, Powder River Mountains, Wallowa Valley), and southern Idaho (Meridian, Rupert, Pocatello) south to northeastern and central eastern California (Sugar Hill, Cedarville, Mono Lake, Benton, Wyman Creek), southern Nevada (Lee Canyon, Charleston Mountains, Saint Thomas), and along the western slope of the Wasatch Range to southwestern Utah (Ogden, Provo, Parleys Park, St. George). Winter range uncertain; taken in migration in southern California (San Jacinto Mountains, Argus Mountains, Horse Springs, Providence Mountains, Pilot Knob)." Paynter (1968), "Great Basin region from eastern Washington and southern Idaho south to central-eastern California, southern Nevada, and southwestern Utah; winter range little known, but extends south at least to Guerrero."

V. g. swainsonii - AOU (1957), "Breeds from northern British Columbia (Atlin, Glenora, Great Glacier, Telegraph Creek, Hazelton, Francois Lake, Fort St. James), southwestern and central southern Mackenzie (Fort Simpson, Fort Smith), northern Alberta (Peace River, Lesser Slave Lake), central Wyoming (Fort Sheridan), southwestern South Dakota (Black Hills), and western Nebraska (Sioux County, Crescent Lake) south to southern California west of the Sierra Nevada (San Diego, Yreka, San Bernardino Mountains, Witch Creek), central-northern Oregon (mouth of the Deschutes River, Weston, Fort Klamath), central Idaho (Moscow, Lost River Mountains), southwestern Utah (Zion Park), central and southeastern Arizona (Santa Catalina Mountains, Huachuca Mountains), southern New Mexico (Silver City, Chloride, Cloudcroft), and western Texas (Guadalupe Mountains). Winters from southern Sonora (rarely Alamos), Durango (Chacala), Michoacan (Zamora, Los Reyes), Morelos (Cuernavaca), and Veracruz (Vera Cruz) south to El Salvador (Mount Cacaguatique). Migrates through the Great Basin, Baja California, and western Mexico." Paynter (1968), "Northern British Columbia and southwestern

Vireo gilvus (con't.)

and central-southern Mackenzie south, exclusive of Great Basin region, to southern California, central Idaho, central and southeastern Arizona, New Mexico, and western Texas; winters from southern Sonora south to Nicaragua."

B. California distribution of the species

Small (1974) noted the breeding range in California is "in suitable habitat, length of state and west of deserts and Basin and Ranges region; otherwise, any suitable lowland area."

V. g. leucopolius - Grinnell and Miller (1944), "As breeding, western margin of Great Basin; more specifically, suitable areas in Modoc County and in Mono and Inyo Counties east of the forests of the Sierra Nevada. In migration, Colorado River Valley and Colorado and Mojave deserts.

V. g. swainsonii - Grinnell and Miller (1944), "Breeds in suitable habitat throughout entire length of state west of southeastern deserts and exclusive of Great Basin region in Mono, Inyo, and Modoc Counties. In migration appears additionally on deserts east to Colorado River Valley and, rarely, on inner Santa Barbara Islands."

C. California desert distribution

V. g. leucopolius - Grinnell and Miller (1944), "Some migration records based on specimens (Mus. Vert. Zool.): Mountain Springs Canyon, Argus Mountains, Inyo County, May 27; Horse Spring, Kingston Range, San Bernardino County, June 7; Clark and Providence Mountains, San Bernardino County, May 18-June 2; Vandeventer Flat, San Jacinto Mountains, Riverside County, June 2; near Pilot Knob, Colorado River, Imperial County, May 12-14."

V. g. swainsonii - Grinnell and Miller (1944), "References to migrants on the deserts and along east slopes of mountains of southern California confuse the races V. g. swainsonii and V. g. leucopolius. Sample occurrences of swainsonii in these areas based on recently identified skins (Mus. Vert. Zool.) are: near Benton, Mono County, September 20; Palm Springs, Riverside County, April 27; Mecca, Riverside County, March 18-April 25; 8 miles northwest of Calipatria, Imperial County, May 13; Colorado River Valley, Imperial County, from opposite Cibola to near Pilot Knob, April 1-May 12."

D. Seasonal variations in distribution

Ralph (1971) reported it is possible that warbling vireos migrating along the Pacific Coast are immatures who possess genetically-based navigational tendencies of a non-adaptive sort and that the vast majority of migrants, including nearly all adults, take inland routes. Wauer (1962) noted this species arrives in Death Valley in July and stays on through the summer. Norris and Johnston (1952) reported a warbling vireo was seen on 29 Dec. 1951 at Berkeley, California. Apparently, all previous winter records for the United States were in Texas (2) and Florida (2). Small (1974), "Seasonal status - transient and summer visitor March to October." McCaskie

Vireo gilvus (con't.)

(1976), "Two warbling vireos remained in San Diego through most of December (JD) but could not be found thereafter; it has long been suspected that some fall migrants linger into the early winter and that many December records do not pertain to truly wintering individuals." Bent (1950) noted early date of spring arrival in California is 11 March in Los Angeles, and the late date of fall departure is 3 October at Berkeley.

V. g. leucopolius - Grinnell and Miller (1944), "Summer resident and migrant, the spring migratory movement lasting until the first week of June."

V. g. swainsonii - Grinnell and Miller (1944), "Summer resident and migrant ... Present on breeding grounds from late March through August; spring arrival in mountains may be several weeks later. Detected as migrant in spring as late as mid-May on southeastern deserts. Fall migration from August to early October."

IV HABITAT

A. Biotopic affinities

Bent (1950) - for Los Angeles County - "In the breeding season here, the warbling vireo is chiefly a bird of the mountain canyons, or more definitely of the riparian growth (alders, cottonwoods, sycamores, and maples) along the streams from the tree filled gulches in the foothill mesas barely into the lower edge of the pine belt." Hubbard (1965), "This vireo was common in deciduous growth in riparian spruce woodland and aspen groves in fir forest; it was less common in spruce-fir forests." Dumas (1950) reported in southeastern Washington this species occurred in "brushy river bottoms in sagebrush areas", in "flood plain forests of grassland areas", and in "mixed forest and willow-aspen-brush in montane forest areas". Small (1974), "for breeding, riparian woodlands and other places where deciduous trees are found; otherwise, in migration may appear in any lowland area with suitable thickets and groves of trees." Johnston (1943), "The warbling vireo has been recorded from the plains to 10,000 feet, and is considered... to breed most commonly in cottonwoods and aspens. The two nests found of this species were in aspens, one at 8200 feet and the other at 9000 feet. Thus the warbling vireo's breeding range is determined by its habitat requirements; it seems to nest in any part of these three zones where aspens or cottonwoods are found."

V. g. leucopolius - Grinnell and Miller (1944), "In general features, similar to that of Vireo gilvus swainsonii. Consists chiefly of groves of aspens and cottonwoods. Life zones in summer: upper Sonoran, Transition, and Canadian." Johnson (1965), "Despite the virtual absence of aspens and other broad-leaved trees, the warbling vireo was very common in the Sheep Range where it inhabits ponderosa pines and white firs generally between 6900 and 8400 feet. Above 8000 feet bristlecone pine was also used. In the Spring Range this species was recorded commonly between 7600 and 9100 feet in ponderosa pine, white fir, and clumps of quaking aspen."

Vireo gilvus (con't.)

V. g. swainsonii - Grinnell and Storer (1924), "While usually found in deciduous trees and in the general vicinity of streams it is at times observed well away from water and is occasionally to be seen or heard high in tall coniferous trees. The greatest numbers are to be found in the vicinity of streams in the Transition Zone where three or four will ordinarily be noted in an hour of observation." Laing (1942) noted this species was found in deciduous woods of alder, willow, etc. Grinnell and Miller (1944), "Zonal range in summer wide: from upper Sonoran (occasionally lower Sonoran) through Transition to Canadian. Deciduous trees, especially those growing in moist places, such as alders, willows, and cottonwoods ... In areas of coniferous timber this species will seek out clumps or even single trees of broad-leaf type as headquarters, although foraging and singing some of the time in the evergreens... Orchard trees, aspens, and black oaks may in some places be occupied extensively."

B. Altitudinal range

Bent (1950), "It seems to be equally common in the valleys, in the wooded canyons, or in the mountains, up to 6500 feet in northern Montana and up to 10,000 feet farther south." In Utah (in Zion National Park) this species was said to be common up to 7000 feet.

V. g. leucopolius - Grinnell and Miller (1944), "Altitudinal range from 4700 to 9200 feet."

C. Territory requirements

Nest site - James (1976) noted average nest height in Ontario (sample of 10) was 8.2 m. The choice of nesting habitat of this species in Ontario seems to be based on general configuration (open habitats ranging from open parkland with isolated trees and small groves to the open edge of forest) rather than tree species composition.

V. g. swainsonii - Bent (1950), "the western warbling vireo differs decidedly, in its choice of a nesting site, from its eastern relative. The eastern bird builds its nest almost invariably in trees and at a very considerable height, whereas the western bird often builds in bushes or low trees and much nearer the ground. Most of the recorded nests of the western warbling vireo have been placed at not over 12 feet from the ground; and its highest nests, which seem to be exceptional, have been below the average for the eastern bird." Pierce (1916) reported in the San Bernardino Mountains a nest was found in a small willow on 26 June 1916 and another was found at the extreme end of a small branch of an oak on the same day.

V FOOD

A. Food preferences

Friedmann (1929) noted this species was observed feeding a young cowbird cutworms, mosquitoes (?), small Odonata, flies, and other unidentified insects.

Vireo gilvus (con't.)

V. g. swainsonii - Beal (1907) reported insects accounted for 97% of the diet in California, based on the examination of 110 stomachs, with vegetable matter making up the remaining 3%. In order of descending importance, the insects represented were lepidopterans, hemipterans, coleopterans, and hymenopterans, as well as a small number of flies, grasshoppers, dragonflies, and spiders.

B. Foraging areas

Hamilton (1962) noted this species is assigned to a group of vireos that is comprised of basically montane arboreal foragers.

V. g. swainsonii - Linsdale (1938) reported in Nevada the favorite habitat was in trees 25-30 feet high where there was some undergrowth and leaf litter. However, the birds foraged closely within the crown foliage. Grinnell and Storer (1924) reported this species forages from 10 to 60 feet above ground.

C. Foraging strategies

James (1976) noted warbling vireos in Ontario were found to obtain most of their food from leaves by hovering around the periphery of trees. Also, some food was obtained by hanging from the end of a branch and picking an invertebrate from a leaf. They foraged mostly at the tips of live branches of individual trees. The mean foraging height was found to be 7.7 m in trees averaging 10.0 m in height.

V. g. swainsonii - In Bent (1950) a "Mr. Rathbun" reported that he watched a vireo foraging in some trees and that "often the vireo would poise in the air for an instant to take some insect from beneath a leaf, then begin again its inspection of the twigs and leaves. The bird made this distinction in anything it captured; if the prey was small, it was eaten as soon as taken; but if of large size, it was well minced before being swallowed."

D. Feeding phenology

V. g. swainsonii - Wheelock (1920), "In the fall this bird becomes very friendly, coming into the orchards and gardens to hunt busily among the leaves for small caterpillars. At this time he is fond of the cornel berries that grow along mountain brooks, and occasionally condescends to eat mistletoe, though he prefers to eat insect food." Beal (1907) noted of a sample of 110 stomachs from California, insects only were taken until August and September at which time some vegetable matter was eaten. Caterpillars amount to 82% of the food taken in April, but are of less importance later.

VI REPRODUCTION

A. Territorial behavior

V. g. swainsonii - Grinnell and Storer (1924), "The song season lasts from the time the birds first arrive in the region (early April?) until about

Vireo gilvus (con't.)

mid-July. The species may sing in the heat of midday, unlike most other birds.

B. Courtship and mating behavior

Dunham (1964) reported apparent courtship displays of this species involved chases, distinctive vocalizations, gaping, and "weaving" (one bird rhythmically moving its body from side to side with movements of small amplitude). Also, the tail and wings are spread during such displays.

C. Nesting phenology

Bent (1950) noted 82 egg dates from California fall between 26 April to 25 July. Forty-one records fall between 24 May to 14 June, indicating the height of the season. Ralph (1971) reported summer residents at Point Reyes generally arrive during March and by April are nesting. The majority of Point Reyes adults leave during July and early August, and may be in full migration. At this time there is an increase in young birds, probably representing dispersal of locally produced young.

D. Length of incubation period

V. g. swainsonii - Rust (1920) noted the incubation period of an Idaho nest was 12 days.

E. Length of nestling period

V. g. swainsonii - Rust (1920) reported at an Idaho nest the young were well feathered and able to perch on the edge of the nest at the age of 12 days... it is likely that they would have fledged on the following day, or possibly on the 14th day.

VII POPULATION PARAMETERS

A. Clutch size

V. g. swainsonii - Bent (1950), "The western warbling vireo lays from three to five eggs, usually four."

B. Longevity

Peaslee and Sorrie (1976) noted a warbling vireo banded as an adult in June, 1966 was recaptured in May 1976, indicating an elapsed time of 8 years and 11 months.

C. Habitat density figures

Salt (1957) reported in "scrub-meadow" habitat in Wyoming, this species was found to occur at a density of 60.0/100 acres. In "flatland aspen" habitat it occurred at a density of 13.4 birds/100 acres.

Vireo gilvus (con't.)

V. g. leucopolius - Johnston (1949) noted this species occurred at a density of 5 pairs per 100 acres in a Douglas fir forest study plot and also in a heavily logged coniferous forest. It was also noted in deciduous trees.

VIII INTERSPECIFIC INTERACTIONS

A. Competition

James (1976) reported in Ontario this species did not respond to taped calls of either yellow-throated or red-eyed vireos, and there were several records of warbling and yellow-throated vireos nesting in close proximity to each other and also foraging in essentially the same areas. However, yellow-throated vireos will chase warbling vireos from their nest tree (although this is probably a generalized response towards any small passerine). Also in Ontario competition with yellow-throated and red-eyed vireos is avoided by lateral separation within trees and through habitat selection, respectively. All the species are apparently able to differentiate readily between songs of each.

B. Parasitism

King (1954), "a pair of warbling vireos (Vireo gilvus) was observed feeding a newly fledged cowbird on July 8, 1952." Friedmann (1929), "Two races of this vireo are victimized by the cowbird" (gilvus and swainsonii). "A very common victim... Altogether over forty records have come to my notice... In common with the other species of its family, this vireo normally makes no attempt to rid herself of the parasitic eggs." Only a single record of parasitism on the race swainsonii was cited, and none were given for leucopolius. Friedmann (1963), "The warbling vireo is a frequent host of the brown-headed cowbird; 64 records have come to my attention, involving three races of the vireo, gilvus, swainsonii, and leucopolius, plus all three subspecies of the parasite." Ten records of parasitism are given for swainsonii and two for leucopolius.

V. g. leucopolius - Friedmann, Kiff, and Rothstein (1977) reported six additional instances of cowbird parasitism on the race leucopolius. In Ontario the incidence of cowbird parasitism on this species was one out of every 62 nests, or 1.6%, based on a nest record card program.

IX STATUS

A. Past population trends

V. g. swainsonii - Grinnell and Miller (1944), "Common, in some areas even abundant; the most numerous vireo in California."

B. Environmental quality: adverse impacts

Bent (1950), "In recent years the warbling vireo has probably suffered more from the spraying of the shade trees with poison than from the natural ene-

Vireo gilvus (con't.)

mies that commonly beset small arboreal birds. Their nests have been imperiled by the high-pressure spraying that rocks the elm branches at the vital points of the birds' summer distribution, the roadside trees of our country towns."

C. Potential for endangered status

All published accounts on this species indicate that it is fairly common to abundant within its range. I have encountered no evidence that suggests it is in trouble anywhere within its range in the western United States (editor's note).

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ORANGE-CROWNED WARBLER
Vermivora celata

I TAXONOMY

A. Type description

Helminthophaga celata var. lutescens- AOU (1957) Ridgway. Amer. Journ. Sci., Ser. 3,4, No. 24, Dec. 1872. Pacific Coast, from Radiak (sic) to Cape St. Lucas = Fort Kenai, Alaska.

Vermivora celata orestera - AOU (1957) Oberholser, Auk (22), No. 3, July 1905. Willis, New Mexico.

Sylvia celatus - AOU (1957) Say in Long, Exped. Rocky Mountains, Vol. 1, 1823. (note) Engineer Cantonment near Council Bluff = Omaha, Nebraska.

B. Current systematic treatments

Hellmayr (1935) recognizes 4 races of Vermivora celata including lutescens whose range is given as follows: Pacific Coast of the United States from Cook Inlet, Alaska, south to the San Bernardino Mountains of southern California; winters from Chihuahua to Guatemala and in southern lower California.

Hellmayr (1935) recognizes 4 races of Vermivora celata including orestera whose range is given as follows: Rocky Mountains from northern British Columbia south to southeastern California, southern Arizona, and New Mexico. Winters south to the Mexican states of Tamaulipas, Puebla, Morelos, Guerrero, Michoacan, Jalisco, and southern lower California.

Hellmayr (1935) recognizes 4 races of Vermivora celata including celata whose range is given as follows: Alaska, excepting the coast region from Cook Inlet southward, and the Canadian Territories of Yukon, Mackenzie, Athabasca, and central Keewatin; in migration south to Washington, Arizona, Texas, Florida, South Carolina, New England and eastern Mexico (Hidalgo).

Synonomies - called "Luteoline warbler" (Dawson, 1923).

II DESCRIPTION

A. External morphology of adults

Ridgway (1902) gives detailed descriptions of plumages and measurements of adults and nestlings.

B. Distinguishing characteristics

Bent (1953), "Differs from typical celata in being more brightly olive-green above and distinctly yellow below; in strong light it seems to be a yellow rather than an olive bird." (V. c. lutescens).

Bailey and Niedrach (1965), "The color of this race is intermediate between typical V. c. celata and the yellower V. c. lutescens..." (V. c. orestera).

III. GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "From central Alaska, northwestern and central Mackenzie, northern Manitoba, northern Ontario, and northwestern Quebec south to northwestern Baja California, southeastern Arizona, western Texas, southeastern Saskatchewan, southern Manitoba and western and central Ontario."

V. c. lutescens - AOU (1957), "breeds from southeastern Alaska (Seldovia, Valdez, Haines) south along the coast and the coastal ranges through western British Columbia, western Washington (east to Entiat River), and western Oregon to southern California (Santa Monica, Escondido) and extreme western central Nevada (Tahoe District). Winters from central California (Marysville, rarely; Los Angeles) and southwestern Arizona (Parker) south to southern Baja California (San Jose del Cabo) and through western Mexico to Guatemala (Sierra Santa Elena)."

V. c. orestera - AOU (1957), "breeds in the Rocky Mountains and the mountains of the Great Basin from southwestern Yukon (Kluane Lake area, Carcross) southern Alberta (Jasper Park, Cypress Hills), and southwestern Saskatchewan (Sovereign) south to central eastern California (White and Panamint Mountains), central Nevada (Toiyabe Mountains), central Utah (Parleys Park), southeastern Arizona (Santa Catalina and Graham Mountains), and western Texas (Guadalupe Mountains). Winters from southeastern California (Colorado River Valley), southern Nevada (near Searchlight), central and southeastern Arizona (Fort Verde, Patagonia), and southern Texas (Kerr County, Brownsville) south to southern Baja California (Santiago), Guerrero (Chilpancingo), and Veracruz (Orizaba); casually north to central California (10 miles northwest of Merced)."

V. c. celata - AOU (1957), "breeds from central Alaska, northwestern and central Mackenzie, northern Manitoba, northern Ontario and northwestern Quebec south to the Alaska Peninsula, Kodiak Island, and central eastern Alaska, central Yukon, central Alberta, southeastern Saskatchewan, southern Manitoba, and western and central Ontario. Winters from southern California (rarely west to Santa Cruz Island; Needles), southern Nevada (Colorado River Valley), southeastern Arizona (Tucson), central Texas, southern Louisiana (New Roads), southern Mississippi, (Saucier), southern Alabama (Orange Beach, Ashford), Georgia (Atlanta, Athens), and South Carolina (Chester County) south to southern Baja California (La Paz), Guerrero (Chilpancingo), Guatemala (Tecpan), and southern Florida (Key West, Miami); casually north to Oregon (Eugene area), Tennessee (Memphis, Knoxville), Ohio (Columbus), Connecticut (Greenwich), Massachusetts, and Nova Scotia."

B. California distribution of the species

V. c. lutescens - Grinnell and Miller (1944), "Geographical range - as breeding, entire Pacific watershed west of Cascade-Sierran crests, but exclusive of larger valleys and of a narrow coastal strip south of Santa

Vermivora celata (con't.)

Monica Mountains. In migration, widespread, ranging eastward to Colorado River Valley. In winter, coastal southern California and central section of state. North to Marysville, Yuba County." Bowles (1911), "recorded as breeding in southern California only in the mountains."

V. c. orestera - Grinnell and Miller (1944), "Geographic range - in breeding season, Great Basin region from Warner Mountains, Modoc County, south to White and Panamint Mountains, Inyo County. Occurs locally on east flank of Sierra Nevada. In migration, throughout area east of Cascade-Sierran axis and on the Mojave and Colorado deserts; occasional on west slope of mountains. In winter, entire extent of Colorado River Valley within the state."

C. California desert distribution

Wauer (1964) noted as common summer resident of the springs and associated riparian habitat in the Panamints. Wauer (1964) reported nesting among willows at Thorndike Spring, in the Panamint Mountains. Known to occur in the area of Death Valley National Monument (Wauer, 1962).

V. c. lutescens - Carter (1937), "Frequently seen in willows all during spring."

V. c. orestera - Dawson (1923) recorded in summer from Panamint and Argus Ranges and the White Mountains.

D. Seasonal variations in distribution

AOU (1957), "In winter from northern California, southern Nevada, central Arizona, southern Texas, the Gulf coast, and South Carolina south to southern Baja California, Guatemala, and southern Florida." Small (1974) reported "seasonal status - complex: common spring and fall transient, summer visitor, winter visitor, and resident." Linsdale (1951) notes "transient and winter visitant."

V. c. lutescens - Grinnell and Miller (1944), "summer resident, from early March to early September. Migrant in March and April and from late August through October. Beginning of period of summer residence essentially co-incident with first migratory movements into state in spring. As with many migrant species, departure from breeding grounds in fall not clearly defined; territorial ties apparently are broken early in some instances and a period of late summer vagrancy, with appearance at high altitudes, merges imperceptibly into fall migration. As a summer resident and migrant, common, especially toward the coast. Small numbers remain through the winter." Linsdale (1951) reported "Summer resident on eastern slope of Sierra Nevada in central part of western border of the state, transient elsewhere..." Bowles (1911) noted abundant summer resident, less numerous during the winter months. Dawson (1923), "early spring migrant and summer resident west of the Sierran divide."

Vermivora celata (con't.)

V. c. oresteria - Grinnell and Miller (1944), "summer resident, migrant, and winter visitant, in eastern sections of state. Present on breeding grounds, from May to August. Migrations chiefly in April and the first half of May, and in late August, September, and early October. Common in summer and in migration. Fairly common through the winter in the Colorado River Valley." Linsdale (1951), "summer resident on upper parts of several of the higher mountain ranges, transient in other parts of the state, and winter visitant to extreme southern part."

V. c. celata - Grinnell and Miller (1944), "status - migrant and winter visitant. Occurs regularly in small numbers in September and October, and in April and May; as a winter visitant, rare, except in Colorado River Valley where more numerous." "In migration, throughout southern and central sections of state, from coast east to the Colorado River Valley... In winter, coastal and interior southern California" (Grinnell and Miller, 1944).

IV HABITAT

A. Biotopic affinities

Small (1974), "habitat - live oaks, chaparral, streamside thickets, riparian woodlands, undergrowth of forest and woodland."

V. c. lutescens - Grinnell and Miller (1944), "a mixture of oak woodland and chaparral constitutes particularly favorable environment." Life zones in breeding season: upper Sonoran and transition (Grinnell and Miller, 1944). Bent (1953), "chaparral hillsides and brushy open woods are the favorite haunts..."

V. c. celata - Grinnell and Miller (1944), "no particular plant association is favored conspicuously."

V. c. oresteria - Hubbard (1965), "... fairly common in brushy growth in riparian spruce woodland and aspen groves in fir forest." Grinnell and Miller (1944) noted life zones in summer: transition and Canadian.

B. Altitudinal range

V. c. lutescens - Grinnell and Miller (1944) reported altitudes of nesting: sea level to 7600 feet.

V. c. oresteria - Grinnell and Miller (1944) reported altitudinal range: 4800 to 8500 feet in Warner Mountains.

V. c. celata - Grinnell and Miller (1944) reported altitudinal range = to 7600 feet.

C. Territory requirements

Nest sites - Grinnell and Miller (1944) noted nest sites: hill slopes and steep banks will drained, may be sheltered from above by hanging

Vermivora celata (con't.)

vegetation. Builds nest on or near ground in "tangles" or "under a rooty bank" (Bent, 1953). Finley (1904) notes nest was on a hillside under a fir tree, placed on the ground in a tangle of grass and brier. Nest site: nest tucked up under dry ferns in bank of a hollow where a tree had been uprooted (Finley, 1904). Dawson (1923) reported breeds in semi-wooded areas of the upper Sonoran and transition zones. (V. c. lutescens).

V. c. celata - Bent (1953) reported usually nests on ground or in bush near ground. Nests on or a few inches above the ground.

V. c. orestera - Jewett (1934) found nest in dense mixed grove of aspen, alder, willow, and yellow pine, on the ground at 6600 feet on Hart Mountain, Lake County, Oregon.

D. Seasonal changes in habitat requirements

V. c. orestera - Grinnell and Miller (1944), "habitat - in summer, stream-side thickets and groves of aspens affording moderately dense foliage at middle heights and partly shaded, but not densely covered, ground. In winter underbrush of river bottoms." Phillips (1935) reported "inhabited the willows and alders, and until mid-August none was seen in the ever-greens."

V FOOD

A. Food preferences

Diet consists of 1/10 vegetable matter (fruit, leaf galls, seeds) and 9/10 animal matter (leaf bugs, leaf-hoppers, plant lice, scale insects, weevils, ladybirds, caterpillars, wasps, ants, flies) (Oberholser, 1974).

V. c. celata - Bent (1953) noted probably eats some berries in winter. Probably wholly insectivorous in summer (Bent, 1953).

B. Foraging areas

V. c. lutescens - Grinnell and Miller (1944) reported forage height between 5 and 30 feet above the ground.

C. Foraging strategies

V. c. lutescens - Chapman (1917) notes hunts near the ground, "flitting here and there..."

V. celata - Oberholser (1974), "Forages restlessly through foliage of bushes and trees, apparently preferring the lower levels, and often descends to the ground."

D. Energy requirements

V. c. lutescens - Allen (1915) noted ate 5 cut-worms in five minutes.

Vermivora celata (con't.)

V. celata - West and de Wolfe (1974) reported resting metabolic rate as:

<u>Avg. wt.</u>	<u>ml O₂/hour $\pm$ ISD</u>	<u>kcal/hour²</u>
8.3 g	57.6 $\pm$ 14.8	0.279

Total energy cost kcal/24 hours
9.44

West and de Wolfe (1974) also noted total energy removed over 99 day summer period as 10.6 Mcal/100 ha².

VI REPRODUCTION

A. Territorial behavior

Oberholser (1974), "song is infrequently heard away from nesting territory."

B. Nesting phenology

V. c. lutescens - Wheelock (1904) reported breeding season: May 15 to June 15.

V. c. celata - Bent (1953) noted egg dates: in California, April 3 - June 24.

VII POPULATION PARAMETERS

A. Clutch size

V. c. lutescens - Finley (1904) reported clutch sizes: 3 sets of 5 eggs, 1 of 4 eggs. Wheelock (1904) noted clutch size: 4 or 5 eggs. Willett (1920) reported clutch size: 3 sets of 5 eggs each, 1 set of 4 eggs.

V. c. oresteria - Jewett (1934) noted clutch size: 4 eggs.

V. c. celata - Bent (1953) notes lays from 4 to 6 eggs in a clutch, most often 5.

B. Seasonal abundance

V. c. celata - Burleigh (1942), dissappeared as soon as cold wave hit. Did not regain normal numbers during the remainder of winter.

C. Habitat density figures

Franzreb (1976) reported densities in mixed-coniferous forest, White Mountains, Arizona, elevation 2667-2805 m. Transect: 2.2/100 ha. Spot-map: 6.6/100 ha.

Vermivora celata (con't.)

II INTERSPECIFIC INTERACTIONS

V. c. celata - Bent (1953) reported often seen singly or with small groups of warblers of other species.

A. Parasitism

Payne (1976) noted very commonly parasitized by cowbirds.

V. c. orestera - Friedmann (1971) reported host for Molothrus ater artemisiae.

IX STATUS

A. Past population trends

Hunt and Hunt (1974) noted may have been driven to extinction by habitat destruction by fire and introduced rabbits.

B. Present population status

Jones and Diamond (1976) noted one pair bred on Santa Barbara Island.

C. Environmental quality: adverse impacts

Taylor and Anderson (1973) reported 2 adults males and 1 unsexed immature bird killed by collision with tower.

Vermivora celata (con't.)

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VIRGINIA'S WARBLER
Vermivora virginiae

I TAXONOMY

A. Type description

Helminthophaga virginiae - AOU (1957) Baird, Cassin, and Lawrence, Birds North America, 1860. Cantonment (= Fort) Burgwyn, New Mexico.

B. Current systematic treatments

Hellmayr (1935) recognizes no races of Vermivora virginiae whose range is given as follows: Rocky Mountains from Nevada, Utah, and northern Colorado south to southern Arizona (Santa Catalina Mountains) and north-eastern New Mexico; winter in Mexico south to Morelos, Guerrero, Michoacan and Jalisco.

II DESCRIPTION

A. External morphology of adults

Ridgway (1902) gives detailed descriptions of plumages and measurements of adults and nestlings.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "breeds from central Nevada, southeastern Idaho, northeastern Utah, and central northern Colorado south to southeastern California, southern Nevada, central and southeastern Arizona, and central-northern New Mexico. Winters from Jalisco and Guanajuato south to Morelos and Guerrero; migrant in western Texas; casual in migration to southwestern California, eastern Colorado, western Kansas, Coahuila, and San Luis Potosi." Austin and Rea (1976), "... probably another irregular breeder in the mountains of southern Nevada."

B. California distribution of the species

Grinnell and Miller (1944), "status - rare summer resident in mountains of southeastern border of state." Known stations - McCloud Camp, 9200 feet Mono County August 1, 1917; Clark Mountain, 7000 feet, transition zone, eastern San Bernardino County, May 20, and 24, 1939; near Lemon Grove; San Diego County, September 3, 1931 (Grinnell and Miller, 1944). First record of V. virginiae for California: September 3, 1931 near Lemon Grove, east of San Diego, California by Frank F. Gander (Huey, 1932). Grinnell and Miller (1944), "status - rare summer resident in mountains of southeastern border of state."

C. California desert distribution

Johnson (1976) noted small, isolated breeding populations scattered along Nevada-California border: Wassuk Range, Mineral County, Nevada; Grapevine

Vermivora virginiae (con't.)

Mountains, and White Mountains, Mono and Inyo Counties, California; Clark Mountain and in the San Bernardino Mountains in southern California. Miller and Russell (1956) noted breeding in Cottonwood Creek basin, Mono County, California at 9500 feet.

D. Seasonal variations in distribution

Bailey and Niedrach (1938) reported restricted to transition zone in summer. Huey (1936), "... may be more common than the specimens collected would indicate." Small (1974), "seasonal status - rare spring transient in eastern portion of state; uncommon fall (September - November) transient in coastal southern California; rare summer visitor to limited breeding grounds on Clark Mountain, eastern San Bernardino County and in the White Mountains of Inyo County." Summer resident (Linsdale, 1951).

IV HABITAT

A. Biotopic affinities

Bent (1953) noted shy, retiring species, spends most of its time in thick underbrush. Constantly in motion. Abundant along valley streams, among cottonwoods, willows, and sometimes pines during spring migration. Grinnell and Miller (1944) reported open growth of pinons and white firs with tracts of shrubs between trees. Service berry, snowberry and currant bushes provide necessary plant cover near ground. Marshall (1957) noted in pine-oak areas, occupied a mixture of pines, oaks, and bushes of any kind. Preferred habitat is deciduous brush close to forest (Marshall, 1957). Johnson (1965) cited common between 7500 feet and 8400 feet: mixed woodland and thickets of small white firs, mahogany, aspen, currant and squawbush being occupied. Less numerous from 7600-8200 feet in Spring Range in mahogany, pinon juniper and Gambel oak. Hubbard (1965), "... fairly common in brushy growth in riparian spruce woodland, along with V. c. orestera and in the pine-fir ecotone, especially where Gambel oak occurred." Linsdale (1951), "... numerous in pinon-juniper covered slopes of the mountains." Miller and Russell (1956), "... fairly common in mountain mahogany habitat." Monson (1942) noted usually restricted to transition zone during breeding season. Howard (1899), "common in the pine regions, not lower than 5000 feet."

B. Altitudinal range

Dawson (1923) reported never seen below 5000 feet level.

C. Territory requirements

Nest sites - Bent (1953) notes nests on ground, well concealed. Howard (1899) reported nest placed on ground, under a bush or tuft of grass. Howard (1899), "nest site: on a side hill, under a tuft of grass at an elevation of 7000 feet." Oberholser (1974) notes nests on mountain slopes, mesas, and along streams; in low oak or other scrub, or more open brush; sunk in a depression on the ground, well concealed in grass or under branches of bush. Judson (1898), reported nest on ground, under a bunch of grass.

Vermivora virginiae (con't.)

Small (1974), "habitat - for breeding, arid coniferous forest of chaparral, white fir, pinon pine and juniper." Dawson (1923), "... nest is placed upon the ground, among the pine needles or in the shelter of nodding grasses."

D. Seasonal changes in habitat requirements

Bent (1953) reported in summer found among scrub oak brush on hillsides.

V FOOD

A. Foraging areas

Marshall (1957), "Most foraging was in low bushes, either of riparian or chaparral vegetation, such as Prunus emarginata, Robinea, or manzanita." Grinnell and Miller (1944), "singing and foraging of the males takes place at middle heights in tops of larger bushes or in the trees." Fed in tall yellow pines (Huey, 1936).

B. Foraging strategies

Marshall (1957) noted fed on insects grasped from fine twigs and leaves. Picked insects from willow catkins and twigs. Bent (1953), "Has been seen foraging on the ground, as well as in the foliage, and flying up into the air to capture insects on the wing."

VI REPRODUCTION

A. Nesting comments

Johnson (1976), "... strongly allopatric during the breeding season." Bent (1953) reported egg dates: May 17 - June 26. Bailey and Neidrach (1965) noted females build the nests. Incubation time: approximately 12 days (Bailey and Neidrach, 1965).

VII POPULATION PARAMETERS

A. Clutch size

Bent (1953) noted eggs: 3 to 5, usually 4. Howard (1899) reported clutch size = 4 eggs. Oberholser (1974) cited clutch size: 3-5, usually 4. Clutch size: 4 eggs (Judson, 1898).

B. Seasonal abundance

Rockwell and Wetmore (1914) noted found in family parties in the late summer.

C. Habitat density figures

Marshall (1957) reported 23 pairs/singing males/40.9 miles (linear) of pine oak woodland including 5 pairs/singing males/14.2 miles (linear) of

Vermivora virginiae (con't.)

riparian. Pairs/mile: where species should occur... 2/mile - pine oak and 1/mile - riparian. Marshall (1957), "Some territories of males were 150 to 200 yards long and were bunched together in 'colonies'. A lone territory in Bear Canyon was 100 by 150 yards and thus was no larger than those in groups." Two nests 300 yards apart (Judson, 1898).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Jays steal both eggs and young (Bent, 1953). Nest destroyed by snakes and jays; the jays stealing both eggs and young (Howard, 1899). Bent (1953) reported nests destroyed by jays and snakes.

IX STATUS

no information located

Vermivora virginiae (con't.)

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Vermivora virginiae (con't.)

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LUCY'S WARBLER
Vermivora luciae

I TAXONOMY

A. Type description

Helminthophaga luciae - AOU (1957) J. G. Cooper, Proc. California Acad. Sci., (ser. 1) 2, sic. 8, Dec. 1861. Fort Mojave, near latitude 35° in the Colorado Valley (Arizona).

B. Current systematic treatments

Hellmayr (1935) recognizes no races of Vermivora luciae whose range is given as follows: Valleys of the lower Colorado and Gila Rivers (lower Sonoran zone) from Santa Clara Valley, Utah, south through New Mexico, Arizona, southeastern California, and extreme northern lower California; winters in western Mexico south to Jalisco.

II DESCRIPTION

A. External morphology of adults

Ridgway (1902) gives detailed descriptions of plumages and measurements of adults and nestlings.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "breeds from southern Nevada (Fort Mojave Indian Reservation), Utah (St. George, San Juan River), and southwestern Colorado (Four Corners) south to northeastern Baja California (10 miles west of Pilot Knob), northern Sonora (Colorado River, Magdalena, Oposura) and southwestern New Mexico (Cliff, Redrock); casual in breeding season in the Colorado desert of California (Mecca, Silsbee). Winters from Jalisco (Bolanos) south to Guerrero (Chilpancingo). Casual in western Texas (El Paso region)."

B. California distribution of the species

Grinnell and Miller (1944), "geographic range - entire extent of Colorado River Valley within state. Occurs at least occasionally in Imperial and Coachella Valleys,..." Grinnell and Miller (1944), "status - common summer resident in suitable habitat in extreme southeastern California, from mid-March on through summer." Small (1974), "... range in California - breeds in lower Colorado River Valley, north in eastern Inyo County in suitable habitat along Amargosa River, and as far north as Scotty's Castle in Death Valley National Monument; westernmost breeding outpost is Morongo Valley, San Bernardino County."

C. California desert distribution

Wauer (1962), "A single male was observed singing from a mesquite thicket at the Eagle Borax Works on May 15." Linsdale (1951), "Summer resident

Vermivora luciae (con't.)

along the Colorado River, April to September." Common summer resident in the Mojave desert biome (Behle, 1976). Bent (1953), "On the California side, both at Riverside Mountain and above Blythe, Lucy warblers were numerous and very closely confined to the narrow belt of mesquite, J. Grinnell, 1914 notes."

D. Seasonal variations in distribution

Small (1974), "seasonal status - uncommon summer visitor, mid-March to late August to (in?) breeding area; very rare fall transient along coast from Monterey County south." Migration arrival date (early) Mecca, California - March 29 (Bent, 1953).

IV HABITAT

A. Biotopic affinities

Small (1974), "habitat - for breeding, mesquite thickets and nearby riparian woodland." Grinnell and Miller (1944), "The mesquite clumps afford natural cavities and bark shelters essential for nest sites. Abundant forage surface is provided by twigs and foliage of these trees." Grinnell and Miller (1944), "Mesquite thickets almost exclusively; these warblers range only locally and temporarily into riparian growth and into palo verdes and ironwood." Most numerous in groves of mesquite not far from water (Gilman, 1909). Oberholser (1974), "It is a bird of extensive mesquite groves and of willows and cottonwoods along streams that course through hot deserts." Sole American wood warbler that nests mainly on the lower Sonoran deserts of the southwestern United States and northwestern Mexico (Oberholser, 1974). Haller (1951), "... many were noted in willows bordering irrigation canals,..." Howard (1899), "common along river bottoms... especially in the mesquite and willow thickets."

B. Altitudinal range

Grinnell and Miller (1944) noted life zone = lower Sonoran and stations of record all below 600 feet elevation.

C. Territory requirements

In Bent (1953), "J. Grinnell, 1914, notes the singing males, each representing the forage area and nesting site of a pair, were spaced out very uniformly, so that an estimated strip of mesquite of about 200 yards in length belonged to each."

Nest sites - Bent (1953) reported nest sites were from 18 inches to 15 feet above the ground, averaging 6.5 feet. Nests in mesquite, palo verde, ironwood and catsclaw; also nest sites: in natural cavities under loose bark in woodpecker holes in deserted Verdin's nests (Bent, 1953).

Gilman (1909) noted one pair had a nest in a Texas woodpecker hole in a palo verde tree about 15 feet from the ground. Four general types of

Vermivora luciae (con't.)

nesting sites used: (1) in natural cavities, (2) under loose bark, (3) in woodpecker holes, and (4) in deserted Verdin's nests. Locality: along the Gila River in Arizona. Of 23 nests observed near the Gila River in Arizona: 12 were in natural cavities, 4 under loose bark, 4 in woodpecker holes, and 3 in Verdin's nests. A natural cavity used for nesting was of the following types - a) where a limb had broken off, b) a crack made by a large branch splitting from the trunk, or c) a decayed spot furnishing a sufficient hollow. In all cases the nest site was sheltered from the sun. "Of the nests observed, 15 were in mesquites, 5 in palo verde, 2 in iron-wood, and one in catsclaw." Nests were usually near water but some were 2 or 3 miles away from water. Nest sites averaged six and one-half feet from the ground, the lowest being 18 inches and the highest 15 feet.

Swarth (1905) reported nests from 3 to 15 feet above the ground. Nests found in old woodpecker holes, in natural crevices, behind loose bark, in old Verdin's nests (Swarth, 1905). Howard (1899) noted nest height from 2 to 20 feet. Oberholser (1974) reported nest: on mesas and slopes but chiefly in valleys; in desert brush, thickets along streams, and fringes of timber along rivers; in bush tree or giant cactus. Nest height 2-20 feet (Oberholser, 1974). Dawson (1923) noted nesting in the re-lined nest of a house finch.

V FOOD

A. Food preferences

Bent (1953), "... largely, if not wholly, insectivorous."

B. Foraging area

Oberholser (1974), "Preferred foraging is in mesquites..."

C. Foraging strategies

Oberholser (1974) reported gleans insects.

VI REPRODUCTION

A. Nesting phenology

Bent (1953) noted female does most of the work in nest building. Evidence suggests that at least two broods are raised per season and that the incubation and brooding are done entirely by the female. Shy about the nest with egg date - April 22 to June 27 in Arizona.

Gillman (1909) reported female seems to do all the work of nest building, the male sometimes accompanying her on trips to and from the nest but performing no nest building activities. Earliest completed nest was April 10, the latest May 15 (Gillman, 1909). Swarth (1905), "Several broods are probably raised, as unfinished nests and uncomplete sets were found at the same time that broods of young as large as the adults were seen flying about."

Vermivora luciae (con't.)

B. Post-breeding behavior

Gilman (1909) reported Lucy's warblers stayed around in family groups in mesquite trees in June and July after the young were fledged.

VII POPULATION PARAMETERS

A. Clutch size

Oberholser (1974) noted clutch size: 3 to 6, usually 4 eggs. Bent (1953) reported eggs: 3 to 7, usually 4 or 5 in set. Clutch size = usually 4 or 5 eggs, but often 3 are laid and 2 sets of seven have been found (Howard, 1899). Gilman (1909) noted clutches of 3, 4, and 5 eggs were found.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Dawson (1923) reported nests (eggs and young) preyed on by Gila woodpeckers, lizards, snakes, rats. Howard (1899), "Many nests are destroyed by wood-rats and snakes." Bent (1953), "... many nests are destroyed by wood-rats and snakes as noted by Howard, 1899." In Bent (1953), "Dawson, 1923, notes eggs are eaten by Gila woodpeckers."

B. Parasitism

Bent (1953), "Dawson, 1923, notes nests parasitized by cowbirds."

IX STATUS

A. Environmental quality: adverse impacts

Grinnell and Miller (1944), "Restriction in range and reduction of numbers with destruction of mesquite thickets is noticeable in some sections."

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BLACK-THROATED GRAY WARBLER

Dendroica nigrescens

I TAXONOMY

A. Type description

Sylvia nigrescens- AOU (1957) J. K. Townsend, Journ. Acad. Nat. Sci., Philadelphia, 7, pt. 2, 1837. No locality given = near Fort William, (Portland) Oregon.

B. Current systematic treatments

Hellmayr (1935) recognizes one species (no races) of Dendroica nigrescens whose range is given as follows: North America, from southern British Columbia, Nevada, northern Utah, and northwestern Colorado south to northern lower California, southern Arizona, and southern New Mexico; winters in southern lower California and in Mexico, from Durango to Michoacan, Vera Cruz, and Oaxaca; accidental in Massachusetts.

II DESCRIPTION

A. External morphology of adults

Ridgway (1902) gives detailed descriptions of plumages and measurements of adults and young.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "breeds from southwestern coastal British Columbia, western Washington, central Oregon, southwestern Idaho, northern Utah, southwestern Wyoming and northwestern and central Colorado south in the mountains to northern Baja California, northwestern, central, and southeastern Arizona and eastern and southern New Mexico. Winters from coastal and southern California and southern Arizona south to southern Baja California, southern Guerrero, Morelos and Vera Cruz, casually to Guatemala. Casual in southern and western Texas and southeastern Louisiana. Accidental in Ohio, Ontario, New York, and Massachusetts.

B. California distribution of the species

Grinnell and Miller (1944), "geographic range - in breeding season, all sections of state with exception of lower deserts of the southwest and the Islands; however, occurrence limited in the main to mountains, foothills, or plateaus and to particular plant associations. Sparse or absent in immediate vicinity of coast. In migration, widespread."

C. California desert distribution

Grinnell (1934) reported collected a "mile or so" west of Furnace Creek Ranch at -200 feet on October 21. Wauer (1964) notes breeds in the pinon-

Dendroica nigrescens (con't.)

juniper woodlands in Panamints. Wauer (1964) notes known to occur in the area of Death Valley National Monument.

D. Seasonal variations in distribution

Grinnell and Miller (1944), "status - summer resident from late April until August. Migrates chiefly in April and September, but also in late March and early May, and in October. Common in summer in suitable habitat; fairly common as a migrant. A few individuals remain in the state through the winter." Small (1974), "seasonal status - spring and fall transient and summer visitor, mid-April to October." Bent (1953) reported migration: early date of spring arrival, Grass Valley, California, March 24. Late date of departure: Diablo, California, November 11.

IV HABITAT

A. Biotopic affinities

Small (1974), "... habitat - for breeding, oak woodland, mixed oaks and coniferous forest, pinon-juniper woodland; otherwise, lowland thickets, woodlands, broken forest." Grinnell and Miller (1944), "The common requirement in the diverse areas where this warbler occurs seems to be fairly dense foliage, often stiff, harsh, and semi-xerophytic, which either through local exposure or by reason of the prevailing summer climate in the region is warm or at least moderately dry. Upper Sonoran and transition zones. Dawson (1923), "breeds in lower transition and high upper Sonoran zones practically throughout the state." Bent (1953) noted prefers hardwood and underbrush (oases, scrub oak, pinyon, juniper, manzanita) in the summer. Bent (1953) reported in California lives in chaparral (deer brush, wild lilac, scrub oak) and in humid coast districts, in evergreens (Chapman, 1907). In Bent (1953), Grinnell, 1908, notes in the San Bernardino Mountains, confined to golden oak belt during breeding season. Johnson (1965), "... unusually abundant in the Sheep Range where it occurred from 6500 feet in pinon woodland to 9200 feet in bristlecone pines. Mixed growth of pinon, mahogany, white fir, and ponderosa pine seemed especially favored." Linsdale (1951), "inhabits mainly the pinon covered ridges on the lower mountain slopes." Huey (1926), "abundant nester in the oak belt..."

B. Altitudinal range

Grinnell and Miller (1944) noted altitudinal range: 300-7500 feet. Bent (1953), "J. B. Dixon notes this bird breeds sparingly from 2500 feet to the tops of our mountain ranges in San Diego, Riverside, and San Bernardino Counties." In New Mexico, found in summer between 5500 and 8000 feet in oak and pinyon pine country (Bent, 1953). In Arizona found between 4000 and 7000 feet, in oak belt, about halfway up canyons, among scrub oak and manzanita (Bent, 1953). Howard (1899) reported found from 4000 to 9000 feet, but more common in the oak belt from 4000 to 7000 feet.

C. Territory requirements

Nest sites - Grinnell and Miller (1944) noted nesting spheres: the tops of the trees of small stature which the species frequents (oaks, conifers,

Dendroica nigrescens (con't.)

junipers, pinons). Bent (1953) reported nests in fir trees, 7 to 50 feet above the ground; oaks from 3 feet 3 inches to 25 feet; and manzanita. Also in Ceanothus. Wauer (1964) noted nest site - 20 feet up in a pinon at 7800 feet in Panamint Mountains. Johnson (1965) reported nest site 7 feet up in a pinon at 9000 feet on June 9. Pemberton (1910), noted nest built among the leaves of a fir, at the end of a limb about 30 feet above the ground. Deserted nest found 4 feet up in a cedar at Fyffe, El Dorado County, California, at an elevation of 3700 feet (Ray, 1914). Bowles (1902) notes nests from 3 feet 3 inches above the ground to 25 feet above the ground in oaks and fir. Bowles (1902) reported nest site six feet up in a manzanita bush in patch of manzanita covering about 3 acres. Oberholser (1974), "nest: on slopes or mesas; in open woodlands or denser tree growths, thickets of alders and willows along streams, manzanita, chaparral, in pines of forests, sometimes in thickets of oaks, ordinarily on dry land." Nest height 4-50 feet above ground (Oberholser, 1974). Many nests placed in dense thickets of scrub oak in the forks of the larger limbs (Howard, 1899). Nest placed in white oaks, sycamores, and high up in pines (Howard, 1899).

D. Seasonal changes in habitat requirements

Oberholser (1974), "summer inhabitant of juniper-pinon-oak scrub growing at moderate altitudes on slopes, foothills and in canyons."

V FOOD

A. Food preferences

Bent (1953), "Evidently, mainly, if not wholly, insectivorous." Eats small green caterpillars from oak trees in spring (Bent, 1953). Bowles (1902) noted eats small green caterpillars which are present on oak trees. Feeds largely on insects (moths, butterflies, caterpillars, dragonflies, leaf-eating and June beetles, weevils, grasshoppers, true bugs, and ants) along with a few spiders and leaf galls (Oberholser, 1974).

B. Foraging areas

Grinnell and Miller (1944) noted foraging spheres: the tops of the trees of small stature which the species frequents (oaks, conifers, junipers, and pinons). Marshall (1957) noted like to sing and forage on sunny slopes. Marshall (1957), "... sing and feed in practically all kinds of bushes and trees, but they prefer scrubby oaks and junipers. They often feed in pines and are abundant in pine-oak areas." Oberholser (1974) reported forages in tops of tall trees, in lower parts of trees, even in bushes or thickets.

C. Foraging strategies

Marshall (1957) reported picks caterpillars and other insects from leaves and twigs of trees as it hops rapidly through the foliage. Marshall (1957), "Large insects are swallowed with difficulty after considerable banging (of insect) against a branch." Bent (1953), "... not one of the most active wood warblers."

Dendroica nigrescens (con't.)

VI REPRODUCTION

A. Territorial behavior

Marshall (1957) noted territorial strife is conspicuous, with frequent fights and competitive singing.

B. Nesting phenology

Bent (1953) reported egg dates, in California: May 1 to July 3. Incubation probably performed by the female entirely. Both parents probably share in the feeding of the young (Bent, 1953). Bowles (1902) notes female did all gathering of nesting materials and nest building, while male "scolded". The male does not assist at nest building or incubation (Bowles, 1902). Dawson (1923), reported nesting season: last week in May and first week in June. Wheelock (1904) noted breeding season: May and June.

C. Post-breeding behavior

Huey (1926), "After the young are on the wing they go higher into the coniferous forests."

VII POPULATION PARAMETERS

A. Clutch size

Bent (1953) reported eggs: from 3 to 5, usually 4. Oberholser (1974) noted clutch size: 3-5, usually 4 eggs. Wheelock (1904) cites clutch size: 3 or 4 eggs.

B. Habitat density figures

Marshall (1957), "In some places, stationary singing males, which feed between songs, are little over 200 yards apart." Marshall (1957) noted 142 pairs, singing males/40.9 miles (linear) of pine oak woodland including 11 pairs, singing males/14.2 miles (linear) of riparian; pairs/mile: where species should occur... 7 pairs/mile - pine oak and 1 pair/mile - riparian.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1953) reported jays, crows, snakes eat eggs and young.

B. Parasitism

Friedmann (1971) noted host to Molothrus ater obscurus and Molothrus ater artemisiae.

IX STATUS

no information located

Dendroica nigrescens (con't.)

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YELLOWTHROAT
Geothlypis trichas

I TAXONOMY

A. Type description

Geothlypis trichas occidentalis - AOU (1957) Brewster, Bull. Nuttall Orn. Club., 8, No. 3, July 1883. Truckee River, Nevada.

Geothlypis trichas scirpicola - AOU (1957) Grinnell, Condor, 3, No. 3, May 1901. El Monte, Los Angeles County, California.

B. Current systematic treatments

G. t. occidentalis - Hellmayr (1935) recognizes 11 races of Geothlypis trichas including occidentalis whose range is given as follows: "Western North America from extreme southeastern Alaska, central British Columbia, and Vancouver Island, central Alberta, and the western portion of the Great Plains south to south-central California and southern Nevada; winters through lower California, in western Mexico to Nayarit, and even in western Guatemala."

G. t. scirpicola - Hellmayr (1935) recognizes 11 races of Geothlypis trichas including scirpicola whose range is given as follows: Fresh water marshes of southern California and in the Colorado River drainage. East to Washington County, Utah, and up the Gila and Santa Cruz Rivers at least to Tucson, Arizona, also on the western side of lower California to latitude 30° (apparently resident).

Oberholser (1974) recognizes twenty subspecies. Behle (1976) noted there is intergradation between G. trichas occidentalis and G. trichas scirpicola in some areas. Grinnell and Miller (1944) reported G. t. occidentalis intergradates with G. t. scirpicola in central San Joaquin Valley; Owens Valley, Inyo County.

Synonomies - G. t. occidentalis, Grinnell and Miller (1944) reported common names: Maryland yellowthroat; Delafield yellowthroat; Pacific yellowthroat; tule yellowthroat.

II DESCRIPTION

A. External morphology of adults

G. t. occidentalis - Ridgway (1902) gives detailed descriptions of plumages and measurements of adults.

G. t. scirpicola - Ridgway (1902) gives no description of plumages or measurements. Mentioned under Geothlypis trichas arizela.

B. Distinguishing characteristics

Intraspecific - Behle (1950) reported clines (character gradients) exist in western populations of yellowthroats. Females dull and inconspicuously

Geothlypis trichas (con't.)

colored as compared to the males. Females inferior in size. Females less geographically variable in color characters than males.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Southeastern Alaska, southern Yukon, northern Alberta, central Saskatchewan, central Manitoba, central and northeastern Ontario, central Quebec, and southwestern Newfoundland south to northern Baja California, Colima, Oaxaca, Vera Cruz, the Gulf coast of the United States, and southern Florida. Winters from northern California, southern Arizona, southern Texas, the Gulf states, and South Carolina south to Oaxaca, the Canal zone, and Puerto Rico."

G. t. occidentalis - AOU (1957), "Breeds from eastern Oregon (Hay Creek, Beulah), southern Idaho (near Jordan Valley, American Falls), extreme southwestern Wyoming (Fort Bridger), central northern and eastern Colorado (Windsor, Jackson Reservoir, Wray), and western Kansas (Coolidge, Pratt) south to central eastern California (Little Lake, Death Valley), south-central Nevada (Pioche), central southern Utah (Kanab), northeastern Arizona (Tuba City, Snowflake), northern New Mexico (Espanola, Santa Rosa) and northwestern Texas (Canadian). Winters from southeastern California (Palo Verde), western and southern Arizona (Topock, Tucson), central Nuevo Leon (Monterrey), and southern Texas (Brownsville) south to southern Baja California (San Jose del Cabo), Guerrero (Coyuca), Oaxaca (Cuicatlan), and Guatemala (Ocos, Panajachel)."

G. t. scirpicola - AOU (1957), "Resident in southern California (Santa Barbara, Buena Vista Lake, Mecca), southeastern Nevada (Hiko), southwestern Utah (St. George), and westernmost Arizona (Colorado River) south to northern Baja California (Rosario, Colorado delta) and extreme northwestern Sonora."

B. California distribution of the species

Small (1974) reported breeding range - length of state in suitable habitat including eastern and southeastern deserts and Sierra Nevada.

G. t. occidentalis - Dawson (1923), "Common migrant throughout the state; remains to breed in the vicinity of fresh water marshes (occurring below the Boreal zone) from western central California (except the San Francisco Bay region) and the Death Valley region north to the Oregon line."

G. t. scirpicola - Dawson (1923), "Common resident on fresh water marshes of the Pacific lowlands of the San Diegan district; San Diego, Orange, and Los Angeles Counties northwest to Santa Barbara, and valley of the south fork of the Kern River, Kern County; also along the lower Colorado River from Riverside to the Mexican line according to Grinnell."

Geothlypis trichas (con't.)

C. California desert distribution

Behle (1976) noted common breeder in Mojave desert biome. Wauer (1962) reported known to occur in the area of Death Valley National Monument. Carter (1937), "... sly inhabitant of the sedge beds..."

G. t. occidentalis - Miller and Russell (1956), "Exceptionally high breeding station" at 6700 feet on Wyman Creek. Van Rossem (1911), "fairly common but seemed to be confined to the tules."

D. Seasonal variations in distribution

Small (1974), "Seasonal status - resident, spring and fall transient, summer visitor... Resident in San Francisco Bay area and in southern California; elsewhere, transient and summer visitor."

G. t. occidentalis - Grinnell and Miller (1944), "Status - present in three seasonal roles: summer resident from mid-April until September in northern and central parts of state, except San Francisco Bay region; winter visitant (or permanent resident) in central and southern California; transient throughout state, chiefly in April and September common as a summer resident in restricted areas of suitable habitat; as a migrant common, but in winter scarce."

G. t. scirpicola - Howell (1923) noted regularly migrates through, or winters in the lower Colorado River Valley.

IV HABITAT

A. Biotopic affinities

Udvardy (1958) classifies G. trichas as "limnic" (aquatic inland species, and those of wet succession zones, as long as the plant community is a member of a hydrosere, and the birds does not require trees for nesting). The only warbler so classified.

G. t. occidentalis - Grinnell and Miller (1944), "The sphere of activity is within six feet of the water and principally within three feet." Plant associations meeting habitat requirements: 1. growths of cattails, 2. tules and other sedges (especially where matted and tangled), 3. thickets of young willows, and 4. blackberry vines, accompanied by nettles and dock. Life zones in summer: lower Sonoran and upper Sonoran and locally in transition. Gabrielson and Jewett (1924), "Common in river bottoms." Linsdale (1951) noted occupies low parts of the valleys in the state of Nevada.

G. t. scirpicola - Grinnell and Miller (1944), "Status - resident, common in marshy places. Marshy areas, in situations similar to those occupied by G. t. occidentalis." Life zones: lower Sonoran and upper Sonoran. Chapman (1917) reported permanent resident of fresh water tule beds in California. Bent (1953), "The ecology and nesting habits of the tule and western yellowthroats are similar."

Geothlypis trichas (con't.)

B. Altitudinal range

G. t. occidentalis - Grinnell and Miller (1944) reported nesting station altitudes range from 260 feet below sea level (Bennett's Well, Death Valley, Inyo County) to 6500 feet (Mono Lake, Mono County, California). Chapman (1917) noted ranges to 6000 feet.

G. t. scirpicola - Grinnell and Miller (1944) reported altitudes of occurrence: chiefly "below 1500 feet, but birds may range up to 4200 feet as at Julian, San Diego County."

C. Territory requirements

Nest sites - Wauer (1964) cited nests in the canyon area below the pinon-juniper woodlands, utilizing the spring areas, in one of the best watered zones in the Panamints.

G. t. occidentalis - Dunlavy (1935) reported nested in "high bush zone" (5-15 feet). Grinnell and Miller (1944) noted habitat for nesting: low, thick tangles of plant growth in or about fresh- or brackish- water marshes and sloughs; extremely small areas of flooded ground in river bottoms or along lake shores may suffice.

V FOOD

A. Food preferences

Salt (1957) classified as "foliage-insect" niche.

G. t. occidentalis - Bent (1953) reported food: Hymenoptera 35%, Hemiptera 28%, Coleoptera 15%, Lepidoptera 5%, Diptera 12%, and spiders 4%. "...practically wholly insectivorous."

B. Foraging areas

Morse (1967) noted does not forage regularly above the understory.

G. t. occidentalis - Grinnell and Miller (1944), "Important is continuous cover for concealment in foraging down to the mud or water surfaces."

VI REPRODUCTION

A. Nesting phenology

G. t. occidentalis - Dawson (1923) noted breeding season: May - June.

Bent (1953) reported young hatched naked. Feeding was performed by both parents. Incubation was performed by female. Nesting period from mid-April until June.

Geothlypis trichas (con't.)

B. Length of incubation period

Kendeigh (1945), "The incubation period at one nest was 12 days long."

G. t. occidentalis - Bent (1953) noted incubation period as 14 days.

C. Length of nestling period

Bent (1953) reported young are ready to leave the nest after 10 days.

VII POPULATION PARAMETERS

A. Clutch size

G. t. occidentalis - Bent (1953) noted eggs: 3 to 5, usually 4. Chapman (1917) reported clutch size 4 or 5 eggs, usually 4.

B. Habitat density figures

Kendeigh (1945) reported territories less than one acre in size. Erickson (1948) noted a) 2 breeding pairs on 35 acres of islands and 5.7 breeding pairs/100 acres of islands; b) 0 breeding pairs on 47.48 acres of dykes and marsh. Walcheck (1970) reported 13 pairs/100 acres of cottonwood forest. Salt (1957) cited willow-sedge swamp with 51.7/100 acres and scrub-meadow with 5.0/100 acres.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Owre (1967) reported chuck-will's-widow died trying to eat yellowthroat, which also died. Munro (1940) noted Accipiter velox eats G. trichas. Rand (1943) cited bass (Huro salmoides) was caught with remains of a yellowthroat in its stomach.

B. Parasitism

Young (1963) reported of 88 total nests, 37 (43%) were parasitized.

IX STATUS

A. Present population status

Eaton (1953) reported in winter seen in loose aggregations rather than compact flocks. Oberholser (1974) noted large migrations are nowadays diminished. Warming and drying of the climate, accelerating disturbance and destruction of habitat, increasing pollution are probably "major factors in yellowthroat decline".

B. Population limiting factors

Taylor and Anderson (1973) noted 2710 birds killed by collision with tower.

Geothlypis trichas (con't.)

C. Environmental quality: adverse impacts

Avery, Springer, and Cassel (1976) noted frequently killed at towers. Schnell (1964) reported disappeared after first week of exposure to high level neutron-gamma radiation released from 10 megawatt, air shielded nuclear reactor.

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HOODED ORIOLE
Icterus cucullatus

I TAXONOMY

A. Type description

Icterus cucullatus - AOU (1957) Swainson, Phil. Mag., n.s., 1, No. 6, 1827. Temiscaltiepec, state of Mexico, Mexico.

Icterus cucullatus nelsoni - AOU (1957) Ridgway, Proc. U.S. Nat. Mus., 8, 1885. Tucson, Arizona.

B. Current systematic treatments

Mayr and Short (1970), "Its relationships are not clear, but may be with dominicensis (West Indies, Middle America) or with graduacauda." Phillips, Marshall, and Monson (1964) noted although currently thought of as two races, Icterus cucullatus nelsoni and Icterus cucullatus californicus, on the basis of Van Rossem's splitting in 1945, the California bird is merely the sooted town version of the Arizona race I. c. nelsoni (Ridgway).

I. c. californicus - Paynter (1968) does not recognize I. c. californicus as a race of I. cucullatus.

Synonomies - Huey (1944) reported egg collectors commonly used name: banana oriole.

I. c. californicus - Pendulinus californicus; Icterus cucullatus; Icterus californicus; Icterus cucullatus nelsoni; and Icterus nelsoni (Grinnell and Miller (1944)).

I. c. nelsoni - Pendulinus californicus; Icterus cucullatus restrictus (Paynter, 1968). Icterus cucullatus; Pendulinus cucullatus; and Icterus nelsoni (Ridgway, 1902). Palm leaf oriole (Grinnell, 1915). In Bailey (1910) Bendire calls I. c. nelsoni the Arizona hooded oriole; also known in southern California as palm-leaf oriole.

C. Recent taxonomic revisions

AOU supplement (1944) noted Icterus cucullatus nelsoni becomes Icterus cucullatus californicus from Pendulinus californicus; Lesson Rev. Zool., 7, 1884. California.

I. c. californicus - AOU supplement (1946) noted the recognition of I. cucullatus; is restricted to birds from southern California to northwestern Baja California with the name of California hooded oriole.

I. c. nelsoni - AOU supplement (1946) reported an Arizona hooded oriole restored to list for birds from southeastern California and southwestern Utah to southwestern New Mexico.

Icterus cucullatus (con't.)

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966) noted only black and yellow male oriole in its range. Pattern of tail like that of redstart. Black throat of first year male is poorly defined in contrast to first year orchard and hooded's. Female also like orchard and hooded females but bill is straight and heavy and back is prominently streaked. Peterson (1969), "male: orange and black with a black throat and orange crown or 'hood'. The only common U.S. oriole with an orange crown. Female: black-olive gray head and tail is more yellowish, underparts yellowish, wings with two white bars."

I. c. nelsoni - Ridgway (1902) gives detailed description of male, female, both adult and young.

B. External morphology of subadult age classes

I. c. nelsoni - Chapman (1923) noted nestling of both sexes resemble adult female, after partial juvenile molt male still resembles female until spring when it acquires a black throat and lores. This is first breeding plumage until second fall, when it passes into adult male winter plumage. Wheelock (1920) gives description of young adult.

C. Distinguishing characteristics

Interspecific - Robbins, Bruun, and Zim (1966), "Golden crown and solid black tail separate the adult male from all but the much larger Lichtenstein's (oriole). Female is greener than female and young of Baltimore oriole and has more rounded tail." Sutton and Pettingill (1943) noted I. cucullatus is smaller than the 9 inch Icterus gularis tamauliperisis. Peterson (1969), "female similar to female northern oriole but underparts entirely yellowish. Immature male resembles female but throat is black. Other similar species: female and immature northern orioles have whitish belly; bill is shorter, less curved. Immature male orchard oriole is more greenish and has shorter bill."

I. c. nelsoni - Bent (1958) reported similar in size and coloration to western tanager but tail is nearly even instead of graduated, with yellow patches on wings, and black throat. Distinguished from northern and Scott's orioles by solid black tail. Body color is deeper yellow than Scott's, but less orange than northern oriole. Bill is more slender than Scott's and northern orioles. Ridgway (1902) noted similar to I. c. sennetti, but paler and with forehead wholly yellow.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Central California, southern Nevada, central and southeastern Arizona, southern New Mexico, and western and southern Texas south to

Icterus cucullatus (con't.)

southern Baja California, Guerrero, Chiapas, the Yucatan Peninsula, and northern British Honduras."

I. c. californicus - AOU (1957), "Breeds from central California (Solano County, Fresno, Clark Mountains) south to northwestern Baja California. Casual in southern Nevada where it may breed. Winters casually, north to southwestern California (Pasadena). Southern limits of winter range unknown. Accidental in Kansas."

I. c. nelsoni - AOU (1957), "Breeds from southeastern California (Colorado River Valley), central and southeastern Arizona, and southwestern New Mexico south to northeastern Baja California and southern Sonora. Winters from central Sonora, casually from southern Arizona, south to southern Sinaloa. Casual in southwestern Utah and western Texas." Paynter (1968) noted it breeds central California (San Joaquin Valley and San Francisco Bay area), central and southeast Arizona and southwest New Mexico south to northwest and north-central Baja (lat. 28° N.) and southern Sonora. Winters casually from southwestern California and southern Arizona south to Baja California and southern Sinaloa. Bent (1958) noted breeds from southeastern California (Colorado River Valley), central and southeast Arizona, southwestern New Mexico, south to northeastern Baja California, and southern Sonora, Mexico. Casual in southwestern Utah where it may breed. Winters from central Sonora, Mexico, casually to southern Arizona (Tucson) south to Sinaloa.

B. California distribution of the species

I. c. californicus - Grinnell and Miller (1944) reported Coast district from San Francisco Bay south to Mexican border; San Joaquin Valley north to near Modesto; Colorado desert and eastern Mohave desert north to Providence Mountains and Clark Mountains, eastern San Bernardino County. Occasional in Death Valley, Inyo County.

I. c. nelsoni - Michener and Michener (1932) concluded that "may be expected in Pasadena and vicinity any month of the year, but that their occurrences between early September and late March are unusual." Pickwell (1932) noted on July 21, 1930 as unusual, but positive sighting by author. Dawson (1923) reported in lower Colorado River Valley, Colorado desert and San Diegoan district, west to Santa Barbara and Santa Ynez. Wear (1915) reported on May 26, 1915; one male 4 miles west of Fresno; during the week, three more males were seen. Richardson (1908) heard once April 16, 1906; also seen in summer.

C. Desert distribution

Small (1974) noted in lowland areas of southern half of state; numerous winter records.

I. c. nelsoni - Gilman (1935) reported at Furnace Creek Ranch on May 5 in cottonwood trees. Carter (1937) noted male and female in trap for banding on May 2, 1934. Earliest record for 1935: May 15; heard until May 27. No evidence of nesting, but old nests have been found. Gilman (1937), "a bird not regularly seen in the area of Death Valley." Van Rossem (1911) reported one taken on March 28 and one seen later in year; possible an immature.

Icterus cucullatus (con't.)

Sutton and Phillips (1942) noted very common on washes, several pairs seen. Nests under construction seen June 5 and June 13 in southeastern Arizona. Stephens (1903) reported common at Big Sandy Creek and Bill Williams' Ranch only.

D. Seasonal variations in distribution

I. c. nelsoni - Swarth (1904) noted enters mountains only in migrations. Earlier arrival date April 4 (specimens taken in breeding condition). Oberholser (1923) reported spring migration specimens: Tucson, Arizona - average arrival date = March 23, 1909 and earliest arrival date = March 13; Camp Verde, Arizona - average = April 11, 1916 and earliest = April 5; Escondido, California - average = April 1, 1896 and earliest = March 23; Los Angeles, California - average = March 16, 1906 and earliest = March 14; Santa Barbara, California - average = March 26, 1910 and earliest = March 14. The fall migration specimens: Los Angeles, California - average departure date = October 25, 1911 and latest departure date = November 12; and in Tucson, Arizona - average = September 4, 1987 and latest = October 8. Sloanmaker (1913) noted arrival March 21 near Tucson, Arizona. Illingworth (1901) reported arrives in Los Angeles County from April 4 to May 1; males precede females by two weeks at which time nesting begins. Howell (1916) noted summer visitants arriving on March 16. Bent (1958) reported in spring - arrives California late March and arrives in southern Arizona late to mid-April. In fall - leaves end of August; some individuals remain until September.

IV HABITAT

A. Biotopic affinities

Phillips, Marshall, and Monson (1964) noted in large mesquite, palm, walnut, and sycamore associations of Sonoran zones across Arizona. Huey (1944), "... well known association of I. c. nelsoni with fan palms, they are always to be found in the proximity of the wild fan palms in the desert sections of southern California and lower California."

I. c. californicus - Johnson, Bryant, and Miller (1948) noted seen in desert willows. Grinnell and Miller (1944) reported during breeding: broad-leaved woodland along water courses, including canyons and dry arroyos, in native fan palms, willows, cottonwoods and especially sycamores.

I. c. nelsoni - Bent (1958) noted typically in lower Sonoran zone with exclusion of yuccas and junipers (habitat of Icterus parisorum). Prefers well-watered situations, orioles do not seem greatly interested in the water itself, although occasionally they bathe. Commonly frequent low shrubbery, though rarely alighting on ground. Dawson (1923) noted in lower Sonoran zone.

B. Altitudinal range

I. c. nelsoni - Willett (1912) reported seen up to 4000 feet.

Icterus cucullatus (con't.)

C. Territory requirements

Perch site - Bent (1958) noted often perched on roof-tops, hunting for insects.

I. c. nelsoni - Bailey (1910) reported on windmill near house.

Nest site - Wauer (1973) noted on July 12 a nest was found in tamarisk. Ewan (1944) reported common site in native California fan palms, Washington filifera and Washington robusta. Huey (1944) noted palms are the number one choice for nest site. Also Monterey cypress, fan palm, feather palm, banana, tree yucca, cottonwood, walnut, fig, sycamore, mesquite, pepper, eucalyptus, olive, and ash. Dodge (1897) noted nest suspended under a banana leaf. Seibert (1942) reported nesting in Diamond Park, Oakland, 45 feet up in fan palm. Nest of palm fibers and fastened to an underside of one of large outer palm leaves. Small (1974) reported breeds in sycamore woodlands, palm oases, suburbs, parks, cities, farms, ranches, and other places where palms and broad-leaved trees have been planted.

I. c. nelsoni - Lincoln (1917) noted common in cottonwoods; nest on dead yucca stalk, 20 feet from ground. Bailey (1910) reported in southern California the growth of the bird's habit of nesting in fan palms seems to have paralleled the people's habit of planting fan palms in rows in city streets, etc. In summer, author counted in Redlands and San Diego, 40 nests made of palm fiber in fan palms and 12 nests of palm fiber in other trees. Also found in native Washington fan palm. Old nests found in oaks in Twin Oaks, California. Between individual palm trees, the taller are preferred, the largest number of nests found together were in two groups of very high palms. At Hemet 8 nests were found in lower fan leaves. In Santa Ana Mountains in palms 20-40 feet high (23 nests found). Bent (1958) reported high nesting site (12-45 feet from ground). Hurd (1890) noted the first brood nests are usually in Eucalyptus globulus, but second nests usually in leaves of palm tree. Nest suspended from mistletoe in cottonwood 40 feet up, green in color, and hard to distinguish. Sixty percent of nests found in this type of site; others found mainly in mesquite. Robertson (1931), "in blue gum, but still used the usual palm fiber almost exclusively in the nest." Visher (1910) noted in Arizona in ribs of leaves of fan-leaved palms.

D. Special habitat requirements

Short (1976) reported palm trees seem a requisite (for nesting). Therefore they are found near villages and ranches only, i.e., in Alamos and not in countryside.

I. c. nelsoni - Smith (1907) noted seen in June, but not until advent of agave blossoms in July was it prominent in Whetsone, Arizona. Bent (1958), "shuns arid districts; found in fringes of deciduous trees along streams. Rarely seen away from water, in dense shady groves of cottonwood and mesquite in creek bottoms."

Icterus cucullatus (con't.)

E. Seasonal changes in habitat requirements

I. c. nelsoni - Bent (1958) reported in spring and summer found in city parks and gardens.

V FOOD

A. Food preferences

Bent (1958) noted insects and their larvae, i.e., hairless caterpillars and small grasshoppers, nectar of flowers, fruits, berries, cherries, loquats, nectar of agave, aloes, hibiscus, lilies, and other tubular flowers; also sugar syrup.

I. c. californicus - Grinnell and Miller (1944) noted native and introduced flowers provide sources of nectar; plus fruit and insect diet in summer. Fisk (1973) reported three birds were observed to routinely patronize hummingbird feeders. Nectar has not been listed previously as compromising a considerable part of the diet of orioles principally because it cannot be detected in stomach contents by the customary visual analysis.

I. c. nelsoni - Illingworth (1901) noted chief food - insects and caterpillars. Often seen in berry patches, but are usually in search of insects as proven by a great number of stomach contents. Woods (1934) reported will drink saturated or diluted sugar syrup. Woods (1932) noted eats loquats (Eriobotrya japonica). Woods (1931) reported has occasional drink at hummingbird feeder. Pickens (1929) noted drinking from silk oak (Grevillea robusta) flowers and century plant, and probably Nicotiana glauca. Gandre (1929) reported feeds on nectar of Nicotiana, also in garden: morningglories, Easter lilies, and some Eucalyptus species. Ross (1924) noted fond of flowering maple, also mulberries (they hold them with foot while eating the berries).

B. Foraging areas

I. c. nelsoni - Bent (1958) noted forages in cottonwoods to low bushes on canyon sides; occasionally descends to ground.

C. Foraging strategies

I. c. nelsoni - Bent (1958) reported gleans insects from branches (cottonwood). "Searches for caterpillars in undersides of leaves chickadee-like fashion, picking in crevices for larvae like a nuthatch and snapping up grasshoppers with a little jump as do young meadowlarks." Usually found within 12 feet of ground. In large flowers to get nectar; "punctures base of tube, also slits open unopened lily buds". Does not sally for insects - not agile enough.

VI REPRODUCTION

A. Courtship and mating behavior

Bent (1958), "seen an adult male execute a series of exaggerated bows as he advanced slowly along a horizontal limb of a tree in which a female was perched... singing softly and repeatedly posturing with open bill."

I. c. nelsoni - Dawson (1923) reported upon completion of nest by male, two females arrived, fought over possession of nest, the successor lay her eggs only to have them destroyed in further conflagrations with the aforementioned competitor.

B. Nesting phenology

I. c. nelsoni - Sharp (1907) noted raises two broods per year. Bendire (1895) reported two, possibly three broods raised per season. Nidification in southern Arizona May 20; in California nidification is one month earlier. Two to three broods raised per season. Willard (1913) noted three sets taken July 29 with incubation of half. Bailey (1910) reported begins nesting in April. On June 11 in Palm Springs, nestlings were being fed. Wheelock (1920) noted breeds from April 20 to July 1. Bent (1958) reported in southern Arizona nidification starts approximately May 20 and in southern California nidification starts approximately April 20.

C. Length of incubation period

I. c. nelsoni - Burns (1915) noted 12 to 14 days incubation. Bendire (1895) reported incubation as 12 to 14 days.

D. Length of nestling period

I. c. nelsoni - Bent (1958), "Nestling fully fledged in two weeks."

E. Growth rates

I. c. nelsoni - Bent (1958) noted young are fed by regurgitation for 4-5 days. The eyes open on the fourth day, and pinfeathers soon begin to darken the skin... are very helpless after leaving nest, and are fed and cared for by both parents for some time.

F. Post-breeding behavior

Miller (1919) noted in Los Angeles, by end of August, most males have left, leaving females and young behind.

I. c. nelsoni - Bent (1958) reported after fledging, young remain with adults in family group even after attaining self-support. Robertson (1933) noted post-breeding season altitudinal migration (9/9/32); seen in morning.

Icterus cucullatus (con't.)

G. Miscellaneous

Sutton and Pettingill (1943) reported builds a pensile nest.

VII POPULATION PARAMETERS

A. Clutch size

I. c. nelsoni - Bendire (1895) noted clutch 3-5 eggs; one egg laid per day until clutch completed. Bent (1958) reported 3-5 eggs per clutch.

B. Habitat density figures

Remsen (1977) reported two territorial males on a 16.26 acre (6.58 ha) study site in desert riparian habitat in San Bernardino County, California near Needles. Balda (1970) noted one pair per 100 acres in oak-woodland.

I. c. nelsoni - Bailey (1910) reported nests (24) in radius of 2 rods in Cold Water Canyon in the Santa Ana Mountains, California.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

I. c. nelsoni - Bent (1958), "its wariness, non-territorial habits, and nature of its nesting sites should render it comparatively safe from most natural enemies."

B. Interspecific competition

Rising (1965) noted driven from feeder by the blue-throated hummingbird.

I. c. nelsoni - Shepardson (1915) reported before it could finish nest, they were ousted by the house finch. Icterus cucullatus nelsoni selected new site in same tree (eucalyptus) and raised a successful brood. Next year (presumably) same pair built nest in same area and author found two oriole eggs and one house finch egg. Illingworth (1901), "nest is frequently possessed by house finches, sometimes before the orioles have finished them, but more often after they are deserted." Bent (1958) noted found in same habitat as I. b. bullockii but whereas I. b. bullockii is found on tops of eucalyptus and cottonwoods, I. c. nelsoni is found in shrubbery and branches below.

C. Parasitism

Friedmann (1971) noted has been simultaneously parasitized by the brown-headed cowbird and the bronzed cowbird.

I. c. nelsoni - Bent (1958) reported parasitized by dwarf and bronzed cowbirds. Friedmann (1933) noted second record as a victim of bronzed cowbird in Tombstone, Arizona on June 26, 1913 and third record in

Icterus cucullatus (con't.)

Oracle, Arizona on June 1, 1932. Gilman (1914) noted in Satan, Arizona on July 7, 1914: nest with 4 eggs plus one bronzed cowbird nest site 17 feet in cottonwood, of grass. One oriole egg was infertile. Also nest with 3 eggs plus one dwarf cowbird egg; three nests with two eggs plus two bronzed cowbird eggs in a site 14 feet in cottonwood; and a nest with 2 bronzed cowbird eggs plus 4 dwarf cowbird eggs in a site 20 feet in a cottonwood.

D. General

I. c. nelsoni - Crouch (1943) noted common bird associations of phainopepla is Icterus cucullatus nelsoni (one of 13 associations) in Mission Gorge, San Diego County, California on May 5, 1935.

IX STATUS

A. Past population trends

I. c. californicus - Bent (1958) reported no information on abundance of this species hitherto widespread introduction of fan palm, Washington filifera. It was originally native to a few restricted localities on the border of the Colorado desert.

I. c. nelsoni - Swarth (1905) noted exceedingly common; breeding in mesquite forest. More abundant than Icterus parisorum, mostly seen in deep ravines below the mountains. Willard (1912) reported in Sabino Canyon 14 miles east of Tucson; found nesting in large numbers. Very common in mesquite forest near San Xavier Mission. Willett (1912) reported common summer resident about schools and gardens. Sharp (1907) noted common summer visitor near Escondido, California.

B. Present population status

Phillips, Marshall, and Monson (1964) reported has extended its range northward during this century, i.e., Mount Whipple, Arizona, Date Creek, Arizona, north of Prescott. The northward progress is paralleled in California, i.e., reaching Berkeley.

I. c. californicus - Grinnell and Miller (1944) noted with widespread planting of palms and other trees about cities and ranches this species has invaded new localities, i.e., fern palms are favored but also eucalyptus, pepper, walnut, live oak and cypress may be used for nesting. Bent (1958), "has extended its range northward on Pacific coast in recent years; casually to San Francisco Bay region. Extensive ornamental plantings in southwestern California have increased suitable habitat and have increased its potential population."

C. Population limiting factors

Carothers and Johnson (1975) noted is an exclusively dependent species upon riparian habitat.

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SCOTT'S ORIOLE
Icterus parisorum

I TAXONOMY

A. Type description

AOU (1957) Icterus parisorum (Bonaparte) Proc. Zool. Soc. London, 5, 1837 p 110. No type locality specified - Mexico. Family: Icteridae.

B. Current systematic treatments

AOU (1957) states it is monotypic; no races are listed.

Paynter (1968) states it is monotypic; no races are listed.

Mayr and Short (1970) state it is monotypic. "considered by some authors as a compromising genus ("Bananivorus") apart from genus Icterus. Plumage resembles I. galbula but relationship remains to be established."

C. Synonymies

Ridgway (1902) - Xanthornus parisorum; Icterus parisorum; Icterus melanochrysur; Icterus scottii. Bent (1958) noted it called mountain oriole.

II DESCRIPTION

A. External morphology of adults

Robbins, Bruun, and Zim (1966), "No other adult oriole in its range is black and yellow. Note the redstart tail pattern. Female...can be identified by its straight heavy bill and prominently streaked back." Dawson (1923) gives detailed descriptions of male, female and both the male and female. Bent (1958) describes field marks: male adult has strongly marked head, throat, and back and terminal parts of the tail are black as are the wings. Ridgway (1902), "Immature male - similar in coloration to adult females, but larger. Young male and female - similar to the lighter-colored adult females but paler, and with the remeges more broadly margined with whitish" (first plumage). Robbins, Bruun, and Zim (1966) state that the sexes are dimorphic; the female lacks the black head and throat of the male; and the female closely resembles the female Orchard and Hooded orioles.

B. Distinguishing characteristics

Peterson (1969), "male - Lemon yellow with Black back, head, wings and tail. Solid black head and pale yellow pattern distinguish it from other species. Female more greenish/yellow beneath than most other female orioles." "immature male - black throat similar to young male hooded and orchard orioles; dingier underparts, grayer back, more extensive black on face. Female Orchard oriole is smaller and has shorter bill than female I.p. Female hooded oriole has warmer yellow underparts. Female northern oriole has whitish belly."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from southern Nevada, southwestern Utah, north-central Arizona, north-central New Mexico, and western Texas south through south-eastern California (Inyo Mountains, Campo) to southern Baja California, central northern and south-eastern Sonora, and southeastern Coahuila. Has nested recently in central Nevada and northeastern Utah. Winters regularly north to northern Baja California and southern Sonora, casually to southwestern California (Garnsey, San Diego), south to southern Baja California, central Michoacan, Guerrero, and Puebla; east to western Nuevo Leon and Hidalgo. Casual in coastal California (Santa Barbara, San Diego) and in east-central Utah." Paynter (1968) noted range: "Breeds from central western and southern Nevada, Utah, north-central New Mexico, and western Texas south through southeastern California to southern Baja California, Michiacan, Guanajuato, and Oaxaca; winters from northern Baja California (casually to southwestern California) and southern Sonora south in lowlands to Oaxaca; east to western Nuevo Leon and Hidalgo."

B. California distribution of the species

Dawson (1923) reported distribution north to Inyo Mountains; also near San Diego and also on west slope of Sierra Nevada in Walker Pass, Kern County. Stephens (1903) reported they were seen and heard in Providence Mountains where they were breeding. Swarth (1904) on October 31 and November 12 collected species in San Fernando Valley. Reported this was a late date and unusual location (also plumage was a shade lighter). Grinnell and Miller (1944) reported it breeds in Inyo region and Mojave Desert and on eastern slopes of mountains bordering Colorado Desert; on Pacific slopes locally in Walker Pass, Kern County and rarely in San Diego County. Migrants in coastal southern California.

C. California desert distribution

Bent (1958), "it seems to avoid the real desert...(found) with the tree Yucca in the stony canyons along the edge of the desert, and...along the western edge of the Colorado Desert." Lamb and Howell (1913) noted it seen in yucca forest in Antelope Valley, California. Grinnell (1910), "a fairly common summer visitant to the desert in the NE side of the San Gabriel Mountains; common in tree-yucca belt near Fairmont, Antelope Valley." Noted it seems to occur only as a straggler on Pacific Slope of the county. It might occasionally remain all summer in the hot Lower Sonoran washes along the south base of the mountains. Carter (1937) reported one pair near waterhole on May 7, 1934 and female banded on May 10, 1934. Huey (1936) reported species on January 1, 1936 feeding on prickly pear cactus fruit (first winter record for this species in California). Greene (1954) reported on December 30, 1953 a male seen in Palm Canyon; there are very few instances of wintering birds of this species in California. Wheelock (1920) reports species in California desert regions of Sierra Nevada.

Icterus parisorum (con't.)

D. Seasonal variations in distribution

Stephens (1916) reported seeing adult male on February 26, 1916. This is the earliest date it was seen. Visher (1910) noted abundant summer resident of the oak-zone in the Catalina Mountains; it was the most noticeable bird in June (Arizona). Gullion, Pulich, and Evenden (1959) reported common summer residents in the Joshua tree forests and Mohave yucca areas on the desert ranges from April 26 to August 24. Salt (1953) reported seen April - September on Glen Oaks Canyon, Glendale (coastal chaparral belt of southern California). Bent (1958) reports Spring arrival in California on March 22 (San Felipe Canyon); and April 1 in Reche Canyon near San Bernardino and Fall departure in California (San Diego) on September 2.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) reported prefers arid woodlands of desert slopes and plateaus, thus principally the tree yucca "forests" and the pinon-juniper association. Palms, agaves, and smaller species of yuccas, live oaks, and and other broad-leafed trees are occasionally used for nesting. Van Rossem (1936) reported a common summer visitor in pinyon - mountain mahogany association. Grinnell (1951) noted pinon-juniper formation in desert scrub scrub association. Bent (1958) reported occupies an intermediate zone, i.e., juniper-pinon belt in foothills; desert slopes of mountains, or more elevated, semi-arid plains between the mountain ranges where yuccas are widely scattered. Robbins, Bruun and Zim (1966) reported common in Joshua trees, yuccas, pinons, and junipers of the southwest. Phillips, Marshall and Monson (1964) reported in live oaks, and yucca associations in mountains of southeastern and central Arizona, northern Arizona almost to the Colorado River. Marshall (1957) reports dependably found in pines and oaks and riparian trees within pine-oak association, but usually in places adjacent to dry encinal slopes. Johnson, Bryant and Miller (1948) reports most frequently in Joshua trees and also junipers and pinons and where the above are absent it uses Yucca monavensis. Dawson (1923) noted resident in the arid Upper Sonoran fringes of southwestern deserts. It breeds from tree yucca to pinon associations, chiefly upon flanks of desert-facing slopes. Long (1943) reported vegetation largely sagebrush and juniper.

B. Altitudinal range

Dawson (1923) reported normal altitude: 4000-6000 feet (upper Sonoran Zone). Grinnell and Miller reports life zones: Lower and Upper Sonoran nest 500 feet near San Diego to around 8000 feet in the Cow Mountains, Inyo, Co. Montgomery (1905) reported common at Altudo (4750 feet), Marleys Well (4000 feet), and Green Gulch (4700-6000 feet) in the Chisos Mountains. Johnson Bryant and Miller (1948) reported range of 3200-7300 feet; zonally through creosote bush belt, through pinon belt, and sporadically the white fir area and more abundant than other Icterus species.

Icterus parisorum (con't.)

C. Territory requirements

Perch sites - Bailey reported males in July sing from ends of higher branches or tops of shorter trees. Grinnell and Miller (1944), "...singing posts may be as high as the plant growth permits."

Nest sites - Grinnell and Miller (1944) reported nests in palms, agaves and smaller species of yuccas. Live oaks, and other broad-leafed trees are occasionally used for nesting. "...often the nests are no more than six feet from the ground." Bent (1958), "through out its breeding range builds nest in variety of situations depending upon environment. In Baja California: in dense foliage of fig tree (8 feet up), in vines suspended from cacti, in weeds growing out of a crevice in a perpendicular rock." In Pinal County, Arizona: near human development in Yucca baccata about 4 feet up, also 5-7 feet up in sycamore (18 feet up) also in oak, pines, and Joshua trees. In Coso Valley, California: in Yucca arborescens (Giant yucca) (6 feet up). Dawson (1923) reported nests in tree yuccas - Joshua trees (Yucca arborescens) of eastern desert ranges and the Walker's Pass region or in Mohave yucca (Y. mohavensis) of Antelope Valley and northern slopes of San Bernardino range. Further south nests found in Y. baccata and Washingtonia filifera in Palm Canyon and also in pinons, live oaks and sycamores. Tatschel (1967) reported nests in pinyon-juniper association in Juniperus monosperum, 10 feet from the ground. Willard (1923), "under drooping leaves of a sapwood or a tall spanish bayonet." A nest was also found in a pine tree 40 feet from the ground (not hanging as usual) and another was found 12 feet up in another pine. Wheelock (1920) reported nests were hung under yucca leaves or other low trees. Sutton and Pettingill (1943) reported I. parisorum builds a semipensile nest.

V FOOD

A. Food preferences

Grinnell and Miller (1944) noted cactus, agave, yucca fruits, and nectar of these plants were food sources. Stephens (1903) reported feeding on figs and also perches in orchards (in desert). Marshall (1957) noted feeding on small soft bugs. Bent (1958), "largely on insects and their larvae also some fruit and nectar." Also ate grasshoppers, small beetles, caterpillars, butterflies, berries, apricots, figs, peaches, and fruit of cactus Cereus gunnosus. Leck (1974) noted it a frequent visitor at sugar water feeders in summer (Arizona).

B. Foraging areas

Grinnell and Miller (1944) noted they forage widely through low desert scrub in search of insects near the ground. Marshall (1957) forage among dead hanging pine needles. dense sycamore foliage and foraging secretively not unlike Hepatic or Western tanagers.

C. Foraging strategies

Salt (1953) reported forage for insects in foliage. Bent (1958), "in feeding they sit quietly on the limbs prying and peering into such buds that are

Icterus parisorum (con't.)

within reach, any necessary change of position...by clambering along...with hardly any fluttering of the wings."

VI PREPRODUCTION

A. Territorial behavior

Marshall (1957) noted they are strongly territorial; sing from tops of tall conifers, oaks and agave stalks. Willard (1918) reported it is far more usual for the same pair of birds to remain mated for life than it is unusual. Bent (1958), "The males are the chief performers, but...near a nest...would detect a female singing."

B. Nesting phenology

Wheelock (1920) reports breeding from May to June 15th. Amadon and Phillips (1947) noted (3) juveniles were taken during August near Las Delicias, Mexico; which seems to indicate that this species in the South part of its range nest later than those in the North. Bent (1958) reported egg dates - Arizona: 11 records, May 15 to June 28; 6 records, May 22 to June 4; California 75 records, April 24 to June 25; 40 records, May 9 to May 22. Possibly 2 broods in south part of range. Van Rossem (1916) reported in Palmdale between April 27 - May 5 was fairly common in tree yuccas. 2 nests were found and 1 begun April 30; 1 incubation begun May 5. Dawson (1923) noted about 1 May in Mojave Desert; 1 brood was raised.

C. Length of incubation period

Bent (1958) noted incubation by female for 14 days.

D. Length of nestling period

Bent (1958) noted young in nest around 2 week; they were fed by both parents.

VII POPULATION PARAMETERS

A. Clutch size

Wheelock (1920) noted eggs: 2-4; light blue and marked with grey and brown. Bent (1958) noted 2-4 eggs in a clutch; usually 3. Dawson reported a clutch size of 3-4 eggs; rarely 5 eggs.

B. Habitat density figures

Marshall (1957), "singing males are widely spaced..." The territory embraces "canyon walls from the bottom to far up the slopes resulting in low density," although the very obvious singing can mislead one to think their numbers are greater. Balda (1970) reported 10 pairs/100 acres in oak woodland and 2 pairs/100 acres in oak-juniper-pine woodland.

Icterus parisorum (con't.)

VIII INTERSPECIFIC INTERACTIONS

A. Parasitism

Friedmann, Kiff and Rothstein (1977) noted the second known instance of I. parisorum being parasitized by the Bronzed Cowbird.

IX STATUS

A. Present population status

Phillips (1964) noted a common summer resident in Arizona.

B. Past population trends

Willetts (1912) noted breeds in small numbers in San Diego County. Bent (1958) reported range extension: central-western Nevada and northeastern Utah. Oberholser (1918) Reported specimen in central western Nevada (range extension). An adult male and female were taken 10 miles East of Stillwater, Nevada on May 11, 1899 in junipers. The range extended northward 100 miles with this account with previous limit of range: White Mountains, Nevada. Dawson (1923) noted total population does not begin to compare to those of Icterus bullockii and Icterus cucullatus nelsoni. Grinnell (1915) reported status: common summer visitant to extreme arid Upper Sonoran zone of southeast portion of state. Common on desert slopes of the Santa Rose and San Jacinto Mountains, on Walker Pass and along isolated ranges of Inyo region as far north as the Inyo Mountains.

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BROWN-HEADED COWBIRD

Molothrus ater

I TAXONOMY

A. Type description

Molothrus ater artemisiae - Grinnell (1909) noted this form was described from a specimen taken at Quinn River Crossing, Humboldt County, Nevada.

Molothrus ater obscurus - Gmelin (1789) reported the type locality was "Nova Hispania", i.e., Mexico.

B. Current systematic treatments

AOU (1957) reported three races of M. ater are recognized by the current checklist: the nominate race, ater, and obscurus and artemisiae. Dickey and van Rossem (1922) noted the race californicus was described from Buena Vista Lake, Kern County, California on the basis of its darker coloration, larger size (in relation to obscurus), and relatively shorter tail. (Note- this race was not accepted by the AOU Checklist Committee).

Synonomies - Friedmann (1929) noted the following names have been applied to various races of the cowbird: cowbird, cowpen, cow-pen finch, cow-pen bunting, cowpen bird, cow bunting, cow blackbird, cow troopial, cow oriole, brown-headed oriole, brown-headed starling, clodhopper, shiney eye, lazy bird, shift-bird, parasite, sheep-bird, buffalo bird, sheep-blackbird, brown-headed blackbird, coffee-headed blackbird, blackbird, prairie blackbird, little blackbird, cuckoo bunt, cuckold, chuckold, common cowbird, salt bird, etc.

M. a. artemisiae - "Molothrus pecoris, part; Molothrus ater, part; Molothrus ater ater, part. Cow blackbird, part; cowbird, part; Nevada cowbird, part; sagebrush cowbird, part" (Grinnell and Miller, 1944).

M. a. obscurus - "Icterus pecoris; Molothrus pecoris, part; Molothrus ater, part; Molothrus ater ater, part; Molothrus ater artemisiae, part; Molothrus ater californicus. Cow troopial; cow blackbird, part; common cowbird; cowbird, part; dwarf cowbird; sagebrush cowbird, part; California cowbird; Nevada cowbird, part" (Grinnell and Miller, 1944).

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "A rather small blackbird with a short, sparrow-like bill. Male: A blackbird with a brown head. Female: All gray; the finchlike bill is a good mark." Under similar species: "Gray female cowbird can be told from (1) female rusty and (2) female Brewer's blackbirds by shorter bill, smaller size. Some other all-gray birds are (3) young starling (shorter-tailed, longer-billed) and (4) catbird (darker, chestnut crissum). (5) Near southwestern border see bronzed cowbird." Robbins, Bruun, and Zim (1966), "Common on farmland, often feeding in mixed flocks with red-

Molothrus ater (con't.)

wings, Brewer's, or common grackles. Note its heavier bill, slighter build, and uptilted tail when it walks. The plain mouse-gray female lays its speckled egg in the nests of other species, especially of warblers, vireos, and sparrows." Stanley (1941), "The cowbird exhibits marked sexual dimorphism in both color pattern and size. The males were found to be 25 per cent heavier than females." Phillips, Marshall, and Monson (1964), "The male has a deep coffee-brown head and black body, whereas the female is uniform grayish-brown. Sometimes she is vaguely streaked on the breast with darker, and the throat may be whitish, particularly in the northeastern race. The bill is short, deep, straight-edged, and sparrow-like."

B. External morphology of subadult age classes

Peterson (1961), "Juvenal: Paler than female, buffy gray with soft breast-streakings; often seen fed by smaller birds. When with other blackbirds, cowbirds are smaller and feed with tails lifted high." Robbins, Bruun, and Zim (1966), "Young resemble female but have faint breast streaks; they beg noisily for food from their foster parents." Hill (1976), "First-year birds sexed by plumage revealed that 99% of the females had wing chords of 99 mm or less and 98% of the males had wing chords of 103 mm or greater. Using these criteria approximately 90% of all birds could be sexed by wing length alone." Phillips, Marshall, and Monson (1964) noted the juveniles are grayish-brown, with buff edges to all the feathers, and this buff predominates on the underparts, which are thus streaked and speckled with dark. The pale edgings give a characteristic scaled appearance to the wing. Juvenal males in August and September molt into a plumage somewhat like that of adult males, but they retain some light juvenal feathers in the under wing coverts.

C. Distinguishing characteristics

Intraspecific - Friedmann (1929) reported males with wing lengths of less than 105 mm are generally Molothrus ater obscurus, those with wing lengths of 105-112 mm are usually ater, and those over 112 mm are artemisiae. Female obscurus have wing lengths less than 95 mm, female ater between 95-100 mm, and female artemisiae over 100 mm. Rothstein (1978), "Cowbird nestlings show significant geographical variation in rictal flange color." It appears that nestling obscurus have yellow flanges, while nestling artemisiae probably have white flanges. Phillips, Marshall, and Monson (1964) reported M. a. ater differs from M. a. artemisiae in its thicker bill, which is rather arched at the base. The female has a whiter throat, contrasting more with the chest, than in the two western races. M. a. ater is slightly smaller than M. a. artemisiae in wing and tail lengths. Ridgway (1902) noted the race obscurus is similar to M. a. ater in coloration, but decidedly smaller. The mean wing length of adult male obscurus is 100.3 mm, whereas that of a sample of adult male M. a. ater is 110.5 mm.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Friedmann (1929), "The southern limit of the cowbird's range is not as well known as its other boundaries but probably coincides with the extent of the

Molothrus ater (con't.)

upper and lower Austral zones in Mexico south to Colima, Oaxaca, and Vera Cruz. The center of abundance of the cowbird seems to be the plains and prairie region west of the Mississippi..." It is scarce in parts of the south Atlantic and Gulf states and in the Pacific Northwest. AOU (1957), "Central and northeastern British Columbia, central southern Mackenzie, central Saskatchewan, southern Manitoba, central Ontario, southwestern and central eastern Quebec, New Brunswick, and southern Nova Scotia south to northern Baja California, Durango, northern Tamaulipas, Louisiana, southern Mississippi, and South Carolina. In winter to Guerrero, Oaxaca, central Veracruz, the shores of the Gulf of Mexico, and southern Florida."

Phillips, Marshall, and Monson (1964) noted the race artemisiae appears to interdigitate with the race obscurus in a checkerboard of breeding occurrences, and the two races have apparently not occurred at the same breeding locality yet. Artemisiae occurs as a transient and winter visitant in southern Arizona, while obscurus breeds over Arizona except in the northeast, and it is the predominant race in winter.

M. a. artemisiae - AOU (1957), "Breeds from central and northeastern British Columbia (Nulki Lake, Swan Lake, Peace River district), central southern Mackenzie (Fort Simpson, Fort Resolution), northeastern Alberta (Athabaska Delta), central Saskatchewan (Flotten Lake, Emma Lake), southern Manitoba (Lake St. Martin, Hillside Beach), and western Ontario (Rainy River; intergrades with M. a. ater) south through central Washington (rarely west to Tacoma) and eastern Oregon (Klamath County) to northeastern and central eastern California (Alturas, Independence), southern Nevada (except the Colorado River Valley), Utah (except the extreme southwestern section), northeastern and central eastern Arizona (Kayenta, Springerville), western New Mexico, Colorado (Fort Lyon), western Nebraska, and through western Minnesota to northwestern Iowa (Sioux City). Winters from western and southern California, southeastern Arizona (Tucson), northeastern Texas (Dallas), and southeastern Louisiana (New Orleans, Pearl River) south to southern Baja California (Miraflores), Michoacan (Morelia), Guerrero (Chilpancingo), and Veracruz (Cordoba). Transient in eastern Iowa (Linn and Johnston Counties), Kansas, and central Texas; casual in northern and coastal British Columbia (Massett, Atlin, Calvert Island), west of the Cascades in Washington, Oregon, and California, and in northeastern Ontario (Moose Factory)."

M. a. obscurus - AOU (1957), "Breeds from northwestern, central, and southeastern California (Hoopa, Death Valley), the Colorado Valley in southern Nevada, extreme southwestern Utah (St. George), north-central and northeastern Arizona (northeastern slope of San Francisco Mountains, Show Low), northwestern and central southern New Mexico (Manuelito, Grant County, Playas Valley, Las Cruces), western and southern Texas (El Paso, Houston), and southern Louisiana (Marsh Island, St. James Parish) south at least to northern Baja California (San Quintin, Colonia), southern Sonora (Guayman Alamos), northern Durango (Rancho Baillon), and northern Tamaulipas (Matamoros). Winters from north-central California (Sacramento Valley), southern Arizona (Parker, Phoenix, Tucson), and central Texas (Fort Clark, Boerne) south to southern Baja California (San Jose del Cabo, Santiago), Colima

Molothrus ater (con't.)

(Manzanillo, Colima), Guerrero (Iguala, Rancho Correza), Oaxaca (Tehuantepec City), and western Veracruz (Orizaba)."

B. California distribution of the species

Behle (1937) noted the cowbirds in the Sacramento Valley appear to be the race obscurus, thus they must have moved into the Valley from the south. Large-sized birds in the San Joaquin Valley may be derived from artemisiae moving into the Valley through the Kern River gap. Neff (1931) reported the brown-headed cowbird first appeared in the Sacramento Valley in numbers in 1930-1931. Small (1974) reported the species occurs in most of state except higher portions of the Sierra Nevada, Cascades, Klamath Mountains, in the humid coastal coniferous forest, and in parts of the northern Coast Range. Resident within the state, but a summer visitor only to the Modoc Plateau and the Great Basin area.

M. a. artemisiae - Grinnell and Miller (1944), "Geographic range - in summer (assumed to be breeding): east side of Sierra Nevada and Cascade Mountains from Oregon line south to central Inyo County where range of M. a. obscurus is met. In winter: lower Sacramento Valley..."

M. a. obscurus - Grinnell and Miller (1944), "Geographic range - Imperial Valley and Valley of the Colorado River from the Mexican line north, here and there at oases, over the deserts as far as central Inyo County; the Pacific slope of southern California northwest from San Diego through the coast counties to San Francisco Bay, but not in the northern humid coast belt north of Marin County; valleys of inner northern coast district" (and the central valleys).

C. Seasonal variations in distribution

Crane, DeHaven, and Woronecki (1972) noted movement data for 67 recoveries and 87 returns of brown-headed cowbirds banded in Colusa County, California indicated that most birds spend the year in the vicinity with some going north into Oregon, Washington, and British Columbia, apparently as migrants. Few birds move south. Of the birds remaining in California, about 65% moved to mountainous areas to breed, while the rest remained in the central valley to breed. Individuals concentrate in the Sacramento Valley in fall. "From our movement data and the morphological data and breeding-range descriptions of the above authors (Neff, Bent, and Grinnell and Miller), we postulate that both subspecies winter in the central valley of California, but that M. a. artemisiae migrates northward to breed, whereas M. a. obscurus remains and breeds in the valley and mountain areas of California." Phillips, Marshall, and Monson (1964), "The fall migration begins early, in late July... The brown-headed cowbird is recorded away from its winter range in Arizona from March 18... until October 5... and October 16..." Bent (1950) noted apparent early spring arrival dates in California are 20 February at Gilroy and 24 March (median of 13 years, April 13) at Berkeley. Apparent late dates of fall departure from California breeding grounds are 18 July (median of 10 years, July 13) at Berkeley. Friedmann (1929) reported migration (spring) of cowbirds can be divided into the following phases: 1. Arrival of vagrants,

Molothrus ater (con't.)

2. Arrival of migrant males, 3. Arrival of resident males, 4. Arrival of migrant females, 5. Arrival of resident females, and 6. Arrival of immature (?) males and females.

IV HABITAT

A. Biotopic affinities

King (1954) noted in eastern Washington the cowbird inhabits deciduous forests of flood plains, willow-hawthorn riparian thickets beset with taller trees, and open ponderosa pine woodland. Wauer (1964) reported in pinyon-juniper association in the Panamint Mountains in June, 1960. Breeding (young being fed by house finch). Small (1974), "habitat - riparian woodland, meadows, pastures, ranches, agricultural land, suburbs, towns, parks."

M. a. artemisiae - King (1954) reported in Whitman County, Washington the "cowbird is a regular member of the summer avifauna of deciduous flood-plain forest, willow-hawthorn riparian thickets beset with taller trees, and the open ponderosa pine woodland. Cowbird populations attain their greatest density in stream valleys providing tall trees for perching, and the species is uncommon or absent in the comparatively treeless uplands, occurring in only relatively small numbers in timber tracts and along the edges of ponderosa pine woodlands." Grinnell and Miller (1944), "Life-zones (breeding), chiefly upper Sonoran; enters Transition, and even Canadian, locally, where adjacent to upper Sonoran. Habitat - in summer range, pastures, meadowlands, and tall sagebrush and tracts of willows in near-vicinity of water."

M. a. obscurus - Grinnell and Miller (1944), "Life-zones, lower Sonoran and upper Sonoran; extends into Transition, as in Yosemite Valley; most numerous in lower Sonoran. Habitat - river bottomlands primarily, especially where pastures or meadowlands lie adjacent to tracts of willows and cottonwoods; also invades orchard and suburban areas even where closely built up, as in Los Angeles and Pasadena."

B. Altitudinal range

M. a. artemisiae - Grinnell and Miller (1944), "Altitudes of known occurrence in summer, 3900 feet, at Independence, Inyo County, up to 11,600 feet, on McAfree Meadow, White Mountains, Mono County...; at other than supposed breeding places, down to -178 feet, in Death Valley."

M. a. obscurus - Grinnell and Miller (1944), "Altitudes of breeding occurrence extend from 200 feet below sea level, near Mecca, Riverside County, up to 5100 feet in Cedar Canyon, Providence Mountains, San Bernardino County."

C. Territory requirements

Perch sites - Friedmann (1929), "During the summer of 1921 (at Ithaca, New York) numerous individual male birds were seen daily on certain trees or on definite telegraph poles. From these perches they would sing and display;

Molothrus ater (con't.)

they might fly off but would soon circle and come back. There was no question that they were tied down to their respective singing trees... Not only was a certain tree used by each male, but a certain part seemed to be preferred, usually the higher branches."

Courtship and mating sites - M. a. obscurus - Payne (1973), "Mating is restricted to special perches that are usually used by single adult males."

Nest sites - Mayfield (1965) noted the distribution of cowbird eggs in host nests fits closely that predicted from a random placement of cowbird eggs. Berger (1951) reported in Michigan parasitized nests of field-nesting species were in portions of fields bordered by a woodlot or thicket, whereas non-parasitized nests were not near such vegetation. Norris (1947) reported in Pennsylvania, "Until mid-May most cowbird eggs were laid in the nests of birds of field and open country, after mid-May in nests of woodland birds."

M. a. obscurus - Grinnell and Miller (1944), "In breeding season seeks fosterers mostly among those passerine species which nest in riparian growth; but the total number of birds in the nests of which this cowbirds' eggs have been found in California is very large and inclusive of species of almost every ecologic niche anywhere in the general breeding area of the cowbirds."

V FOOD

A. Food preferences

Friedmann (1929), "The cowbird feeds upon whatever is most available, taking what it can get most easily." Specific items found in the stomachs of birds collected at Ithaca, New York include weed seeds, weevils, lepidopterous larvae, spiders, beetles, caterpillars, hemipterans, orthopterans, and other insects. Beal (1900) noted twenty percent of the food consists of "harmful or annoying" insects, 16 percent of grain, more than 50 percent of weed seeds, and fruit is almost absent from the diet. Backus (1954) reported when two cowbirds and an unidentified wren sought rest on an ocean-going ship during a storm, the cowbirds killed and ate the wren. McAtee (1911) noted species parasitized by cowbirds feed the cowbird nestlings the normal food for their own nestlings. The stomachs of cowbird nestlings that were examined included terrestrial cutworms, carabid beetles, weevils, vegetable fibers, snails, homoptera, and moths.

M. a. obscurus - Payne (1973), "Field observations and examination of stomachs showed that rice spilled during harvest or left for game birds was the main food in winter."

B. Foraging areas

Stewart (1972), "The sites where individual birds fed on successive days may have depended more on movement of flocks than on earlier experiences of individual birds."

Molothrus ater (con't.)

M. a. obscurus - Payne (1973), "In the winter months, cowbirds, fed in flocks in the harvested rice fields of the central valley (of California) with other species of icterids, mainly red-winged blackbirds (Agelaius phoeniceus), tri-colored blackbirds (A. tricolor), and Brewer's blackbird (Euphagus cyanocephalus)... Flocks of cowbirds were seen in pastures with cattle and around feed-lots in the central valley. At night they roosted in marshes near their feeding areas." Grinnell and Miller (1944), "Forages mostly on open ground, often in vicinity of cattle, but roosts in trees."

C. Foraging strategies

Bent (1950), "In its association with these animals (cattle) it is quite fearless, searching for food about the heads of the grazing animals or even between their feet, sometimes even alighting upon their backs, where they are supposed to relieve the animals of annoying insects. The movements of the cattle undoubtedly stir up grasshoppers and other insects, making them more easily available for the birds."

M. a. obscurus - Roth (1971) noted two male cowbirds attacked a junco, apparently intending to kill it, while a female cowbird watched.

D. Feeding phenology

Friedmann (1929) reported during spring migration, cowbirds feed mostly on seeds and animal food constitutes only 10-15% of the total stomach contents. During the mating period the percentage of animal food increases slightly, and throughout the breeding season it constitutes around 50% of the items taken. During the molting season (July through September) animal matter still predominates, but during fall flocking and migration, the diet is almost entirely vegetable. Beal (1900) reported animal food was almost absent from the diet in January, February, and March and also in October, November, and December. In May, June, and August animal food constituted about 50% of the total food consumed.

E. Energy requirements

Lustick (1970) noted molting cowbirds increased their oxygen consumption 13 percent over that of non-molting birds, while maintaining the same thermal conductance, suggesting that the increase is the energy required in feather formation.

VI REPRODUCTION

A. Nesting behavior

Bent (1950), "the cowbird builds no nest at all, relying on other species to hatch its eggs and rear its young."

B. Host selection

Friedmann, Kiff, and Rothstein (1977) noted the total list of species known to have been parasitized by this species now stands at 216, including

Molothrus ater (con't.)

375 different races. True fosterers (species that actually raised young cowbirds) number 139 species.

C. Age of first breeding

M. a. obscurus - Payne (1973), "First-year males appear not to hold mating sites, and they have significantly smaller testes in the breeding season than the older adults." (Thus, there is a likelihood that males do not ordinarily breed until their second year). First-year females do apparently breed.

D. Territorial behavior

Friedmann (1929) noted both male and female cowbirds frequent a definite territory during the breeding season, but make only weak attempts to defend it. In a New York study cowbirds were never seen to fight, and their method of defense was restricted to an intimidation display. Laskey (1950) noted cowbirds were observed to occupy a definite home range, but at no time did they appear to defend a territory. They used a particular "domain" for pair formation and mating, but they did not drive other cowbirds from food within this area, and they tolerated cowbirds of both sexes within the area in social contacts, feeding and flying together with them.

E. Courtship and mating behavior

Friedmann (1929), "The cowbird has three types of display, depending upon whether the bird is on the ground, in the air, or in a tree at the time. No species has been accused of more varieties of sexual relationship. The cowbird has been called monogamous, polyandrous, polygamous, and promiscuous by various writers, and not infrequently several of these terms have been used by the same author." Laskey (1950) reported following their arrival on the breeding grounds in spring, male cowbirds indulge in elaborate bowing ceremonies, intimidation gestures, pursuits and fights, striving for dominance among themselves. The species is monogamous. Within a particular area, a particular male and female attain dominance over other members of their own sex, and all copulations occur only between these two dominant individuals in a given area. Dominance over the other individuals is maintained by an elaborate series of threat displays, etc. Nice (1937), "With a small population of cowbirds, this investigator found the species predominantly monogamous, with some tendency towards polyandry." However, where there was a larger population, promiscuity seemed to prevail.

M. a. obscurus - Payne (1973) noted cowbirds may be polygynous, with a few adult males servicing several females. Mating is restricted to special perches that are usually used by single adult males.

F. Nesting phenology

Payne (1973), "Brown-headed cowbirds in central California breed in late spring and early summer, mainly from early May to late June. Local differences in the time when breeding ceases were related to the time of local seasonal droughts, with activity lasting for a few weeks longer in the irri-

Molothrus ater (con't.)

gated central valley than in the dry inner coast range." King (1954) noted in eastern Washington cowbirds arrived on the breeding grounds between 13-23 May and were observed in courtship immediately. Fresh egg dates extended from 14 May to 4 July. Berger (1951) reported the cowbird laying season in Washtenaw County, Michigan extended from 21 April to 26 July during a four-year study there. Norris (1947) reported in Pennsylvania the cowbird laying season extended from mid-April to mid-July, with its peak in May. Bent (1958) noted 130 California egg dates are between 3 April to 21 July, with 66 occurring between 7 June to 29 June.

M. a. obscurus - Payne (1973) reported in central California this species begins laying in late April and early May. The breeding season of cowbirds coincides with the peak of nesting of both residents and migratory species such as the flycatchers, vireos, and warblers. Nesting continues into the late summer and coincides with the late nests of some important foster species.

G. Length of incubation period

Bent (1950) noted an egg followed at Baltimore, Maryland hatched in 11-1/3 days after laying. Nice (1953), "For sixty years cowbird eggs have been stated to hatch in ten days - 'about the shortest period of any of our passerine birds'. This myth was started through a guess by a friend of Major Bendire and was generally accepted, although no good evidence was ever produced. From 1918 to 1952 there have been 62 cases reported of cowbird eggs hatching in 11 to 12 days and not one case in ten days." Norris (1947), "The incubation period (10 eggs) ranged from 11 to 13 days and averaged 11.6 days."

H. Length of nestling period

Norris (1947), "Records (11) of the cowbird's age at nest-leaving averaged 8.7 days (extremes: 8 and 10 days)."

I. Growth rates

Friedmann (1950) reported at the age of one hour a young cowbird weighed 2.5 g; the average weight at the age of one day is 4.5 g; at the end of the second day the weight may be 7.5-8.5 g; thus, for the first two days the increase in weight is about 100%. From then on the rate is slower, averaging about 50% of the third day and gradually lessening until the eighth day when it is 10% and 5.5% on the ninth day. When the cowbird leaves the nest, it weighs about 33 g or approximately 13 times its hatching weight. Neal (1973) noted although cowbirds develop much faster than similar-sized non-parasitic passerines, they apparently do not acquire independent homeothermy any earlier. It appears, therefore, that expending energy to maintain a constant body temperature is not as important as expending energy for growth." Nice (1939) reported it is possible that a differential growth rate between the sexes operates with nestlings. Other factors possibly influencing nestling growth rates of cowbirds are differences in parental care and the size of the egg from which the nestling hatches.

VII POPULATION PARAMETERS

A. Clutch size

Davis (1942) noted the available data suggest that this species lays in clutches of four or five eggs. Nice (1949), "Four observers have found that 4 species of cowbirds lay in clutches and that the intervals between clutches last from 5 to 8 days and possibly longer. Eggs may be laid at daily intervals or 1 or 2 days may be skipped." Walkinshaw (1949) noted from 15 May to 20 July 1944 a single female cowbird laid 25 eggs in nests in a study area in Calhoun County, Michigan. Payne (1965) reported in Michigan female cowbirds lay an average of 10 to 12 eggs during the breeding season. Mean clutch size is 3.1 eggs, cowbirds laying in clutches of one to six eggs. Mean clutch size late in the breeding season is significantly lower than early in the breeding season. Most cowbirds lay several clutches in a season.

M. a. obscurus - Payne (1976), "A comparative study of populations of parasitic cowbirds in central California, southern Oklahoma, and northern Michigan showed a mean clutch size of 3.91 to 4.05 in all three areas. Estimates of the mean number of eggs laid in a season were 25.0 for Oklahoma, 24.1 for California, and 11.3 for northern Michigan."

B. Nesting success

Friedmann (1963), "The general breeding success of the cowbird... is often much lower than that of its chief victims. The rate of cowbird success is higher in the case of larger, less susceptible hosts." Norris (1947) noted in 237 observed nests in Pennsylvania, host species laid 668 eggs, of which 383 (57.3%) hatched; the cowbirds laid 108 eggs, of which 46 (42.6%) hatched; 37.7% of the host eggs and 26.8% of the cowbird eggs produced fledglings. Of the host eggs that hatched, 64% produced fledglings. Of the cowbird eggs that hatched, 63% produced fledglings. With 4 exceptions, all parasitized nests that produced young produced at least one host young. "The 35 non-parasitized (successful) nests produced 2.94 fledglings per nest; 19 parasitized (successful) nests fledged 2.05 host young per nest, indicating that each parasite was raised at the expense of about one host young." Goertz (1977) reported of 14 cowbird eggs known to have hatched in 11 nests of 7 species in Louisiana, 9, or 64%, resulted in fledged young. Petrinovich and Patterson (1978), "With a much smaller expenditure of reproductive energy the cowbirds seem to achieve almost the same production of fledglings per nest (0.61 for non-parasitized white-crowned sparrows compared to 0.64 for cowbirds)." Hill (1976), "Cowbird parasitism decreased the number of host fledglings, as an average of 1.54 young fledged from each non-parasitized nest while only 0.53 young of the host species fledged from each parasitized nest. Cowbirds were less successful than their nest-mates as only 0.32 cowbirds fledged per parasitized nest." Elliott (1978) noted in Kansas in parasitized nests of 5 species, 13 (8.3%) of 157 cowbird eggs were successful, while 17 (12.4%) of 137 host eggs were successful. In the unparasitized nests, 23 (21.5%) of 107 eggs were successful. Hofslund (1957), "The per cent of cowbird eggs hatched was less than that of the

Molothrus ater (con't.)

yellow-throat, 42.5 per cent as compared to 65.8 per cent. Only nine of the 20 parasitized nests produced cowbird fledglings, an average of 1.3 cowbirds per successful nest, but only 0.6 per cent cowbirds per parasitized nest. The yellow-throat, therefore, can be considered as only a fairly favorable host." Berger (1951), "Of 112 parasitized nests observed (in Michigan), 53 contained one cowbird egg, 36 contained two, 15 contained three, six contained four, and two contained five. Of 196 cowbird eggs observed, 60 (30.6%) hatched. Forty-three of these 60 young cowbirds (21.9% of the 196 eggs fledged."

C. Mortality rates per age class and sex ratios

Darley (1971) noted in Ontario "The population was composed of 37 percent adult males, 18 percent adult females, 22 percent yearling females, and 23 percent yearling males. The excess of males appears to stem from a higher mortality in adult females (55 percent) than adult males (38 percent). Yearling males and females have similar mortality rates if one assumes the sex ratio in eggs to be 1:1." Hill (1976) noted the sexing by plumage of 4316 first-year cowbirds showed a 1:1 sex ratio. The apparent fact that there is an excess of males in older age groups indicates that some selective factor must operate at a later time in life. Crase, DeHaven, and Woronecki (1972) reported of 10,000 cowbirds of known sex taken from traps in Colusa County, California, approximately 7500 were males and 2500 were females, for a 3:1 ratio. Thus, it is possible that females have a higher mortality rate than males.

D. Longevity

Mitchell (1911) noted members of the genus Molothrus had an average duration of 65 months and a maximum of 145 months and of all the passerine birds in the London Zoological Park, no other genus equalled the record set by this genus. Rowland (1931) reported a female cowbird banded on 5 May 1925 in Massachusetts was killed in South Carolina on 2 February 1931, indicating an age of at least seven years.

E. Habitat density figures

Stamp (1978) reported there were an estimated 40 pairs per 40 hectares in cottonwood riparian habitat and 8 pairs per 40 hectares of mesquite riparian habitat along the lower Verde River, Maricopa County, Arizona.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Friedmann (1929), "The enemies of the cowbird are of two main types -- predacious mammals and birds, and parasitic invertebrates." There are apparently single instances of cowbird predation by a marsh hawk and by a prairie falcon. Cowbird eggs are destroyed by the usual nest predators, e.g., snakes, jays, and wrens, and also by host species that destroy the eggs. Humans tend to remove cowbird eggs from the nests of hosts.

Molothrus ater (con't.)

M. a. obscurus - Payne (1973) noted cowbirds were seen feeding in mixed flocks with red-winged blackbirds (Agelaius phoeniceus), tri-colored blackbirds (A. tricolor), and Brewer's blackbirds (Euphagus cyanocephalus); presumably these species represent competitors to cowbirds.

IX STATUS

A. Past population trends

Friedmann (1929) reported cowbird populations in this country were greatly increased by deforestation that accompanied colonization and settling of this country. Irrigation of the southwest has also made arid desert country suitable for the species, and the presence of cattle on newly cleared lands has further enhanced the expansion of the species' range. Dickey and van Rossem (1922), "A general impression seems to have sprung up that cowbirds have only recently invaded California. It is unquestionably true that their numbers have increased greatly during the past few years, but in our belief this is due simply to natural increment rather than influx, and is adequately explained by the increasingly favorable conditions that have inevitably resulted from the present extensive development of dairying, truck-gardening, and irrigation projects in general." Phillips, Marshall, and Monson (1964), "It has become much commoner in recent years in Arizona, and also has spread into the northeast section and Grand Canyon Village. Apparently it was rare in winter at Tucson even as late as 1927..."

M. a. artemisiae - Grinnell and Miller (1944), "Status - summer resident, locally common, in Great Basin territory. Migrant, vagrant or winter visitor sparingly in western and southern portions of state. Numbers variable and seasonal movements irregular or obscure."

M. a. obscurus - Rowley (1930), "During the time from 1920 to 1929 it has been interesting to note the apparent increase of the dwarf cowbird (M. a. obscurus) in southern California. In 1920, the sight of a cowbird in the willow thickets of the San Gabriel River district and adjacent semi-arid washes was not common, and eggs were found only occasionally. Up to 1925, my records failed to show the finding of cowbird eggs in nests of any other species but California yellow warbler and San Diego song sparrow." Robertson (1931) first observed this species in Orange County on 27 May 1923, but it had become quite common by 1931. Grinnell and Miller (1944), "Status - permanently resident, though there is considerable shifting of populations locally, with dispersal to breeding stations in the spring. Now common or even abundant in places. Has increased phenomenally in southwestern California since about 1915, in the San Francisco Bay region since about 1922, and in the Sacramento Valley since 1927, if not earlier; however, old records indicate that some cowbirds have been present throughout historical times in each of the major areas now so well populated."

B. Present population status

Mayfield (1965), "The cowbird's success with its new hosts has probably brought a surplus in population that may help to account for its continued expansion of range northeastward and southeastward into areas of marginal suitability."

Molothrus ater (con't.)

C. Population limiting factors

Rothstein (1975) noted adaptations against brown-headed cowbird parasitism include nest desertion, egg removal (rejection), egg burial, and aggression against the cowbirds themselves. All lead to reproductive failures for the cowbirds. Middleton (1977) reported cowbirds regularly lay eggs in nests of the American goldfinch in Ontario, but they rarely fledge successfully, probably because of the highly granivorous diet of the goldfinch. Thus, laying in goldfinch nests is a poor strategy for cowbirds. Rothstein (1976), "Most cowbird eggs laid in waxwing nests are rejected and others may fail because of the waxwing's frugivorous diet. Even if only 7.5% of the waxwing nests are parasitized, a considerable proportion of the cowbird's reproductive effort is wasted." Scott (1977) reported cowbirds were found to parasitize catbirds less frequently than other available hosts. Parasitism on catbirds and other hosts that eject eggs may be an important cause of cowbird egg mortality. Price (1947) noted in attempting to enter the cavity nest of a prothonotary warbler, a female cowbird became wedged in the small entrance hole and died trying to extricate herself. Bowditch (1928) reported a male cowbird was found in New Jersey on 25 July 1928 that died of tuberculosis, being the first reported instance of this disease in birds. Rothstein (1976) noted single real or artificial brown-headed cowbird eggs were experimentally added to 58 cedar waxwing nests and rejection occurred at 69.0% of the nests. Twelve naturally parasitized nests also demonstrated that rejection is the usual response by cedar waxwings to cowbird parasitism.

D. Potential for endangered status

(Nearly every account of this species indicates that it is increasing in numbers in all parts of its range. Hence, it is a most unlikely candidate for endangered status).

Molothrus ater (con't.)

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HEPATIC TANAGER
Piranga flava

I TAXONOMY

A. Type description

Van Rossem (1942) examined type specimen of P. f. hepatica in 1933 and 1938 at Cambridge, England. "It is an adult male in perfect plumage... typical in both color and size. The back is strongly reddish gray, the under parts are brightly colored and the flanks are olive gray. Measurements are as follows: wing, 101mm; tail, 81.5mm; exposed culmen, 18.2mm; tarsus, 22.2 mm; middle toe minus claw, 16.0mm... the type locality of Piranga hepatica should be corrected to the Valley of Mexico."

B. Current systematic treatments

Howell (1965) noted original description of Piranga flava savannarum from Nicaraguan lowland pine savanna.

Hellmayr (1936) recognized 13 races of Piranga flava, including hepatica, whose range is given as follows: "Highlands of Mexico, west of the Sierra Madre del Oriente, north to central-western Texas, New Mexico, and north-western Arizona." (Note that this includes the U.S. portion of the range of P. f. dextra, as treated by the AOU Checklist). He lumped Oberholser's race oreophasma under hepatica.

Storer (1970) recognized 15 races of Piranga flava, including hepatica. The races zimmeri and intensa are lumped under hepatica. The ranges of hepatica and dextra given here are essentially identical to those given in the AOU Checklist (5th ed.). The two races recognized here that were not included in Hellmayr (1936) were described subsequent to that publication. Both occur in the neotropics.

Synonomies - Van Rossem (1931) argued for the recognition of the race oreophasma Oberholser as distinct from hepatica, contrary to Zimmer's 1922 remarks. He believed that hepatica occurred at least as far north in Mexico as Nayarit. Van Rossem (1942) described the race P. f. zimmeri "from Arizona south along the west slope of the Sierra Madre and adjacent ranges to extreme southern Sonora and southwestern Chihuahua." (Thus, if now recognized by the AOU, this would be the race occurring in California). The race was described as being "Paler and grayer than any of the named North American races of P. flava." Note: This race not recognized by AOU Checklist. Oberholser (1919) described P. hepatica oreophasma and attributed all U.S. populations to that race. Also recognized P. hepatica hepatica from central and southern Mexico and P. hepatica dextra from eastern Mexico. If oreophasma was now recognized by the AOU, it would presumably be the form occurring in California. Van Tyne and Sutton (1937) recognized P. f. oreophasma Oberholser as being a valid race.

C. Recent taxonomic revisions

Sutton and Phillips (1942), "Piranga flava is represented by two races in Mexico and the United States. The southern eastern race, dextra, ranges from

Piranga flava (con't.)

Guatemala (at least in winter) north to Oaxaca and Guerrero and along the Sierra Madre Oriental and the mountains farther north and west at least to Chloride, New Mexico. The northwestern race, hepatica, ranges from central northern Arizona (east in southern Arizona at least as far as the Chiricahua Mountains) south to the Jacala region of Hidalgo, and Morelos. Northern birds average larger than southern birds, but recognition of additional races (specifically, P. f. oreophasma Oberholser and zimmeri van Rossem), based only on slight size differences, is not warranted in view of the fact that some southern birds are notably large and vice versa." This paper contains the best discussion of the taxonomy of the U.S. races. Hellmayr (1936), "Separation of a northwestern race (P. f. oreophasma), which has been advocated by Oberholser and more recently by van Rossem, seems to me unwarranted. There is no difference in color, so far as I can see, and on the average slightly larger size in birds from the United States (and apparently Sonora) is hardly a sufficient reason for maintaining an additional race, since measurements vary a good deal in all the subspecies of P. flava."

II DESCRIPTION

A. External morphology of adults

Davis (1945) gave weights of dextra as follows: male - 49.1 g; female - 45.3 g. Davis (1944) gave weight of a female taken at a Guerrero locality on 19 August as 39.7 g. Poole (1938) noted weight, wing area (sq. cm.), and wing area per gram given as 35.9, 153, and 4.26, respectively, sample size and origin of bird (other than hepatica) not stated. Oberholser (1974), "Blackish bill; dark gray cheeks. Male: dull red ('liver colored'). Female: mostly dusky gray above; gray cheeks; yellow below. Length, 8½ in.; wing-span, 12-3/4 in."

B. External morphology of subadult age classes

Oberholser (1974) noted under oreophasma (= dextra in AOU Checklist), gives a detailed description of plumages of juveniles and adults. In general, the first nuptial plumage of the male is similar to the adult female plumage, but with a few red spots here and there... the overall appearance, however, is yellow. The second-year male is similar to the adult male (i.e., mostly red), but still retains some patches of olive-green above and yellow below. From their first winter on, females are virtually indistinguishable as to age.

C. Distinguishing characteristics

Interspecific - Peterson (1961), "Male: darker than summer tanager; dull orange-red; dark ear patch, blackish bill. Female: dusky above, yellowish below; known from female orioles by shorter bill, lack of wing-bars; from female summer tanager by more orange-yellow throat, gray ear patch, and blackish bill. Male summer tanager is rosier, has pale yellowish bill." Robbins, Bruun, and Zim (1966), "The dark bill and dark cheek distinguish the brick-red male from the summer tanager. Female and young are told from western tanager and oriole by lack of white wingbars; from summer tanager by the dark bill, dark cheek patch, and call, chuck, repeated several times. Song is like scarlet's but slightly lower." Wauer (1973), "Fall birds can be

Piranga flava (con't.)

very confusing because the bill color of the summer tanager can be very dark in fall. The liver-red color of the hepatic tanager male is the only positive field characteristic in fall." Le Febvre and Warner (1959) describe plumage differences between P. bidentata and P. flava.

Intraspecific - Oberholser (1919) described P. hepatica oreophasma as being larger, but with "a relatively somewhat smaller bill" than nominate hepatica of Mexico. Also, male oreophasma were said to have darker upperparts with a more reddish back and with the ventral surface more deeply colored. Female said to have upper and lower parts rather darker, the back averaging more grayish and less greenish than hepatica. Hellmayr (1936), "Piranga flava dextra Bangs: Nearest to P. f. hepatica, but rather smaller and darker; males clearer red with narrower edges of gray to the dorsal feathers; female more yellowish green above."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) - range of species as a whole - "Northern Arizona, northern New Mexico, and central western and southern Texas south through Mexico (except the Yucatan Peninsula), Central America, and South America to central Peru, Bolivia, central Argentina, Uruguay, and southern Brazil. Migratory in northern part of range." Range of subspecies hepatica - "Breeds from northwestern and central Arizona (Hualpai Mountains, Bill Williams Mountain, Flagstaff) and southwestern New Mexico (Silver City, head of Rio Mimbres) south through the highlands of Mexico west of the Sierra Madre Oriental to Guerrero (Omiteme) and Oaxaca (25 miles northeast of Oaxaca). Winters from southeastern Arizona (Patagonia) and southern coastal Sonora (Guaymas) south to limit of breeding range and into coastal and lowland areas." Johnson (1965) reported first record for Nevada, birds occurring in breeding condition in the Sheep Range and in the Clover Mountains, Lincoln County, Nevada. Ligon (1961), "It seems to be the most common in the southern half of the state, although it is statewide wherever the Transition zone prevails. It occurs less commonly in the Sangre de Cristo and other more northern mountains."

B. California distribution of the species

McCaskie and Stallcup (1966), "In coastal California this species has been collected near Shandon, San Luis Obispo County, on 8 November 1959 (Miller and McMillan, 1964) and at Poway, San Diego County on 30 December 1960 (Huey, 1961); one was seen in Live Oak Canyon near Claremont, Los Angeles County, between 21 and 27 March 1964 (AFN, 1964). One was collected along the Colorado River near Imperial Dam on 18 November 1960 (Phillips, Marshall, and Monson, 1964)." Miller and McMillan (1964) reported a juvenile male was collected near Shandon, San Luis Obispo County on 8 November 1959. It was a bird of the year. Wade (1964) reported observations of this species in the Sunland area, Los Angeles County, in July and August, 1963. Huey (1961), "On 31 December 1960 Mr. Charles Kent shot a bright-red adult male, Piranga flava hepatica, at Poway, San Diego County, California. This specimen represents the westernmost occurrence of this species, and is the first record for California."

Piranga flava (con't.)

C. California desert distribution

McCaskie (1976), "Two or three hepatic tanagers were present along Arrastre Creek in the San Bernardino Mountains, June 5-July 1 (Brodkin and Dunn), a pair was on Clark Mountain, June 12 (Van Rossem) and, most interestingly, three were found in the New York Mountains, July 29 (Van Rossem); this species is a recent addition to the breeding avifauna of California, and is previously unrecorded from the New York Mountains." McCaskie (1975), "A pair of hepatic tanagers undoubtedly nested on Clark Mountain (Summer), and another pair was present at the upper end of Arrastre Creek in the San Bernardino Mountains in June (Brodkin)." McCaskie (1974), "Hepatic tanagers could not be found around Arrastre Creek, but at least one pair was on Clark Mountain, in late June (Garrett et al.)." McCaskie (1973), "Two pairs of hepatic tanagers were present at Arrastre Creek in the San Bernardino Mountains May 26 (LCB) when one bird was seen building a nest; a female carrying food there on July 21 (Garrett et al.) suggests that nesting was successful. The species is apparently becoming established as a breeding species in these mountains. An out-of-range hepatic tanager was seen in Santa Barbara July 16 (RW)." McCaskie (1972), "Kim Garrett and Jon Dunn spent much time searching the area around Arrastre Creek in the San Bernardino Mountains for possible nesting hepatic tanagers after their appearance there in May. On June 18 they were rewarded when the male they were watching flew to a nest high in a yellow pine and fed the brooding female; three days later the pair of birds was watched feeding young in the nest, and a fledgling was seen with the adults on July 8. This is the first known nesting for California, although birds may have been nesting in this area in recent years." McCaskie (1971), "Most interesting was the presence of a pair of hepatic tanagers along Arrastre Creek near Round Valley in the San Bernardino Mountains on July 10-27 (Garrett et al.); this species is a casual straggler to California, however, there are two previous summer records from this area (May 21, 1967 and May 30, 1968) and the possibility of nesting should be considered."

D. Seasonal variations in distribution

Wauer (1973) noted as uncommon summer resident from May 1 through September 25. Oberholser (1974), "Migration: late April to mid-May; late August to early October (extremes: April 19, June 3; August 20, October 16)." Smith (1917), "On the last visit I paid to its haunts, September 6, it was still in evidence, but in diminished numbers. I recall seeing no males alive that had mixed plumage, and in the series taken there are none. It is possible that immature birds had departed from the region before my first meeting with the species." Monson and Phillips (1941), "A female noted by Phillips at Patagonia on December 3 (1939), and a pair seen there by Monson on February 21, 1940, and taken by Phillips on March 9, establish the hepatic tanager as a wintering bird in Arizona." Swarth (1904), "A fairly common summer resident, generally distributed over the mountains during the migration, but in the breeding season restricted more to the canyons between 5000 and 7000 feet. In 1902 the first arrival was noted on April 11, and the following year on April 16; about the middle of May they were quite abundant in the higher pine regions..." Ligon (1961), "The southward migration starts rather early, and most of the birds are out of the state by September 15."

Piranga flava (con't.)

Arrival in the spring may be as late as early May." Phillips, Marshall, and Monson (1964), "Southern Arizona migrations... are from April 3... to May 14 and again from September 11 to October 25..." Winters regularly (but rarely) in Santa Cruz County, from the Sonoita Valley west to the Pajaritos Mountains.

IV HABITAT

A. Biotopic affinities

Johnson (1965) reported a male collected on 26 June in ponderosa pine-Gambel oak zone on Ella Mountain, Nevada. In Brewster (1881) from Frank Stevens, May 30, 1880 "The species is rather common here (Chiracahua Mountains). They keep mostly among the pines (but sometimes in oaks) and several haunt the vicinity of the house..." Brandt (1951) assigned this species to the "upper canyon defile of the lower Mountain subzone of the Transition life zone." Bailey (1928), "... found in the Guadalupe Mountains in oaks and pines on the edge of the Transition zone, especially on rocky wooded hill-sides; while others were seen 300 feet higher in the yellow pines at 7000 feet." (Given under the race "oreophasma"). Marshall (1957), "Although the hepatic tanager seems to need groves of tall trees, its greatest abundance is in pine-oak areas, particularly where the terrain is rugged so that different kinds of vegetation come together. But it is common in open ponderosa pine forest northward in Arizona, far beyond the limits of pine-oak woodland." Bent (1958), "In 1922, we found hepatic tanagers fairly common in the Huachuca Mountains, in Arizona, nesting in the tall yellow pines in the upper parts of the canyons, above 5000 feet and near the lower limit of the heavy pine timber. In the Chiracahua Mountains, Arizona, they were seen mostly in the pines, but sometimes in neighboring oaks." Oberholser (1974), "... it occurs in dry pine-oak woods on the small mountain ranges which rise like islands above the deserts of Arizona, New Mexico, and Trans-Pecos Texas. It seems to prefer tall trees, particularly pines." Phillips, Marshall, and Monson (1964), "Common summer resident in dense oaks, fairly common in pines and large pinons, throughout Arizona, except in north and northwest, where local."

B. Altitudinal range

Johnson (1965) noted in Nevada mountains birds between 6500-8100 feet on 7-8 June and mentioned another bird taken at 7200 feet on 26 June. Phillips, Marshall, and Monson (1964), "Has been recorded on migration in lowlands only six times... Lowland reports are mostly erroneous." Van Tyne and Sutton (1937) reported they took specimens in the Chisos Mountains, Texas between 5300-7300 feet. Wauer (1973), "Uncommon summer resident above 5000 feet in the Chisos Mountains from May through September 25. Lowland records are questionable; I have never found this tanager below the Chisos woodlands." Brandt (1951), "... it nests at between 5300 and 7500 feet in elevation (in the wooded mountain canyons)." Ligon (1961), "The summer range of the hepatic is largely centered in the Transition zone, above the 7500-foot level, but the bird may occur as low as 6500 feet. Young were noted at the head of the Mimbres River in the Black Range, 7000 feet, June 27, and in August in the Guadalupe Mountains at 6700 feet." Burleigh and Lowery (1940) recorded

Piranga flava (con't.)

oreophasma between 5800-8600 feet, noting (erroneously, I think) "that this species is not influenced to any marked degree by altitude."

C. Territory requirements

Nest site - Bent (1958), "The nest (3 eggs collected on May 26, 1922) was about 50 feet from the ground and about 12 feet out from the trunk, in a fork near the end of a horizontal branch of a tall yellow pine. It was suspended by its edges between the two prongs of the fork. It was made of green grass, green and gray weed stems, flower stalks and blossoms, and was neatly lined with finer dry and green grasses. After I left Arizona, Frank C. Willard collected a nest and two eggs of the hepatic tanager in Miller Canyon on June 15, 1922. The nest was placed at the tip of a branch of a large sycamore, 25 feet above ground. In the Thayer collection is a set, taken by O. W. Howard, that was found 19 feet from the ground in an upright fork of a madrona." Howard (1904) suggested that hepatic tanagers and other passerine species place their nests near active nests of Coues' flycatchers because the latter species can successfully repel jays and other nest predators. Observations were made in the Huachuca Mountains, Arizona. Brandt (1951), "On its level limbs (Douglas fir)... the hepatic tanager weaves its root-lined nest... The second group includes two birds that resort to the firs, apparently because of their decided preference for level branches on which to nest, and because they probably require more or less densely concealed hiding places; these are the long-crested jay and hepatic tanager... they prefer for their nesting sites at least the close vicinity of an area having the cold temperature that seems required for the prosperity of the fir trees... seem to have a predilection for placing their flat, basinlike abodes on the level, frond-like limbs of a fir... its preferred nesting tree is the fir, and wherever down currents of cold air are influential, thereby inducing the Douglas fir to prosper, here one is liable to find the nest of this exotic visitor. Seldom is its abode in the lower story of the tree, for the bird has no qualms about placing its cradle 60 feet above the rocky canyon floor." Oberholser (1974), "Nest: on mountains and within canyons; in juniper-pinyon-pine-oak forests; on branch of tree, usually horizontal..." Bailey (1928), "Nest - largely on low oak branches, a slight structure made of coarse rootlets and dried plant stems, lined with finer materials." Ligon (1961), "Nest: usually in walnut or oak trees, on horizontal branches 10 to 15 feet above the ground; rather frail, made of dry twigs and coarse rootlets; lined with softer materials." Scott (1883), "nest was on the outer branch of a live oak, and was an entirely similar structure to that of Piranga erythromelas, and contained three young birds." Rowley (1962) found nest above Cuernavaca that was "placed about ten feet up at the end of a horizontally growing pine branch."

D. Special habitat requirements

Brandt (1951), "In the case of the tanager, however, it does not care to go much above an elevation of 7500 feet, and consequently, does not follow the firs to the uppermost highlands, where, in suitable areas, these trees form considerable forests. If the tanager fed its offspring on a product of the firs, then most likely the bird would follow the tree to its optimum devel-

Piranga flava (con't.)

opment. On the other hand, we find that this tanager is a bird which inhabits only those firs growing at lower levels where, due chiefly to drafts of cold air and water, these trees develop small, outlier stands of Canadian zone. In turn, these habitat islands are generally surrounded by areas of Transition environment, while above on the hot canyon slopes there may even be a sea of live oaks, representative of the upper Austral zone. So here we have a case of a passerine bird which frequently builds its nest in a tree growing in a life area that essentially is ecologically different from that whence the bird secures the food for its young."

V FOOD

A. Food preferences

Johnson (1965) noted a bird feeding (apparently) on caterpillars. Marshall (1957), "These few observations and five stomachs taken in November and July indicate a diet of insects." Brandt (1951), "it seems to have a weakness for mulberries." Bailey (1928), "Those seen by Major Goldman in the Burro Mountains in the middle of September were feeding on wild grapes and wild cherries in a northeast slope canyon at 6500 feet..." From Vernon Bailey (MS): "One came regularly to eat a piece of beef put out on the fence at the back door of the cabin."

B. Foraging strategies

Marshall (1957), "Most of the hepatic tanager's foraging is in foliage ranging from that of low oaks to the upper parts of tall pines. The birds hop slowly and rather awkwardly among the branches, constantly stopping to peer at the foliage. One pair fed in scrubby second-growth oaks and Chihuahua pines. The two birds stayed together and hopped slowly among the ends of the lowest branches, reaching deliberately out among the leaves and grasping objects in their bills. They flew low from one tree to the next, and once the female hopped along the ground to pick up something. Occasional graceful, long, and successful insect-capturing flights were seen. Usually the bird took the flying insect by only a slight deviation in its direct course to a new perch. One left the center of a tree and dipped its head to pick something from the outer foliage, on its way to the next tree, where it sat and swallowed this prey. Another fed by leaping from branches into the foliage of Quercus viminea. The birds are attracted to flowers of agaves, madrones, and oaks. Practically every available kind of tree is used for foraging. Pairs are usually found: the members stay close together as they forage, and one follows the other in swift flight, sometimes from one side of a large canyon to the other." Wetmore (1921), "In feeding they worked methodically, flying from tree to tree... Usually they alighted among the lower limbs and then worked out on the tips of the branches, flut-tering up from limb to limb toward the top. Once a male dropped to the ground after an escaping insect."

VI REPRODUCTION

A. Age of first breeding

Scott (1883), "The males noted breeding in the greenish yellow plumage were as accomplished as songsters as were the brilliant males, but I think the females do not sing." Popper (1951), "One bird that sang precisely like a male P. flava had a much different appearance. Reddish coloring appeared only on its cap, instead of being the dominant color. The throat was light yellow, the rest of the underparts darker yellow, the back as of a female tanager. Perhaps this was a yearling male." Edwards and Lea (1955), "One male taken on April 2 was colored much like a female but was somewhat more orange on the throat and top of the head. It had been singing persistently and its testes were slightly enlarged." Van Tyne and Sutton (1937), "An immature male taken on May 24, 1932, was in breeding condition. The plumage of this specimen is like that of the female except that it is slightly greener above and the tail is somewhat tinged with orange instead of greenish yellow."

B. Territorial behavior

Marshall (1957), "The hepatic tanager seems to be strongly territorial, which results in frequent bickering and chasing. Its song, the most conspicuous in the dawn chorus, begins while the caprimulgids are still singing. It continues for a half hour or so while the males are stationary in their respective pines. Six or seven can be heard from the same observation point. Later, they begin to move widely, singing from various trees for a while; then most are still until the next day." Cruden and Hermann-Parker (1977) provide evidence that hepatic tanagers defend a feeding territory in Mexico against orioles and other species.

C. Nesting phenology

Oberholser (1974), "Breeding: early May to late August." Van Tyne and Sutton (1937), "The male and female taken at Mount Ord on May 29 were feeding young in the nest." Wauer (1973), "I found a nest on a pinyon pine near the lodge on May 12, 1968, and an adult male was seen carrying food near there on June 10, 1967." Brandt (1951), "This tanager has been known to have nests with fresh eggs as early as May 20, and as late as June 23, but the height of the season is around the last days of May." Bent (1958), "Egg dates-Arizona: 16 records, May 21 to July 10; 8 records, June 1 to June 19. New Mexico: 1 record, June 29."

D. Post-breeding behavior

Oberholser (1974), "It is normally found singly or in pairs, but family parties or autumn groups may number five to ten individuals."

Piranga flava (con't.)

II POPULATION PARAMETERS

A. Clutch size

Bent (1958), "Four eggs usually make up a full set for the hepatic tanager, but often only three are laid and rarely as many as five."

B. Habitat density figures

Balda (1970) found that there were 3 pairs per 100 acres in an oak-juniper-pine woodland and 1 pair per 100 acres in oak woodland in Chiracahua Mountains, Arizona study areas.

VIII INTERSPECIFIC INTERACTIONS

A. Parasitism

In Bent (1958), "Frank C. Willard told me that he found an egg of the bronzed cowbird in a nest of an hepatic tanager. This is probably a rare occurrence, for I can find no such report by anyone else." Rowley (1962) reported a nest of this tanager was found above Cuernavaca which contained three tanager eggs and two eggs of the red-eyed cowbird with incubation commenced." Friedmann (1971), "To the two previous records of the hepatic tanager as a victim of the bronzed cowbird may be added a third... a parasitized nest containing three eggs of the host and one of the parasite collected at Rancho Vicente, Cerro Baul, Oaxaca, Mexico, 28 May 1966, by J. Stuart Rowley, and presently in the museum of the Western Foundation of Vertebrate Zoology. This is the first record for this tanager (subspecies P. f. hepatica) as a victim of the southwestern race of the bronzed cowbird (M. a. assimilis), the previous records having to do, one each, with the two other races of the parasite, M. a. aeneus and M. a. loyei."

IX STATUS

A. Environmental quality: adverse impacts

Oberholser (1974), "The existence of the hepatic tanager as a breeder in Texas seems precarious. For many years, especially since 1950, droughts, insects and overgrazing have been killing mature junipers, pines, and oaks within the Trans-Pecos. By 1972, only the Guadalupe Mountains, highest in Texas, still maintained extensive acreage suitable for this species. In the Davis and Chisos Mountains to the south-lower and drier-this tanager's habitat looked poor in the 1960's. However, in the Chisos, an adult male was seen carrying food near the Basin lodge, June 10, 1967, and a nest was discovered in the same area, May 12, 1968 (Wauer)."

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LAZULI BUNTING
Passerina amoena

I TAXONOMY

A. Type description

Emberiza amoena - AOU (1957) Say, in Long, Exped. Rocky Mountains, Vol. 2, 1823. Rocky Mountains, source of the Arkansas = near Canyon City, Colorado.

B. Current systematic treatments

Shows a close relationship between Lazuli and Indigo (P. cyanea) buntings, but should remain separate species (Thompson, 1976). P. amoena is monotypic - i.e., no subspecies (Paynter, 1970). Hellmayr (1938) recognizes only one race of Lazuli bunting - Passerina amoena (Say). Species within the genus Passerina are very similar in their skeletal characters; stated that earlier classification of Hellmayr (1938) and Paynter (1970) are adequate (Hellack and Schnell, 1977). Phillips, Marshall, and Monson (1964) consider the Lazuli a subspecies of the Indigo, referring to the former as P. cyanea amoena.

Synonomies - Spiza amoena; Cyanospiza amoena; (Grinnell and Miller, 1944). Emberiza amoena; (Paynter, 1970). Emberiza amoena; Fringilla amoena, Spiza amoena; Cyanospiza amoena; Passerina asserina; (Ridgway, 1901). Lazuli finch; (Dawson, 1923). Lazuli finch; Lazuli painted finch; blue linnet; (Grinnell and Miller, 1944).

C. Hybridization

Hybridizes with P. cyanea in Great Plains (Paynter, 1970). McCaskie (1973) notes male Indigo mated to a female Lazuli; young were seen off the nest 10 June. Bleitz (1958) notes a male Indigo mated to a female Lazuli in Soledad Canyon, Los Angeles County, California, on 10 June, 1956. Eggs were sterile. Sibley and Short (1959) gives extensive review of P. amoena and P. cyanea hybrids; includes weights, measurements, descriptions. Kroodsma (1975) study extends documentation of hybridization between P. amoena and P. cyanea northward; discusses the identification of hybrid characteristics. Emlen, Rising, and Thompson (1975) give extensive examination of hybridization in P. amoena; includes color plates of hybrids.

II DESCRIPTION

A. External morphology of adults

Male: a small bright blue finch... band across breast and sides cinnamon (Peterson, 1961). Male: length 5-5.5 inches, wing 2.8-3, tail 2.1-2.3, bill 0.4. Female: length 5-5.4, wing 2.6-2.8, tail 2-2.3, bill 0.4 (Bailey, 1928). Length of adult male: 133.3-139.7 mm (5.25-5.50 inches); wing 73 (2.87); tail 55 (2.17); bill 10 (0.40); tarsus 17 (0.67). Female smaller (Dawson, 1923).

Passerina amoena (con't.)

B. External morphology of subadult age classes

Ridgway (1901), "Young - similar to adult female but rump and upper tail-coverts light brown, without bluish or greenish tinge, and usually with chest and sides narrowly and indistinctly streaked. Immature males have the blue, especially on the upper parts, more or less clouded or overlaid by cinnamon-brown."

C. Distinguishing characteristics

Interspecific - Robbins, Bruun, and Zim (1966), "... suggests a bluebird except for the wingbars... told from sparrows by the plain, unstreaked, brown back; from Indigo buntings by the broad whitish wingbars." Bent (1968), "Its song resembles that of the Indigo bunting but is... weak, less warblerlike, definite, and not rambling."

Intraspecific - Dawson (1923), "Young birds resemble female... streaked below on chest and sides."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Breeds from southern British Columbia, northwestern and central Montana, southern Saskatchewan, central North Dakota, and northeastern South Dakota south to northwestern Baja California, southeastern California, southern Nevada, southwestern Utah, central Arizona, northern New Mexico, and western Oklahoma; east to eastern Nebraska and western Kansas. Winters from southern Baja California and southern Arizona south to Guerrero and central Vera Cruz (AOU, 1957). Ridgway (1901), "Western United States and British Provinces; north to British Columbia, Idaho, Montana, etc.; south (in winter) to Cape St. Lucas, Sinaloa, Durango, and Valley of Mexico; east nearly or quite across the Great Plains to South Dakota, Kansas, etc." Peterson (1961), "Breeds from southern British Columbia, southern Alberta, southern Saskatchewan south to northwestern Baja California, southern Nevada, central Arizona, northern New Mexico; east to central North Dakota, northeastern South Dakota, central Nebraska, and western Kansas." Western North America from southern British Columbia, southern Saskatchewan, and North Dakota south to northern Baja California, central Arizona, northern New Mexico, and western Oklahoma and east to northeastern South Dakota, eastern Nebraska, and western Kansas; winters from southern Baja California, southern Arizona (rarely), and Chihuahua south in Mexico to Guerrero and Vera Cruz (Paynter, 1970). Hellmayr (1938), "Range - western North America, from southern British Columbia and Alberta, southeastern Saskatchewan, and northwestern North Dakota south to northwestern lower California, northern Sonora, and western Texas; winters in Mexico."

B. California distribution of the species

Grinnell and Miller (1944), "Breeds throughout state except on coastal islands and in lower Sonoran deserts of southeast." Bent (1968), "In

Passerina amoena (con't.)

California... occurs as a migrant in all seasons... except on the coastal islands and the lower Sonoran deserts of the southeast." Dawson (1923), "Of general occurrences as a breeder... throughout the state." Sharp (1907), "Lazuli bunting - Common but somewhat irregular in its appearance. April 30 to June 2" near Escondido, California. Noted in Visalia and Porterville during May (Ray, 1906). P. amoena noted breeding in Piedmont, Alameda County, California, in 1933 (Dyer, 1933). Noted September 1-8, but few records are available from the Channel Islands (Pitelka, 1950). Male P. amoena noted in June on the Farallons (Dawson, 1911).

C. California desert distribution

Grinnell and Storer (1924), "... does not inhabit at nesting time the dry chaparral." Small (1974), "range in California - length of state for breeding (except southeastern deserts)." Given as a "less common fall migrant" in the Death Valley (Wauer, 1962). Stephens (1903), "Lazuli bunting - Seen only near Needles and Ehrenberg." A pair of Lazuli buntings noted 20 August in Death Valley; "not regularly seen in the Valley" (Gilman, 1937).

D. Seasonal variations in distribution

The northward migration from Mexico begins in late March and the birds reach the Pacific coast in April (Bent, 1968). Small (1974), "Seasonal status (in California, ed.) - summer visitor, mid-April to early September." Lamb (1912), "In the spring they did not arrive until May 14" in the Mojave desert. Dawson (1923), "Occurs more widely during migrations at lower levels. No winter records." Peterson (1961), "Winters in southern Arizona, Mexico." Arrival date (earliest): 17 April (1934) at Twentynine Palms (Carter, 1937). P. amoena - Uncommon spring and fall migrant from May 20 to June 28 (spring) and from August 22 to September 17 (fall) in southern Nevada (Guillion, Pulich, and Evenden, 1959). Listed as a migrant in May, only (southern Arizona and Mexico, ed.) (Marshall, 1957). Turner (1972), "northward migration begins in late March." Spring migration of P. amoena noted shortly before 15 April (Gaylord, 1899). Average arrival date (n = 17 years) given as 23 April; latest departure 28 August (Allen, 1933). P. amoena noted from 15 April to 11 September in Monterey County, California (Linsdale, 1947).

IV HABITAT

A. Biotopic affinities

Lazuli buntings prefer areas with high shrub density and low ground cover (Whitmore, 1975). Thompson (1976), "It occupies dry, brushy canyon slopes and hillsides... prefer the interface between open fields and woodlands." Robbins, Bruun, and Zim (1966), "Found in scattered deciduous or scrub growth, especially near water." Dawson (1923), "... to brushy margins of springs and streams in semi-arid Sonoran territory." Peterson (1961), "Sage, broken brushy slopes, briars, burns, streamsides." P. amoena nest

Passerina amoena (con't.)

in canyons with a water supply (Wauer, 1964). Clumps of bushes, broken chaparral; occurs near springs and streams in arid regions (Grinnell and Miller, 1944). Breeding activity noted in mixed shrub and pinons (Johnson, 1974). Phillips, Marshall, and Monson (1964), "... in willow associations of the Sonoran zones." Willett (1908), "Lazuli bunting - Rather common in river bottom." Jenkins (1906), "Abundant on all the dryer hillsides from Monterey to San Carpojo." Habitat: rose bushes, willows, gooseberry, and Symphoricarpus thickets (Grinnell, 1905). Snodgrass (1904), "Common everywhere except in arid sage-brush regions" in Washington. Oberholser (1974), "favors dry, brushy, semiopen hillsides... frequents willows and stream-side thickets (Texas, ed.)." Linsdale (1936), "never far from streams... avoids the sage brush tracts and resorts to the... shrubbery." Bailey (1928), "Though not interested in sagebrush... is attracted by wild rose, wild plum, and gooseberry thickets, willows, alders, and chaparral."

B. Altitudinal range

Grinnell and Miller (1944), "Altitudes of nesting range from near sea level... to at least 7500 feet in the Warner Mountains." Noted from about 3000 to 6500 feet in the Panamint Mountains, California (Wauer, 1964). Johnson (1974), "singing males... at 5600 and 6700 feet elevation." Seventy-eight hundred feet given as normal upper limit; noted breeding at 7000 feet in northern New Mexico (Ligon, 1961). Grinnell and Storer (1924), "... Lee Vining Creek at 9000 feet" (in California, ed.). Bent (1968), "to elevations of 10,000 feet in the Sierras." P. amoena called rare above 4500 feet in Sierra Nevada (Barlow, 1901). Noted at 7000 feet; called rare above 4500 feet in Sierra Nevada (Ray, 1903). Linsdale (1936), "were most common from 5000 to 7000 feet, but occurred to 8000 feet" in Pine Forest Mountains, Nevada.

C. Territory requirements

Perch sites - Stevenson (1936), "Yellow pine" used as perch sites by singing males. Bent (1968), "male sang from the top of a 6 foot live oak." Grinnell and Miller (1944), "song posts... tops of tall trees if these are present." Grinnell and Storer (1924), "... males perch at the tops of the taller bushes... singing males were spaced about 100 to 200 yards apart."

Nest sites - Nest sites (several given) are usually about 1.5 to 4 feet high; in willow clumps, rose tangles, chaparral, small pines, scrub oak, stalks of weeds; Artemisia listed as preferred site in southern California (Bent, 1968). Grinnell and Miller (1944), "Plants... on the nesting territory are: Artemisia vulgaris, A. californica, poison oak, rose and blackberry thickets, thistle patches, low growths of willows, and Ceanothus cuneatus." Dawson (1923), "... nesting - at least in southern California - Artemisia heterophylla... 14 were in pure stands of A. heterophylla; 2 in mixed stands; 2 in poison oak; and 1 in a blackberry tangle." Peterson (1961), "A loose cup in bush." Grinnell and Storer (1924), "Its nest was 18 inches above the ground in the crotch of a small chokecherry... another nest... was 4 feet above the ground in a mountain

Passerina amoena (con't.)

lilac." Nest in low sagebrush (Artemisia sp.) (Guillion, Pulich, and Evenden, 1959). Nest noted 1 foot high in an "iron weed" patch near Escondido, San Diego County, California (Carpenter, 1907). Gilman (1907), "nesting in the small wild cherry shrubs and in the wild roses." Bolander (1907), "nest... was built in a live oak bush about three feet from the ground." Barlow (1901), "... nest and four fresh eggs... bush about three feet high." Cohen (1900), "nests... all situated in bushes on the high bank of a creek in the foothills, all about three and a half feet from the ground." Lamb and Howell (1913), "nests were located within a small space among the weeds" in the Tejon Mountains. Jensen (1923), "nest placed 8 feet up in a bunch of willows on the river bank... Altitude 7100 feet." Ligon (1961), "nest: in rose bushes, willows, and other low-growing shrubs, usually near water." Merriam (1896) notes two nests in San Diego County - one place in mallows, and another in a eucalyptus. Shows contrast in nest sites.

D. Special habitat requirements

P. amoena made heavy use of water during winter in California (upper Carrizo Spring, Riverside County.) (Smyth and Coulombe, 1971).

V FOOD

A. Food preferences

Omnivorous; take grasshoppers, caterpillars, bees and ants, several weed seeds, and the like (Bent, 1968). Oberholser (1974), "it forages for seeds of needlegrass, canarygrass, bluegrass, filaree, and others; also grasshoppers, caterpillars, beetles, and cicadas." Diet - weed seeds, insects, "alfalfa weevil", "codling moth" (Bailey, 1928). Miller (1939) noted feeding on canarygrass (Phalaris californica) near Berkeley, California.

B. Foraging areas

Forages in bushes, lower parts of trees, and on the ground (Oberholser, 1974). Grinnell and Miller (1944), "Foraging takes place in... low dense tangles."

C. Foraging strategies

A male P. amoena was noted feeding on grass seeds by pulling-off flower heads while in flight; bird then returned to perch in order to open seeds. Detailed account (Miller, 1939). P. amoena observed feeding on twigs, flower clusters, and on the ground; several cases of "hawking" insects are noted (Bent, 1968). Cameron (1908), "hover... on the open prairie when searching for grasshoppers or grubs..." Classified as a member of the "ground-seed" foraging guild in Glen Oaks Canyon, Glendale, California (Salt, 1953). P. amoena described as a member of the "ground-brush foraging guild" (Bock and Lynch, 1970).

Passerina amoena (con't.)

D. Feeding phenology

Diet consists of 64% animal matter in spring, and 53% animal matter in summer (Martin, Zim, and Nelson, 1951).

E. Energy requirements

P. amoena, and other fringillids, require less energy than smaller, more active birds (i.e., chickadees and kinglets) (Bock and Lynch, 1970).

VI REPRODUCTION

A. Territorial behavior

Bent (1968), "The males regularly arrive first, take up territories in suitable breeding areas, proclaim their presence by singing from a series of conspicuous song perches within the chosen areas, and defend them." Three nests in Alameda, California, noted within several yards of each other (all active) (Cohen, 1900). Grinnell (1914), "In May... singing males were spaced out along Strawberry Creek." Sutton (1943), "It sang loudly... as if advertising or defending a nesting territory." Emlen et al (1975), "defending territories... with the result that suitable habitat was subdivided into a series of non-overlapping, interspecific territories" - includes map of territories.

B. Courtship and mating behavior

Oberholser (1974), "Lazuli males sing from mid-April into June, usually from atop a tall bush or tree, from a high wire, or sometimes in flight." Gives several accounts of courtship behavior - "her wings spread and quivering... the male again flew to her and mounted her" (Bent, 1968). Thompson (1976), "... the female solicits the male to copulate." Dawson (1923), "... while the female lurks... he mounts a spray and yields an outburst of music." Youngworth (1935) notes a male Lazuli courting a female Lazuli and a female Indigo; outcome unknown.

C. Nesting phenology

Bent (1968), "In California nesting occurs in May and June and on into July" - Lists breeding dates from throughout the species range; two broods are sometimes raised. Wauer (1964), "Nesting Lazuli Buntings... in May and June." Season: May-July; one or two broods (Dawson, 1923). Finley (1906), "it took four weeks for these birds to build a nest and start their brood of young into the world." Merriam (1896) reported finding pair breeding 30 April in San Diego County.

D. Length of incubation period

Incubation period = 12 days (Bent, 1968). Incubation = approximately 12 days (Finley, 1906).

Passerina amoena (con't.)

E. Length of nestling period

Bent (1968) gives many detailed accounts of parental care of the young; female does about 80% of the feeding of the young. Nestling period = 10 days. Finley (1906) reported nestling period = approximately 10 days.

F. Post-breeding behavior

Bent (1968), "After breeding it may be found at even higher elevations. After nesting... move about and congregate in areas of suitable food."

VII POPULATION PARAMETERS

A. Clutch size

Average clutch of 4 eggs; range = 3-5 eggs (Bent, 1968). Ligon (1961), "Eggs: 3 or 4; plain bluish white or pale greenish blue, sometimes spotted." Clutch size of 5 eggs listed for Montana (Cameron, 1908). Cohen (1900), "An instance of three nests of four eggs each" in Alameda, California.

B. Habitat density figures

Density figures for P. amoena ranged from 0.0 to 20.8 birds/40 ha during a study in Nevada County, California (Beaver, 1976). Bent (1968), "The size of the territory has not been clearly established" - states that males were spaced every 100-200 yards on a hillside in Santa Barbara. Twenty-four and one/tenth breeding pairs/100 acres noted for P. amoena in the Palouse prairies of the northwest (Wing, 1949). Density = 50 birds per 100 acres (Salt, 1957). Density ("density index; see text) was lowest in sagebrush plains and highest in dense chaparral brushland and Festuca Prairie (Dumas, 1950). Disturbed floodplain woodland: Lazuli bunting = 40 territorial males/km² (Van Velzen, 1972). Chaparral (near Oakland, California): Lazuli bunting = 4.0-4.5 males/100 acres (Bridge and Bridge, 1965). Coastal chaparral (near Oakland, California): Lazuli bunting = 2 males/100 acres (Hall, 1961). Bushy foothill (Ramona, California): Lazuli bunting = 5 males/100 acres (1 male observed on 20 acre site) (Bond, 1956). Density of Lazuli buntings ranged from 4 birds/100 acres to 24 birds/100 acres. Figures are given for 5 oak stands during all periods of the year (Anderson, 1970). Density of P. amoena given as 0.2 pairs/100 acres on a burned forest plot in the Sierra Nevada (Bock and Lynch, 1970).

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1968), "A loggerhead shrike... killed an immature Lazuli bunting."

B. Competition

Davis, Fisler, and Davis (1963) notes interspecific interactions of western flycatchers and Lazuli buntings during nesting. P. amoena was driven from

Passerina amoena (con't.)

gnatcatcher nest sites. Author suggested interspecific competition between these species for nest sites (Root, 1969). Whitmore (1975) notes aggressive behavior and probable competition (breeding season) between Lazuli and Indigo buntings. Sites several cases where both male and female buntings chased intruding conspecifics (Bent, 1968). Edwards (1919) notes nest preemption of P. amoena by white-footed mouse. P. cyanea invading western range of P. amoena, the former cited as being the more aggressive of the two (Wells, 1958).

C. Parasitism

Hanna (1918) notes cowbird parasitism in eastern San Bernardino on 4 July, 1918 of P. amoena. Cowbird eggs (1 or 2) found in 3% of P. amoena nests examined in San Bernardino (Hanna, 1928). P. amoena nest with one cowbird egg; incubation "well advanced" (Stoner, 1937). Nesting attempt of a male Indigo and a female Lazuli bunting was deserted (eggs sterile), and parasitized by a cowbird (Molothrus ater) (Bleitz, 1958). King (1954), "this species is very heavily parasitized by the cowbird." Friedmann (1971), "It is now known to rear the young cowbirds and to be truly a fosterer for the parasite."

D. Interspecific associations

Crouch (1943) noted as a regular associate of the phainopepla in San Diego County; "little friction is evident among them". P. amoena noted in frequent association with chipping sparrows at Twentynine Palms (Carter, 1937). Were noted in association with chipping sparrows during migration at Twentynine Palms (Bent, 1968).

IX STATUS

Grinnell and Miller (1944), "Status - summer resident from end of April to August; common. Of widespread occurrence as a migrant in late April and early May and in August... September." Lamb (1912) cited as very rare in the Mojave desert of California. Apparently has increased slightly in southern Nevada mountains since 1940 (Johnson, 1974).

A. Past population trends

Bent (1968), "has rapidly invaded the lumbered areas in the vicinity of Humboldt Bay... It has spread into the irrigated parts of... states where the water has changed sagebrush or other unsuitable habitats into suitable ones." Turner (1972), "planting of shelterbelts and control of fire has allowed... species to expand their ranges" (referring to Lazuli and Indigo buntings). Called a common migrant in Los Angeles, California; nesting unusual (Swarth, 1900). P. amoena declining in numbers towards the end of a 10-year study in Monterey County, California (Linsdale, 1947).

B. Population limiting factors

Bent (1968), "It can not seem to adapt itself to a populous human environment. In the more arid regions it is commonly restricted to the brushy

Passerina amoena (con't.)

cover around springs or streams." Dependent upon abundant moisture during the breeding season (riparian habitats) (Johnson, 1965).

Passerina amoena (con't.)

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BROWN TOWHEE
Pipilo fuscus

I TAXONOMY

A. Type description

Pipilo fuscus eremophilus - AOU (1957) van Rossem, Trans. San Diego Soc. Nat. Hist., 8, No. 11, August 24, 1935. Lang Spring, 5500 feet altitude, Mountain Springs Canyon, Argus Mountains, Inyo County, California.

van Rossem (1935) noted subspecific characters - Most closely resembles Pipilo fuscus carolae Mc Gregor of the Sacramento - San Joaquin Valley of California, but bill smaller, tarsi and toes decidedly shorter, and coloration slightly darker and grayer. Resembles Pipilo fuscus crissalis of the Pacific slope of southern California, but wing and tail longer, bill much more slender, both in lateral and vertical profile, and coloration grayer.

B. Current systematic treatments

Peters (1970) recognizes 18 races of P. fuscus including P. f. eremophilus.

Hellmayr (1938) recognizes 15 races of Pipilo fuscus, including eremophilus.

Dawson (1954) recognizes nineteen subspecies at present.

Grinnell and Miller (1944) - Pipilo fuscus crissalis, part; Pipilo crissalis crissalis, part; Pipilo crissalis senicula, part. California towhee; Argus Mountains towhee, brown towhee and Argus towhee. (Synonomies).

II DESCRIPTION

A. External morphology of adults

van Rossem (1935) reported the gray, dark coloration of the desert race is more pronounced in the single juvenile than in the worn adults. Since wear tends to obscure comparative color values between races of this species it seems likely that fresh-plumaged adult specimens will show even more definite differences than are apparent in worn species. Verner and Willson (1969) noted the species is "sexually monomorphic".

B. External morphology of subadult age classes

Bent (1968), "At the time of leaving the nest the fully feathered juvenile has a bobbed tail and is in a lacy brown coat with spotting on the chest, somewhat like that of a thrush" (for subspecies P. f. mesoleucus). During October the post-juvinal molt is completed in the same subspecies.

C. Distinguishing characteristics

Interspecific - Davis (1951), "More important, eremophilus is so obviously a member of the "crissalis" group that any minor coloration differences

Pipilo fuscus (con't.)

between this race and its neighbors are neither 'toward' nor 'away' from the radically different mesoleucus, but merely reflect adaptive response to the features of the local environment."

III GEOGRAPHICAL DISTRIBUTION

Miller (1941) notes the subspecies closest relatives occurring to the west in the Kern River basin.

A. California distribution of the species

Bent (1968), "This very restricted race of the brown towhee is considered a relict population of a group formerly more widely distributed but now confined by the deserts surrounding the Argus Mountains." Small (1974) reported California range of species - absent from extreme northern, north-eastern, eastern, and southeastern portions of state; not found in west edge of San Joaquin Valley; widespread elsewhere.

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944) noted habitat of subspecies eremophilus "In, or near to, willow thickets which grow at permanent springs or seepages in canyons. In foraging, and even in nesting, ranges out into adjacent desert brushland of canyon slopes."

B. Home range size

Bent (1968) noted territory for P. f. mesoleucus: Each pair of canyon towhees lives by itself in an area whose size is such that the pairs are generally spaced about 300 yards apart. For subspecies petulans: Individual territories may be over 5 acres (Berkeley Hills).

C. Territory requirements

Bent (1968) reported the species maintains a typical passerine territory providing all the necessities for its comparatively sedentary life.

Perch sites - Bent (1968) noted the subspecies mesoleucus roosts in dense bush 4-8 feet off the ground.

Nest sites - Peterson (1961) reported nest of species: "A cup in bush or low tree."

V FOOD

A. Food preferences

Bent (1968) noted food: seeds in winter and insects in summer for mesoleucus.

Pipilo fuscus (con't.)

B. Feeding phenology

Dawson (1959) noted in all probability, birds of this subspecies P. f. senicula depend primarily on the tissue fluids of insects and to a lesser extent on fruit for free water during the drier parts of the year.

C. Energy requirements

Long (1973) reported standard metabolism of species 13.7 kcal/24 hour.

VI REPRODUCTION

A. Territorial behavior

Bent (1968) noted male of the species defends his territory vigorously from all encroachment by others of his species. Verner and Willson (1969) reported males of the species guards nest during incubation.

B. Courtship and mating behavior

Bent (1968) reported courtship of mesoleucus: as canyon towhees probably mate for life (perhaps only 2 or 3 years at best), there is seldom the opportunity to observe the first meeting of the two mates, though it is conceivable that this might take place in fall when groups of young having become independent of their parents, scatter and cross paths. Copulation of petulans may occur on the ground, but on one occasion it was observed on the top of a three-story building. Courtship behavior has not been described in great detail. On several occasions during the breeding season the male has been observed approaching the female with wings slightly drooped and quivering.

C. Nesting phenology

Verner and Willson (1969) noted males of the species feeds young during fledling period. Long (1973) reported egg weights as 4.75 g and shell weights as 0.39 g. Phillips (1951) cited late molt in the species.

D. Length of incubation period

Bent (1968) reported no accurate data are available on the length of the incubation period in this race - P. f. mesoleucus. Verner and Willson (1969) noted male of the species incubates or covers eggs.

VII POPULATION PARAMETERS

A. Clutch size

Peterson (1961) reported eggs of species spotted. Clutch size 3-4.

B. Longevity

Bent (1968) noted longevity of P. f. mesoleucus is perhaps only 2 or 3 years at best.

Pipilo fuscus (con't.)

C. Seasonal abundance

Small (1974) noted seasonal status of species: common resident.

D. Habitat density figures

Grinnell and Miller (1944) reported status of subspecies eremophilus: "Permanently resident. Numbers small, and exceedingly localized as to occurrence."

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Anderson (1965), "A bullfrog was observed to capture and eat an adult brown towhee in W. Howard, Copeia, 1950:152." Zimmerman (1970) reported brown towhees often voice alarm calls when detecting a roadrunner. Stensrude (1965), "On several occasions adult brown towhees and unidentified fledgling birds were carried to the nest."

B. Parasitism

Friedmann (1971) noted the species has been found to be "true fosterers, not merely passive victims." Bent (1968) reported two records of parasitized by brown-headed cowbirds in New Mexico. Bent (1968) noted external parasites of the families Ricinidae and Hippoboscidae have been found on specimens banded near Tucson.

IX STATUS

no information located

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ABERT'S TOWHEE
Pipilo aberti

I TAXONOMY

A. Type description

Pipilo aberti dumeticolus - AOU (1957) van Rossem, Condor, 48, No. 2, April 2, 1946. Three miles northwest of Calexico, Imperial County, California, altitude -3 feet.

van Rossem (1946), "type - male of the year in complete, new, fall plumage, No. J.-1429 Dickey collection taken 3 miles northwest of Calexico, Imperial County, California, altitude -3 feet, October 13, 1921; collected by A. J. van Rossem."

B. Current systematic treatments

Peters (1970) recognizes 3 races including P. a. dumeticolus.

Marshall (1960) noted Abert towhee arose from the California towhee, after the latter had become geographically isolated from the canyon towhee (Davis, 1951:98-99). Grinnell and Miller (1944), Pipilo abertis; Pipilo aberti. Abert finch, Abert towhee.

II DESCRIPTION

A. External morphology of adults

van Rossem (1946), "subspecific characters - entire plumage generally paler and redder than in Pipilo aberti aberti Baird of Arizona. Upper parts in fresh plumage snuff brown instead of hair brown; under parts avellaneous with a distinct cinnamon tinge instead of fawn color; chin and throat with dark streaking narrower and usually with only the extreme point of the chin dusky. Size generally similar to aberti but tail shorter and bill less deep at base." Verner and Willson (1969) noted the species is "sexually monomorphic".

B. External morphology of subadult age classes

Bent (1968), "Birds undergoing the post-juvenile (first fall) molt retain the primaries and secondaries, and usually the rectrices."

C. Distinguishing characteristics

van Rossem (1946) noted the lighter, more russet and cinnamon tones which characterize the new race, as compared with the more grayish and pinkish tones of aberti, are most pronounced in fresh plumage but are apparent in most specimens even into March and April - Interspecific.

Davis (1951), "From dumeticolus, aberti differs in darker, grayer pileum and dorsum, and grayer underparts with a pinkish rather than cinnamon suffusion" - Intraspecific.

Pipilo aberti (con't.)

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957) notes southern Nevada, southwestern Utah, central Arizona, and southwestern New Mexico south in the Colorado River drainage to southeastern California, northeastern Baja California, northwestern Sonora, and southeastern Arizona. Range - resident in the valleys of the Virgin and lower Colorado Rivers from southwestern Utah (St. George) to northeastern Baja California and northwestern Sonora, and in the Salton Sea Basin of southern California (west of Whitewater).

B. California distribution of the species

Small (1974) reported species range in California: lower Colorado River Valley; Imperial and Coachella Valleys of Colorado desert. Seasonal status of the species: resident.

C. Seasonal variations in distribution .

Grinnell (1904), "Immediate vicinity of the Springs, and several on hill-side just back of town. Palm Springs is doubtless its westernmost station." Hollister (1908), "Breeding on the California side about Needles where many full grown young were seen early in May." Extremely abundant in the river bottoms (Price, 1899). Grinnell (1912), "Far more numerous than in December, 1903."

IV HABITAT

A. Biotopic affinities

Bent (1968), "In the Imperial Valley of California I have observed them occurring frequently in a reed (Phragmites communis), and somewhat less commonly in a species of Baccharis, and in an introduced tree, Tamarix gallica." Swarth (1905), "breeds in limited numbers in the mesquite forests." Davis (1951) noted P. a. dumeticolus of the Virgin and Colorado Rivers and the Colorado desert in California has much the same habitat preferences as typical aberti. Dawson (1954) reported in the riparian woodland community, the most important plants with which the Abert towhee is associated are willows (Salix), arrowweed (Pluchea), and, on the Alamo River, a reed (Phragmites). In the desert scrub, this towhee is associated mainly with mesquite (Prosopis) and saltbrush (Atriplex). The Abert towhee is divided into two subspecies, both of which occupy areas where very high summer temperatures prevail. Grinnell and Miller (1944) noted life-zone strictly lower Sonoran. Breninger (1901), "common along the river and about mesquite growths."

B. Altitudinal range

Grinnell and Miller (1944) noted altitudes of known occurrence range from about 200 feet below sea level, as near Mecca, Riverside County, to 11,000 feet above at Whitewater, same county.

Pipilo aberti (con't.)

C. Territory requirements

Davis (1951) noted three plants are important above all others as nest sites and cover. These are mesquite, willow, and arrowweed. Mesquite is apparently the most important as cover, and willow for nest sites.

Nest sites - Willard (1918) reported they frequently used exactly the same site year after year. Nest twelve feet up in a cavity near the top of a rotten cottonwood stump. Gilman (1915), "Eight nests found, with two and three eggs to the set. Three nests were in mesquites, two in Dondia bushes, two in Zizyphus shrubs, and one in an umbrella tree. Gilman (1903) reported nest in a pepper tree. Two nests found in orange trees. Nest in a desert bush about two feet from the ground. Peterson (1961) noted nest of species is a grass cup in bush, low tree. Bent (1968), "P. a. dumeticolus is known to nest in willows and mesquite and has also been recorded nesting in arrowweed and mistletoe clumps (Phoraden sp.) probably located in mesquite (van Rossem, 1911), and in such introduced plants as pepper trees (Schinus molle) and orange trees near Palm Springs, Riverside County, California (M. F. Gilman, 1903)."

V FOOD

A. Food preferences

Bent (1968) reported no comprehensive study of the food habits of Abert's towhees has been published, but presumably the general nature of their diet approximates those of the brown and the spotted towhees (P. fuscus and P. erythrophthalmus) analyzed in California by F.E.L. Beal, 1910 - animal material constituted 14% of the total food taken by the former and 24% of that by the latter.

B. Foraging strategies

Marshall (1960) noted as to bark feeding by Abert's towhee, Brewster, 1882 reported: "I have seen them hunting insects in the bark of large trees in a similar method to that of wrens". Dawson (1954) reported when water is available during hot weather the Abert towhee apparently makes extensive use of it. Marshall (1960) noted the Abert towhee, California towhee, and green-tailed towhee are known to scratch at above-ground feeding stations, where they scatter the seed as if the scratching instinct is so inextricably wound up with feeding that it cannot be halted when inappropriate.

C. Competition

Marshall (1960) reported all the observed contacts between Abert's and canyon towhees at the two study areas (near Tucson, Arizona) are summarized in the Table, where intraspecific and intergeneric conflicts are also indicated for comparison. These show that there is no more aggression, in the form of supplanting attacks and chases at food, between the two species of towhees than there is between them and other genera with which they do not seriously compete.

Pipilo aberti (con't.)

VI REPRODUCTION

A. Territorial behavior

Marshall (1960), "Territories of established pairs in each species are maintained all year. In fall and winter, however, the pairs wander over a larger area than the contracted nesting territory, and they then tolerate within what will become the nesting territory all other members of their species."

B. Nesting phenology

Verner and Willson (1969) noted male incubates or covers eggs. Also male in species feeds nestlings or fledglings. They raise two or more broods (Cooper, 1870).

C. Length of incubation period

Cooper (1870) reported incubation as twelve to thirteen days.

D. Length of nestling period

Cooper (1870) noted in a fortnight, the young left the nest.

VII POPULATION PARAMETERS

A. Clutch size

Bent (1968), "W.G.F. Harris writes: The Abert's towhee usually lays three or four slightly glossy eggs, sometimes only two and less frequently five." Cardiff and Cardiff (1950) noted September 16: four fresh eggs in nest. Bent (1968), "H. Brown, 1903 reported there is a single record of a clutch of five eggs, apparently for P. a. dumeticolus." The clutch size for birds of both subspecies range from two to four (C.K. Averill, 1933; F. M. Bailey, 1928; Bendire, 1890; van Rossem, 1911; and M.F. Gilman, 1903), with the usual number three (in Bent, 1968). Peterson (1961) noted eggs of species pale blue-green, scrawled. Hanna (1924) reported 17 eggs; 4.04 g average weight; sets showing maximum 5.59; minimum 3.82; normal 3.96.

B. Habitat density figures

Austin (1970) reported breeding pairs density of species per 100 acres. 1968: 2.0; 1969: 4.0 in Bosque.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1968), "A number of predators appear to prey on Abert's towhees at all stages in their life history, and Bendire (1890) suggests that snakes, jays, squirrels, hawks, and owls all take a toll of eggs, young, and, in some cases, adults."

Pipilo aberti (con't.)

B. Parasitism

Bent (1968), "Abert's towhees of both subspecies are occasionally parasitized by cowbirds (Molothrus ater obscurus).\" Friedmann (1931) noted two nests in Mesa, Arizona were parasitized by dwarf cowbirds. Bent (1968) reported two Helminth parasites have been found in Abert's towhees of the subspecies dumeticolus.

IX STATUS

A. Past population trends

Stephens (1903), "Rather common in the bottom lands of the Colorado River and its tributaries, of which this species is strictly limited."

B. Population limiting factors

Davis (1951) reported the restriction of the species to desert vegetation in the immediate vicinity of water, whether intermittent or persistent, implies a rather limited number of plant associations available to it.

Pipilo aberti (con't.)

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Pipilo aberti (con't.)

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RUFIOUS-CROWNED SPARROW
Aimophila ruficeps

I TAXONOMY

A. Type description

A. r. ruficeps - AOU (1957) Ammodromus ruficeps (Cassin), Proc. Acad. Nat. Sci. Phila., 6, 1852, p. 184. from Calaveras River (Stockton, California). Family: Fringillidae.

B. Current systematic treatments

A. ruficeps - Paynter and Storer (1970) recognized 12 races of ruficeps, including A. r. ruficeps. Wolf (1966) Aimophila genus is divided into 3 major groups. Aimophila ruficeps is in the ruficeps complex - ruficeps, rufescens, and notosticta. This group is set off from other species by its radiation in the pine-oak woodland of primarily Mexico and Central America. They have similar songs, similar plumage patterns including rusty head stripes. Storer (1955) The genus Aimophila contains 2 groups showing definite affinities, but Aimophila ruficeps is one of 4 species in this genera that shows no affinity towards either group. Mayr and Short (1970) state relationships within the genus are uncertain; it is an uncomplicated polytypic species.

A. r. ruficeps - AOU (1957) Listed 8 races of A. ruficeps, two of which occur in California: A. r. ruficeps: Central California and coast ranges, and A. r. canescens: Southwestern California (this does not include island races). Grinnell and Miller (1944) reported intergradation with A. r. canescens poorly known. Presumably it takes place in Kern County and south to San Luis Obispo County, possibly also Tulare County.

C. Synonymies

Scientific - A. r. ruficeps - Grinnell and Miller (1944) Ammodromus ruficeps; Ammodramus ruficeps; Peucaea ruficeps; aimophila ruficeps. Ridgway (1901), Ammodromus ruficeps; Ammodromus aramus ruficeps; Peucaea ruficeps; Peucaea ruficeps; Aimophila ruficeps.

Vernacular - A. r. ruficeps - Bent (1968), Western swamp sparrow. Grinnell and Miller (1944), Brown-headed finch; Red-capped finch; Rufous-crowned finch; Rufous-crowned sparrow; Rufous-headed sparrow.

II DESCRIPTION

A. External morphology of adults

Peterson (1961), "field marks; Note the black "whisker" bordering the throat. A dark sparrow with an unstreaked breast and rufous cap." Myers (1909) reported orange-skinned nestlings with tufts of black down.

A. r. ruficeps - Ridgway (1901) gives detailed description of adults, young, male and female.

Aimophila ruficeps (con't.)

B. Distinguishing characteristics

Interspecific - A. r. ruficeps - Simpson (1925), "field mark which distinguishes it most readily from chipping sparrow is dark stripe running from base of bill down each side of throat." Bent (1968) A. r. ruficeps is lighter than A. r. obscura, reds and grays are lighter than A. r. canescens and is generally darker than A. r. sororia. In the juvenile: A. r. ruficeps is lighter than A. r. canescens and A. r. obscura. Grinnell and Storer (1924) A. r. ruficeps resembles Bell and Nevada Sage sparrows but it is brown rather than grayish; it possesses a reddish brown crown patch and has no dark spot on chest. Its niche is different, and does not perch in prominent perches.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Central California, central northern Arizona, southwest New Mexico, southeast Colorado, and northwest and central Oklahoma, south discontinuously to southern Baja California, Guerrero, Oaxaca, and central western and northern Veracruz."

A. r. ruficeps - AOU (1957), "Resident in coast ranges and on western slopes of Sierra Nevada in central California (Clearlake Park, Marysville Buttes, McChesney Mountains, Onyx)." Paynter and Storer (1970) give the range of A. r. ruficeps as: central California in coast ranges and on western slopes of Sierra Nevada.

B. California distribution of the species

A. ruficeps - Jones and Diamond (1976) reported first recorded on Anacapa in 1940. Have been breeding since 1963. Immigration attributed to reduction of grassland and increase of scrub and also extinction of horned lark. Wheelock (1920) noted along California coast from 40°N south to Cabo San Lucas (Baja). Sharp (1907) listed as breeding in Escondido, California.

A. r. ruficeps - Grinnell and Storer (1924) reported resident in Upper Sonoran in Yosemite; found at Pleasant Valley and El Portal singly, never in flocks. Grinnell and Miller (1944) reported coast ranges from Marin and Sonoma Counties south to San Luis Obispo County and from Marysville Flats, Sierran foothills from Placer County south to Kern County.

C. Seasonal variations in distribution

Phillips (1951) noted migration away from lowland (breeding grounds) in winter.

A. r. ruficeps - Bent (1968) reported a slight altitudinal shift may occur, especially in the interior. They are found in lower altitudes in winter. It is possible that some individuals of the Sierra-Nevada populations move upward when the foothill breeding grounds become very hot and dry in late summer.

IV HABITAT

A. Biotopic affinities

Baptista (1973) reported bathing on leaves of a eucalyptus about 5 feet from the ground. Leaves had droplets from lawn sprinkler. Van Rossem (1946) reported A. ruficeps breed in Upper Sonoran zone. Richardson (1904) noted rather shy, seen in brush in foothills and higher mountains.

A. r. ruficeps - Grinnell and Miller (1944) reported preferred habitat "hillsides that are grass covered and grown to sparse low bushes, scarcely dense enough to constitute true chaparral. Rarely bushes may be absent if rock outcrops are present. Slopes are sunny and well drained. Preference is shown for California sage in its typical open growth, associates with grass tussocks." Bent (1968), "scattered low bushes on driest slopes not hard chaparral but coastal scrub or coastal sage scrub; or where chaparral is regrowing after fire." Grinnell and Storer (1924) noted lives on open stands of low bushes on driest slopes, not known to occur in dense bush. Like dwarf chaparral. Sheldon (1909) noted in wild gooseberry thickets in the canyons, and patches of rock piles on the hills. Bent (1968) reported isolated pairs in coastal scrub sagebrush near woodlands or small steep slopes away from trees.

B. Altitudinal range

A. r. ruficeps - Grinnell and Miller (1944) reported Life Zone: Upper Sonoran and Altitudinal range: 300 to 3200 feet.

C. Territory requirements

Perch sites - A. r. ruficeps - Brewster (1879) noted males sing from tops of (spit bush) low bushes. Grinnell and Miller (1944) reported favorite perches are bush tops and rocks in order to survey terrain. Pemberton (1910) reported favorite perch - top of sage.

Nest sites - Wheelock (1920) reported on ground in hollow. Tatschel (1967) reported nest on ground near boulders with plants nearby: Noline sp. and Bouteloua sp. Nest only in one vegetative community. Balda (1970) reported is a ground nester in oak woodland. Carpenter (1907) reported nest about 1 foot high in a brush pile; nest of yellow grass and some horsehair. Myers (1909) noted nest on ground under clump of grass over which some wild flowers were blooming. Barlow (1902) reported colony in sage growth. Birds very secretive about exact nest location.

A. r. ruficeps - Barlow (1902) reported nest site: flush with the ground. Carpenter (1919) reported bunch grass on side of steep ravine under which was a depression in hard decomposed granitic soil.

Special requirements - A. r. ruficeps - Jenkins (1906) noted bear Big Sur on steep slopes with golden yarrow, mock heather, low growing creosote bush, poison oak and where shrubs too dense rufous-crowned were absent.

Aimophia ruficeps (con't.)

D. Seasonal change

A. r. ruficeps - Bent (1968) reported in winter juveniles can be found in still typical breeding habitat.

V FOOD

A. Food preferences

A. r. ruficeps - Bent (1968) noted food items: oats, Erodium, grass seeds, Hymenoptera, crickets, caribid beetles, grasshoppers, arachnids. Simpson (1925) reported food for young fed by female parent consisting of while grubs and small caterpillars with occasional black insect or butterfly.

B. Foraging areas

A. r. ruficeps - Grinnell and Miller (1944) reported within grass beneath bushes. Usually stay close to ground and out of sight. Flight over bush tops are rapid and short.

C. Foraging strategies

A. r. ruficeps - Bent (1968), "usually keep close to ground, hopping slowly about herbaceous layer and low shrubs."

D. Feeding phenology

Barlow (1902) reported contents of 22 stomachs: June 27, 1901: 97% vegetable matter (small oats, Erodium, grass, seeds), 3% animal matter (Hymenoptera). September 22, 1901: 88.4% vegetable matter, 11.6% animal matter (crickets, caribid beetles, ants, grasshoppers, Hymenoptera, olive scale). Vegetable matter consisted of chickweed, Polygonum, Amaranthus, Erodium, and oats. March 16, 1902: 50% each of vegetable and animal matter. April 27, 1902: 6% vegetable matter (oats, Erodium) and 94% animal matter (Chrysomelids, Lempyrid beetles, Jassids, Arachnids).

A. r. ruficeps - Bent (1968), "a decided shift from seeds to insects is manifest during the nesting season."

VI REPRODUCTION

A. Territorial behavior

Bent (1968), "The male proclaims the territory he and his mate occupy by his song." Stated that some pairs remain mated through the winter.

B. Courtship and mating behavior

Bent (1968) reported little information on courtship available. Lists calls given in spring by both male and females; such calling and courtship noted as early as February.

Aimophia ruficeps (con't.)

A. r. ruficeps - Pemberton (1910), "on perch, giving song, having ventriloquistic power."

C. Nesting phenology

A. r. ruficeps - Willet (1912), "Breeds mostly in April and May in Southern California. Bent (1968), "most young are found from May to August; earliest nesting begins in March." Bent (1968) gives egg dates: March 22 to July 10 (N = 24) and April 17 to May 13 (N = 13).

D. Length of incubation period

A. r. ruficeps - Bent (1968) reported incubation period unknown to date.

E. Length of nestling period

Bent (1968) noted nestling period apparently unreported.

F. Post-breeding behavior

Bent (1968), "Ordinarily...small family groups of five or six are the largest "flocks" of rufous-crowned sparrows one encounters, for it is quite non-gregarious, at least throughout most of California."

VII POPULATION PARAMETERS

A. Clutch size

Myers(1909) reported 3 eggs/clutch (near Los Angeles). Wheelock (1920) reported on eggs: 3-5/clutch; plain white or bluish white. Carpenter (1907) reported clutch of 3 (.71 x .62 inches) of white, almost bluish which fades.

A. r. ruficeps - Bent (1968) noted usually 4, sometimes 2-5 eggs/clutch (slightly glossy, pale bluish, white-unmarked).

B. Habitat density figures

Bent (1968) speaking of A. r. Canescens in California: above Glendora, 13 territories averaged 2.2 acres each (range = 0.96 - 3.78); in coastal sage scrub, 14 territories averaged 1.9 acres each (range = 1.21 - 3.15 acres). Balda (1970) reported 6 pairs/100 acres in oak woodland. It is a ground nester. Balda (1969) found 11 in 100 acres. Total species 36 species/100 acres. Total number: 267 pairs/100 acres.

A. r. ruficeps - Pemberton (1910), "colonies" are the rule, usually a dozen pairs in conifers on 2 to 3 acres on a hillside.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1968), "... is not immune to the enemies of most sparrows...principal

Aimophia ruficeps (con't.)

losses might thus be attributed to snakes and mammalian predators."

B. Competition

Ohmart (1968) reported in Gardner Canyon 3 Aimophila species breed synchronously (A. ruficeps, A. botterii and A. cassinii).

C. Parasitism

Friedmann (1971) reported first record for Aimophia ruficeps as a cowbird victim.

IX STATUS

A. Past population trends

A. r. ruficeps - Grinnell and Miller (1944) reported status "strictly resident, common locally, but suitable habitat not widespread and birds observed with difficulty hence seldom rated as 'numerous'." Willett (1912) reported a fairly common resident of the foothill regions.

B. Present status

A. r. ruficeps - Bent (1968) reported essentially a permanent resident wherever it occurs in California.

C. Environmental quality: adverse impacts

Sharp (1907) reported very rare nest with eggs in March. "said not to have been not uncommon in the earlier days when hillsides have not been cleared of brush." Bent (1968), "No doubt the destruction of much of the original coastal scrub vegetation...by the mushrooming urbanization of Southern California has greatly reduced the populations."

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Aimophila ruficeps (con't.)

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BREWER'S SPARROW
Spizella breweri

I TAXONOMY

A. Type description

Spizella breweri - AOU (1957) Cassin, Proc. Acad. Nat. Sci. Philadelphia, 8, January-February (March 25), 1856. Western North America, California, New Mexico = Black Hills, North Dakota.

B. Current systematic treatments

Hellmayer (1938) recognizes two races of Spizella breweri including breweri.

II DESCRIPTION

Peterson (1961), "A small pale sparrow of the sagebrush. Clear-breasted; resembles chipping sparrow but sandier, crown finely streaked, no hint of rufous or median line." Ridgway (1901) gives detailed descriptions of plumages and measurements of adults and young.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Breeds from central southern British Columbia, northern Idaho, southern Alberta, southwestern Saskatchewan, central eastern Montana, southwestern North Dakota, western South Dakota, and northwestern Nebraska south, east of the Cascades, through Washington and Oregon, to eastern California, central Arizona, northwestern New Mexico, and central southern Colorado. Winters from southern California, southern Nevada, western and central Texas, south to southern Baja California, Jalisco, Guanajuato, and southern Texas; casually north to northern California. In migration through western Kansas and western Oklahoma. Accidental in Massachusetts."

B. California distribution of the species

Small (1974), "Range in California - for breeding, basin and ranges region south to higher portions of Mojave desert; portions of Transverse and Peninsular Ranges, and near Mt. Pinos where open stands of sagebrush exist." Grinnell and Miller (1944), "Geographic range - as breeding, Artemisia belt of Great Basin region and east slopes and crests of Sierra Nevada south to higher parts of Mojave desert and mountains bounding southern and western edge of San Joaquin Valley; also in mountains of southern California south-eastwardly to San Jacinto Mountains and possibly to San Diego County; extends westwardly in a few places to arid foothills and valley floors. In migrations, all sections except northwest coastal districts north of Marin County and offshore islands, commonly east of principal mountains, fairly commonly in Great Valley and coastal southern California. As winter visitant, common on Mojave and Colorado deserts, sparingly in southern coastal district, and north rarely to San Francisco Bay region and Sacramento valley." Dawson (1923), "Distribution in California - breeds in high upper Sonoran and Tran-

Spizella breweri (con't.)

sition zones, chiefly east of the Sierras and locally in the Great Interior Valley or elsewhere... Also a summer or late summer visitor and possible breeder in the Boreal zone to the limit of trees... Winters sparingly in the San Diegan district and along the Colorado River..." Wheelock (1904), "California breeding range: Arid foothill regions of the interior, chiefly along the southern Sierra Nevada."

C. California desert distribution

Howell and Van Rossem (1915), "... winters abundantly in certain parts of the Imperial Valley." Van Rossem (1911) noted as "common along weed-grown fences and in the cotton-fields". "Fairly common on the desert flat above Mecca,".

D. Seasonal variations in distribution

Phillips, Marshall, and Monson (1964), "Common migrant in open parts of the Transition and Sonoran zones statewide." Small (1974), "Seasonal status-some are resident within state; summer visitor to breeding areas; others are transient." Grinnell and Miller (1944), "Status - summer resident, usually from May through mid-August; also migrant and winter visitant, according to locality; at some lowland stations, especially southwestwardly, present throughout the year, but it is not known that individuals are permanently resident at such places. Eastwardly, common to abundant in all three seasonal roles; less numerous and less continuously distributed on Pacific slopes." Winters abundantly in lower California (Hill and Wiggins, 1948).

IV HABITAT

A. Biotopic affinities

Grinnell and Miller (1944), "Habitat - as breeding, typically sagebrush (Artemisia tridentata) in fairly extensive, continuous stands, unbroken by trees and this well isolated. Other brushland species of plants may be intermixed but prove not as attractive as Artemisia. In some lowland nesting areas, to the westward, this sparrow has adopted comparable low brush cover... Life zones in summer, chiefly high upper Sonoran and Transition, but may follow Artemisia association higher into Boreal zones; occasionally nests in lower Sonoran in other brushland associations." Small (1974), "Habitat - for breeding, brushland, particularly that which has extensive stands of Great Basin sagebrush." Phillips, Marshall, and Monson (1964), "Common summer resident in sage and other tall dense brush of upper Sonoran zone. Abundant winter resident in lower Sonoran zone (except in drier open areas, with purer creosote, of the extreme southwest; and except in uncultivated portions of the Colorado Valley); rarer in northern edge of lower Sonoran zone. In winter in southern Arizona it prefers the open desert, leaving the brushy or grassy foothills to its close relative the chipping sparrow." Bent and collaborators (1968), "... characteristic of the arid sage country of the Great Basin and Pacific slopes, where... is often abundant both as a migrant and resident." Bent (1968) reported it is often the most common summer resident in open,

Spizella breweri (con't.)

brushy habitats of the Sonoran and Transition zones in those regions that it breeds. Found on July 29 in a juniper-sagebrush association north of Deadman Flat, 41 miles northwest of Flagstaff in the upper Sonoran zone (Jenks and Stephenson, 1937). Sheldon (1909), "Large flocks appeared in September on the oak-covered hills." Barlow (1901) noted in "sage-brush" near Meyer's Station. Price (1899), "Seen only on the mesa near Yuma (Arizona)." Behle (1944), "Common summer resident in sage-brush areas from valleys up into mountains" in Utah. Linsdale (1951), "... lives in sagebrush at all altitudes both in the valleys and on the mountains" in Nevada.

B. Altitudinal range

Grinnell and Miller (1944), "Altitudinal range of known nesting stations: 350 feet to 10,400 feet in White Mountains."

C. Territory requirements

Nest sites - De Groot (1934) observed nesting in brush covered area above Haypress Meadow at approximately 7800 feet. Wheelock (1904), "Nest: of dry grasses and rootlets; lined with hair; placed generally in sagebrushes a few feet from the ground." Found nesting in large open tracts of sagebrush found throughout the pinon woodlands from 5500-7000 feet (Wauer, 1964). Nests noted in small shrubs on south-facing slopes, not over a foot above the ground in California (Appleton, 1911). Noted nesting in grape vines in vineyard (Tyler, 1910). Nest noted in a candle cactus, near main stem, about one foot from the ground. Nest contained three young (Swarth, 1899). Nest noted in Artemisia tridentata bordering aspen thickets near Convict Creek at an elevation of about 6000 feet in California (Rowley, 1939).

D. Special habitat requirements

Dawson (1924), "The range of Brewer's sparrow in the breeding season is nearly coextensive with that of Artemisia tridentata..." Wheelock (1904), "Wherever in California there is sagebrush there are Brewer's sparrows." Many authors have noted its close association with sagebrush, (Artemisia tridentata) (Bent, 1968).

V FOOD

A. Food preferences

Found weed seed and a few small beetles in the stomachs of three Brewer's sparrows (Bryant, 1911). Brewer's sparrows were found to eat 47.7% animal food and 52.3% vegetable food.

B. Foraging areas

Grinnell and Miller (1944), "Foraging activity is chiefly on the ground, but also at times in the bushes."

Spizella breweri (con't.)

VI REPRODUCTION

A. Territorial behavior

Grinnell and Miller (1944), "Bushtops are resorted to regularly as way-points in moving about the breeding territories and for lookout and song posts."

B. Nesting phenology

Dawson (1923), "Season: May - July, according to elevation, usually one brood." Wheelock (1904), "Breeding season: May and June." Clutch of 3 eggs ready to hatch on May 17, 1926 at 6000 feet in Mono County, California (Rowley, 1939).

C. Post-breeding behavior

Dawson (1924), "It is not impossible that the Brewer's sparrow nests twice in a season, once at a lower level, and again several thousand feet higher." Wheelock (1904), "As soon as they (the young) are able to fly, they care for themselves, and the parents turn their attention to another brood. As soon as they (the young) are able to fly, they care for themselves."

VII POPULATION PARAMETERS

A. Clutch size

Clutch size: 3 eggs (Rowley, 1939). Clutch size: 2, 3, or 4 eggs; three the most common (Tyler, 1910). Clutch size 3 to 5 eggs; 3 or 4 the usual number (Bent, 1968). Wheelock (1904), "Eggs: usually 4..." Dawson (1923), "Eggs: 3 or 4, very rarely 5."

VIII INTERSPECIFIC INTERACTIONS

no information located

IX STATUS

no information located

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Spizella breweri (con't.)

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WHITE-CROWNED SPARROW
Zonotrichia leucophrys

I TAXONOMY

A. Type description

Zonotrichia leucophrys gambelii - Nuttall (1840) noted this form was described from a specimen taken near Fort Wallah-Wallah (Walla Walla), Washington.

Zonotrichia leucophrys oriantha - Oberholser (1932) reported this form was described from a specimen taken at Barley Camp, Warner Mountains, 14 miles southwest of Adel, Oregon at an elevation of 6400 feet.

B. Current systematic treatments

AOU (1957) recognizes five races of the white-crowned sparrow, the nominate race of eastern Canada and the eastern United States; gambelii; oriantha; pugetensis (of southwestern British Columbia south to northwestern California); and nuttalli (along the humid coastal strip between Mendocino County south to Santa Barbara County, California).

Synonomies - Z. l. gambelii - Fringilla leucophrys; Fringilla gambelii; Zonotrichia gambelii; Zonotrichia leucophrys intermedia; Zonotrichia gambelii intermedia; Zonotrichia leucophrys, part; Zonotrichia leucophrys nuttalli, part; Zonotrichia leucophrys leucophrys, part. White-crowned finch; gambel finch; western white-crowned finch; western white-crowned sparrow; Ridgway sparrow; white-lored white-crowned sparrow; gambel sparrow; intermediate sparrow; Nuttall sparrow; and desert white-crowned sparrow (Grinnell and Miller, 1944).

Z. l. oriantha - Zonotrichia leucophrys intermedia, part; Zonotrichia leucophrys gambelii, part; Zonotrichia leucophrys, part; Zonotrichia gambelii, part; Zonotrichia intermedia, part; Zonotrichia leucophrys leucophrys, part. Western white-crowned sparrow; white-crowned sparrow; gambel finch; Ridgway sparrow; Hudsonian white-crowned sparrow; Oregon white-crowned sparrow (Grinnell and Miller, 1944).

C. Recent taxonomic revisions

Grinnell (1928) noted this race (pugetensis) is intermediate in several characters between gambelii breeding to the north and nuttalli breeding to the south. Four subspecies of the white-crowned sparrows were recognized by this author (this was prior to the description of oriantha). Banks (1964), "The name Z. l. oriantha Oberholser, formerly used for the montane birds, is considered to be a synonym of Z. l. leucophrys." This author recognizes only four races, leucophrys, gambelii, pugetensis, and nuttalli.

II DESCRIPTION

A. External morphology

Robbins, Bruun, and Zim (1966), "Recognized by its pink or yellowish bill, erect posture, gray throat and breast, and prominently streaked crown. Adult and immature are told from white-throated by posture, bill color, and lores. Geographic races show minor differences in head pattern and bill color." Peterson (1961), "Adult: a grayish breast and a puffy crown striped with black and white make this abundant bird a very handsome sparrow. Immature: browner, with head-stripings of dark brown and light buff; bill bright pinkish or yellowish (often with dusky tip). In the Rocky Mountain region, 2 races, gambel's and mountain white-crown, can be readily separated. In central California 4 races occur. Of these, the mountain white-crown is seldom noted away from the Sierra. Around San Francisco students often try to separate the various races by appearance and song, but this is risky because even the resident race, nuttalli, varies in song from place to place and the several races tend to intergrade morphologically." Under similar species: "White-throated sparrow has: (1) a conspicuous white throat, (2) yellow spot before eye, (3) black bill. It is considerably browner. Young white-throats, though duller, always look like white-throats; have dark bills."

Z. l. gambelii - Peterson (1961), "White eye-stripe starts from bill. Cleaner, grayer-appearing on neck; lighter back-striping (light gray, red-brown) than the 2 coastal races. Bill pinkish or flesh-colored (not yellowish)."

Z. l. oriantha - Grinnell and Storer (1924), "The juvenal Hudsonian white-crowned sparrows wear a much more streaked pattern of coloration than their parents, the breast as well as the whole upper surface bearing a pattern of narrow streaks. This plumage is worn but a short time. In August all of it (except the wing and tail feathers) is molted, and the bird then acquires the immature or first winter plumage, which resembles that of the adult save for the coloration of the crown, which is brown and buff instead of black and white." Peterson (1961), "(Mountain white-crown) differs in having the white eyebrow-stripe start from the eye. It breeds in high mountains from the Canadian border to the Sierra of south-central California and in Rockies to northern New Mexico. Winters in southwestern United States."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

Z. l. gambelii - AOU (1957), "Breeds from north-central Alaska, northern Yukon, northwestern and central eastern Mackenzie, and central western Keewatin south to southern Alaska, southwestern Yukon, northwestern and central southern British Columbia, southwestern Alberta, northern Saskatchewan, and northern Manitoba; casual in summer north to northern

Zonotrichia leucophrys (con't.)

Alaska and west to islands of Bering Sea. Winters from southern British Columbia, southeastern Washington, southern Idaho, central Wyoming, and northeastern Kansas south to southern Baja California, Tres Marias Islands, Nayarit, San Luis Potosi, and northern Tamaulipas. Casual in migration east to southern Ontario, Pennsylvania, and Georgia. Accidental on Banks Island, Franklin district, and in Japan." Emlen (1943) noted males greatly outnumber females on the west side of the Sierra Nevada in the winter, while on the east side females outnumber males by a ratio of two to one. The sex ratio south of the Tehachapi Mountains is roughly one to one. Lewis, Morton, and Farner (1968) reported was found to be abundant along the Yakima River from Parker southward to Prosser, Washington, thus establishing the known northern limit of the wintering range of this species. Farner (1958) noted in 1955, 1956, and 1957 a population of white-crowns was studied in the area around Hart's Pass in the Cascade Mountains of Washington which proved to be the southern-most breeding population of this race.

Z. l. oriantha - AOU (1957), "Breeds from northern Idaho, northwestern Montana, southern Alberta, and southwestern Saskatchewan south to south-central Oregon, central eastern California, south-central Nevada, southwestern Utah, central eastern Arizona, southwestern Colorado, and northwestern New Mexico. Winters from southern California, southern Arizona, southern New Mexico, and western and central Texas south to southern Baja California, Jalisco, and Queretaro. Casually north to central California." Balda, Weisenberger, and Strauss (1970) reported the first certain breeding records for this form in Arizona are from the San Francisco Mountains in north-central Arizona in 1968 and 1969.

B. California distribution of the species

Hardy, Roberts, and Banks (1965) noted in February, 1964, 952 white-crowned sparrows were netted in Kern County, California. All but three individuals were gambelii, the others being oriantha. The ratio of first-year to adult birds was about 1:1. There were more females among first-year birds and more males among adults.

Z. l. gambelii - Grinnell and Miller (1944), "Through the winter, practically everywhere in the state below the level of heavy snow and interiorly from the narrow humid coastal belt. This includes the Colorado and Mohave desert regions; the San Diegan district and coast region south from San Francisco Bay, the coastal islands, the San Joaquin-Sacramento basin north at least to Tehama County, and lower areas east of Sierra Nevada north to Modoc Plateau district. Winter visitant from mid-September to late April, even to May 14 in exceptional cases. Abundant on suitable ground; at migration times appears in numbers whether scarce or not present at all in midwinter." Mewaldt, Kirby, and Morton (1968), "The migratory races pugetensis and gambelii winter in the lowlands of California often in mixed flocks. On the immediate coast of central California flocks containing pugetensis, gambelii, and nuttalli are not uncommon in winter." King, Farner, and Mewaldt (1965) noted males arrive later on the wintering grounds than females, but arrive on the breeding

Zonotrichia leucophrys (con't.)

grounds first. Females tend to winter farther south than males, and winter flocks are somewhat segregated as to sex. There is possibly a delayed migration on the part of the immatures. Winter populations in central California contain about 60% immatures.

Z. l. oriantha - Grinnell and Miller (1944), "Abundant summer resident of high mountains from late April through mid-September; winter visitant sparingly on Colorado desert, rarely to westward; common migrant to east of principle mountains and in small numbers in coastal southern section in late April and throughout May. In summer, Mount Shasta, Warner Mountains of Modoc County, Lassen Peak, White Mountains of Inyo County, and Sierra Nevada from Gold Lake district, Plumas County, south through Tulare County. In winter Colorado desert east to Colorado River and coastal slopes of southern section from San Diego County north to vicinity of Los Angeles. In migration passes through winter range, and thence northward east of or along mountains to breeding range; occurs but rarely west of Sierra Nevada."

C. Seasonal variation in distribution

Cortopassi and Mewaldt (1965) reported at this time the Federal Banding Office had received 198 recoveries for the species, of which 60 were for the race gambelii. Of the latter, 10 wintered generally in northwestern Texas, and these had been banded in the Dakotas. The mean winter range for most of the other recoveries was somewhat inland of Los Angeles County in southern California. They are mainly allopatric with wintering individuals of the race pugetensis.

Z. l. gambelii - Blanchard and Erickson (1949) noted the gambel sparrow spends about 7 months on its wintering grounds, from 2-4 months on its breeding grounds, and the rest in migration. Mewaldt and Farner (1953) noted in what is apparently the northern-most wintering population of gambelii, there is a preponderance of males, and there is also a tendency for more adult birds to winter this far north than immatures. Michener and Michener (1943) reported at Pasadena, California this species arrives in late September and early October, and there are more adults than immatures. Few new birds arrive in November and December, but there is a rise in new birds in January, the immatures outnumbering adults. This continues until the birds depart in late April or early May. Most birds caught in October or May are presumed to be migrants.

Z. l. oriantha - Bent (1950), "Records of its movements in spring and fall suggest that not only does oriantha leave its wintering and breeding grounds later than does gambelii, but also that, depending on local weather conditions, oriantha may tarry en route between the two." An analysis of published records indicates that this form arrives on its California breeding grounds in late May or early June (occasionally as early as mid-May) and departs by September or early October.

IV HABITAT

A. Biotopic affinities

Small (1974), "habitat - for breeding, mountain meadows and willow thickets, lake edges with thickets, coastal chaparral, coastal brushland; otherwise lowland areas of agricultural type with brush cover nearby, forest understory, suburbs, gardens, farms, ranches."

Z. l. gambelii - Grinnell and Miller (1944), "Habitat - typically a low, scattering, bushy type of cover, whence foraging is carried out short distances onto adjacent open ground. Examples: in Death Valley, in Imperial Valley, and along Colorado River, tracts or clumps of Atriplex bushes, catclaw and mesquite; elsewhere, sagebrush, poison oak thickets, broken chaparral, lines of small willows along stream courses, and the like; in cultivated territory, patches of tall weeds, piles of tree-trimmings, berry patches, accumulations of tumble-weeds along fences, hedges, and garden shrubbery. This sparrow avoids forests, heavy or continuous chaparral, open, unbroken prairie or desert, and swampy ground."

Z. l. oriantha - Grinnell and Miller (1944), "In summer, willow thickets in mountain meadows, along upper stream courses, or around edges of lakes. Cover often utilized in addition to willows includes thickets of young lodgepole pines and Artemisia brush, where they encroach on meadows, and tracts of corn lily (Veratrum). Basic requirements are a combination of damp, grass-covered ground, surface water, and bushes usable as retreats. Such combination of necessity involves low growths of mountain willows..." Maxwell and King (1976), "Although predominantly a nesting bird of alpine and subalpine meadows, it also inhabits shrubsteppe vegetation dominated by sagebrush (Artemisia sp.) at lower altitudes, and the kummholz of the tundra zone at the highest altitudes."

B. Altitudinal range

Z. l. gambelii - Grinnell and Miller (1944), "In migration appears at many up-mountain points to as high as 9000 feet."

Z. l. oriantha - Grinnell and Miller (1944), "Ranges altitudinally in nesting season from as low as 4000 feet, rarely, as on floor of Yosemite Valley, up to 11,200 feet, as at Cottonwood Lakes, Mount Whitney region."

C. Territory requirements

Perch sites - Grinnell and Storer (1924), "When frightened they always seek shelter in brush instead of making off in the open, and when resting between periods of foraging they perch in the tops of thickets."

Nest sites - Banks (1959), "The usual nest site was in a clump of shrubs or vines in an extensive area of shrubs. Occasionally an isolated bush was used. Shrubby areas along walls, fences, or buildings were preferred to equally dense areas away from such structures." (This is for the race nuttalli).

Zonotrichia leucophrys (con't.)

Z. l. oriantha - Grinnell and Miller (1944), "Nests may be placed on the ground at bases of bushes or above ground in bushes and in stunted or young conifers, occasionally as high as 5 feet." Morton et al. (1972a) reported when conditions permit, the nest is most often built on the ground. When there is still a heavy snowpack on at the time of nest building, the birds place their nests up into the first limbs suitable for nest placement in willows and scrub pine. Nest in willows were usually between 41-60 cm high and well exposed, while those in pines tended to be over 60 cm and better hidden.

D. Special habitat requirements

Z. l. oriantha - DeWolfe and DeWolfe (1962) noted nesting habitat requires five elements: grass, bare ground, dense shrubs of scrub conifers, water, and, on the periphery, tall conifers. Grinnell and Miller (1944), "In winter and in migration, any form of bush cover that is adjacent to tracts of open ground supplies the necessary 'edge' situation sought by these sparrows."

V FOOD

A. Food preferences

Z. l. oriantha - Morton et al. (1972b), "We have not made a systematic inventory of what nestlings are fed, but from direct observations and from a few samples retrieved from the gullets of nestlings, it appears that a large variety of items are fed: insects, spiders, earthworms, seeds, tiny flowers, willow leaves, and catkins. In terms of utilizable energy, insects are undoubtedly the most important food."

B. Foraging areas

Grinnell and Storer (1924), "White-crowned sparrows are thicket-dwelling birds at all seasons. Often they may be seen on open level ground or grassland, but never far from some hedge or bush to which they can resort if frightened. Their preference is for isolated or scattered shrubs rather than for broad areas of solid chaparral."

Z. l. oriantha - Grinnell and Miller (1944), "Foraging is carried about on seepages and on the wet ground, never far from cover."

C. Foraging strategies

Brown (1954) noted immature white-crowned sparrows were observed springing 15 to 18 inches in the air to catch gnats on 24 October 1953 near Des Moines, Iowa.

Z. l. oriantha - Grinnell and Storer (1924) reported this species ordinarily forages in flocks. Individuals move with deliberation. "Practically all of their foraging is done on the ground, but they do not habitually scratch like the heavier bodied and stouter clawed fox sparrows and towhees."

Zonotrichia leucophrys (con't.)

D. Feeding phenology

Z. l. oriantha - Grinnell and Storer (1924) noted wintering birds subsist mainly on vegetable matter, while "General observation leads to the belief that a considerable part of this sparrow's food during the summer consists of insects."

E. Energy requirements

Z. l. gambelii - MacMillen and Snelling (1966), "There appears to be no unique physiological adaptations that equip white-crowned sparrows for existence in arid regions. Instead, they rely upon ordinary avian capacities and occupy desert areas only during the winter when sufficient water and succulent food are more readily available." King (1961) noted the minimum mean metabolic rate of 4 weight-matched birds in November and December was 8.6 kcal./bird/day. The rate rose to a range of 13.83 to 15.68 kcal./bird/day in 6 individuals during the vernal premigratory period (24 March to 10 May).

VI REPRODUCTION

A. Age of first breeding

Ralph and Pearson (1971) reported in a population of the race nuttalli at Point Reyes, California, it was found that older males occupy larger territories and are more often successful in breeding than younger males, i.e., first-year birds. Nevertheless, first-year males regularly attempt to breed.

B. Territorial behavior

Patterson and Petrinovich (1978) noted territory size of a population near San Francisco fluctuated only slightly during the breeding season. Lewis (1975) reported in the race pugetensis "Territorial conflicts are infrequent; indeed, nearest neighbors often show nearly complete tolerance of one another and temporary foraging associations of two to four pairs are frequently seen during the first half of May." The females segregate onto the territories established by males on the day of their arrival.

Z. l. gambelii - DeWolfe (1967) noted a decline in territorial behavior was noted by 30 June (the first newly hatched chicks were found on 4 June), and by 10 July adult males were singing songs only sporadically. Oakeson (1954) reported at Mountain Village, Alaska, newly arrived males set about immediately establishing territories (prior to the arrival of the females in mid-May), but their songs were weak, disputes between males infrequent, and the birds were more or less shy and unobtrusive. After the arrival of the females, the males were somewhat more conspicuous in their behavior and sang from exposed perches.

Z. l. oriantha - Grinnell and Storer (1924), "During the nesting season, the white-crowns are in pairs, each pair occupying a separate and

well-defined small area in the willows; but at other seasons they associate in loose flocks." Morton et al. (1972a) reported after arriving at the breeding area, the males establish themselves on areas of snow-free meadow and attract a mate. If no open areas were available, the birds maintained singing perches in nearby conifers until thawed habitat appeared. Thereafter, the thawed area was defended by the lone male, or the mated pair, especially within 50 m of the nest, which was not usually located in the central portion of the territory.

C. Nesting phenology

Mewaldt and King (1977) noted a five-year study of Z. l. nuttalli at Point Reyes, California indicated that this sedentary form ordinarily begins nesting in mid-March and that the nesting season continues for about 125 days. Two broods, sometimes three, are incubated per nesting season. Year-to-year variability of nesting dates was about ± 15 days, delays being correlated with rainy weather during the pre-nesting period. Lewis (1975) noted the race pugetensis is migratory. Territories are established in the Puget Sound region in late April, and the first eggs of the initial clutch are laid at a median date of about 13 May. The first eggs of second clutches are laid at a median date of about 14 June. Eggs are laid daily until the clutch of 2-5 eggs is complete. Incubation begins on the last or penultimate egg. The incubation period is about 12 days. Two or three clutches are laid. Morton (1976), "egg laying begins in mid-March in Z. l. nuttalli at Berkeley..., in the last week in April in Z. l. pugetensis at Friday Harbor..., and in the last week of May in Z. l. gambelii near the Arctic Circle..."

Z. l. gambelii - Oakeson (1954) noted gambel's sparrows arrived on the breeding grounds at Mountain Village, Alaska between 9-25 May, males arriving earlier than females. The males immediately establish territories and first copulations occur in late May and early June; nest-building is also initiated at this time. Most first eggs are laid in the first week of June, and the first clutches hatch in mid-June. The young fledge during the last week of June and become independent during July. Departure apparently occurs mostly during August. DeWolfe (1967) noted in 1957 males arrived on the breeding grounds at College, Alaska on 5 May, females arrived on 16 May, the first complete clutches of eggs were found on 25 May, and the first newly hatched chicks were found on 4 June. On 26 June bob-tailed young out of nest were seen begging for food. On 29 June a young with a full-grown tail was seen; it was partly independent. By 9 July young were completely independent. Morton (1976) reported the events between the onset of nest-building and fledging of the first brood require 7 days less in Arctic populations of gambelii than in mid-California populations (30 vs. 37 days).

Z. l. oriantha - Bent (1968), "The eggs are laid from late May through early August." There appears to be no evidence that a second brood is raised. Depending upon local conditions, there is great variation in laying dates. Morton et al. (1972a) reported males arrive on the breeding grounds first in late May and early June. In this three-year study

Zonotrichia leucophrys (con't.)

the mean date for clutch starts was 16 June 1968, 28 June 1969 and 24 June 1970, the variations being apparently due to storms and snowpack. Females begin incubating while still laying eggs. Eggs are laid one per day in early morning. Following the loss of a clutch or brood, re-nesting nearly always occurred, and several attempts were made if necessary. DeWolfe and DeWolfe (1962) noted males in breeding condition have been collected between 21 May to 29 July. Eggs have been collected between 29 May to 7 August. Adjusted first egg dates ranged from 24 May to 6 July, and the median dates for these fall between 12-15 June.

D. Length of incubation period

Mewaldt and King (1977) noted the incubation period of Z. l. nuttalli is 12 days. Morton (1976), "Incubation period is reported to average 12 days at all latitudes. A variation of several days from this does occur, however. Apparently fluctuations in incubation period are not expressions of phenotypic variation, but, rather, are a function of nest micro-environment."

Z. l. oriantha - Morton, Horstmann, and Osborn (1972a), "The incubation period was measured as the interval between the day the last egg was laid and the day the last chick hatched. It varied considerably among individuals and from year to year for the population. The mean incubation period was shortest in 1968 (10.9 days) and longest in 1970 (13.4 days)."

E. Length of nestling period

Mewaldt and King (1977) reported the length of the nestling period of Z. l. nuttalli is 10 days.

Z. l. gambelii - Oakeson (1954) noted the average nestling period for 13 nestlings that left the nest without any obvious cause for flight was 9 days at Mountain Village, Alaska.

Z. l. oriantha - Morton, Orejuela, and Budd (1972b) reported the mean age at fledging of this race is 9.5 days.

F. Growth rates

Banks (1959), "The largest relative gain occurs during the second day of nestling life. A gradual decrease in relative gain occurs throughout the remaining nestling period. The actual weight gain, however, gradually increases until the greatest gain occurs on the sixth day. The decrease in both actual and relative gain on the final three days of nestling life is probably due to a shift in the energy budget, as more food is utilized in the production of feathers and heat than is converted to flesh."

Z. l. oriantha - Morton et al. (1972b), "Body weight increased rapidly in nestlings during the first 5 days of life... Thereafter, the rate of

Zonotrichia leucophrys (con't.)

growth decreased considerably, apparently due to the metabolic cost of thermoregulation and feather growth. The rate of growth in broods of two, three, four, or five nestlings was not significantly different."

G. Post-breeding behavior

Lewis (1975) reported the young are able to fly when 11-12 days old and become independent of their parents by the time that they are 30 days old. In pugetensis "both parents attend the young of the first brood until the second clutch of eggs is complete after which time the male generally assumes all care of the young. This adaptation favors earlier laying of the next clutch."

Z. l. oriantha - Morton et al. (1972b) noted the young apparently achieve independence from their parents at age 26-30 days. During this time, the young may form into small flocks and move a considerable distance from their fledging site.

VII POPULATION PARAMETERS

A. Clutch size

Z. l. gambelii - Oakeson (1954) noted the average clutch size at Mountain Village, Alaska for six clutches was 4.66 eggs with four or five eggs being laid in each clutch. Bent (1968) reported the average size of 76 clutches is 4.58. Clutch size increases with latitude within the range of the race. Clutch size is greater in this subspecies than in nuttalli or pugetensis.

Z. l. oriantha - DeWolfe and DeWolfe (1962), "For 154 records of Z. l. oriantha taken in California, the clutch size varied from two to seven eggs, with a mean value of 4.0 ± 0.03 . The majority of clutches (88%) had four eggs." Bent (1950) reported within the same latitudinal range as the race nuttalli, the clutch size of oriantha is 4.04 eggs for 145 clutches, whereas that for nuttalli is 3.27 for 215 clutches. The number of eggs in the oriantha clutches was as follows: 3 eggs 5.0%, 4 eggs 87.6%, 5 eggs 6.8%, and 6 eggs (1 record) 0.6%. Morton et al. (1972a) reported the clutch size of Z. l. oriantha at Tioga Pass was 3.93 ± 0.54 . This was based upon 143 records. The clutch size varied from 3-5 eggs. Four-egg clutches were the mode, making up 80.4% of the total. Bent (1968), "although the latitudinal range of oriantha in California is approximately the same as that of nuttalli, its average clutch size is significantly larger than that of the coastal form."

B. Fledging success

Z. l. gambelii - Oakeson (1954), "Of eight broods watched, six were fledged successfully, and at least one of the nestlings in each of the other two is known to have fledged." (For nuttalli at Berkeley, California, the author found only 40% success, while pugetensis in Washington had 50% success).

Zonotrichia leucophrys (con't.)

Z. l. oriantha - Morton et al. (1972a) reported fledging success (young fledged/pair) was 1.4 in 1968, 1.8 in 1969, and 2.0 in 1970.

C. Mortality rates per age class

Cortopassi and Mewaldt (1965), "A comparison of the survival of the 32 known adults and 60 known immatures banded from September through February suggests that birds banded as adults enjoy no survival advantage over immatures banded as migrants on their winter range." The weighted mean survival rate of 198 banding recoveries was 43%, although this assumes (wrongly) a constant mortality rate throughout the year.

D. Longevity

Cortopassi and Mewaldt (1965) noted the mean age for 198 recovered banded birds was about 16 months. This "should not be equated with normal life expectancy because most of these birds died by the hand of man, or at least in close proximity to man. Such mortality is probably not typical for the species as a whole."

Z. l. gambelii - Crawford (1950) reported a banded gambel's white-crowned sparrow lived until it was at least eight years old.

E. Habitat density figures

Ralph and Pearson (1971) reported an unusually dense population of the race nuttalli at Point Reyes, California was probably due to the exceptionally suitable habitat and the high density of winter flocks maintained by a nearby feeding station. They found one pair per 0.37 ha.

Z. l. oriantha - Morton et al. (1972a) noted in favorable habitat (with 70-80% open ground), a pair sometimes occupied 15,000-20,000 m² although they actively defended only within a radius of 50 m of the nest. In habitat where there was only 20-30% open area available for foraging, the territories were as small as 1500 m². DeWolfe and DeWolfe (1962), "Although every mountain meadow with the essential habitat elements suitably arranged had its population of Z. l. oriantha, the numbers at each place were small indeed... The small populations were only in part a result of sparse distribution of breeding pairs within a suitable area. Even under optimum conditions the meadows suitable for oriantha are widely scattered in the Sierras, often separated from each other by miles of unsuitable country."

VIII INTERSPECIFIC INTERACTIONS

A. Predation

Bent (1968), "the white-crown is subject to the usual factors that cause attrition in animal populations, whether disease, the complex of factors engendering winter mortality, or direct predation by accipitrine hawks, shrikes, weasels, and the like."

Zonotrichia leucophrys (con't.)

Z. l. oriantha - Morton et al. (1972a) felt that coyotes, badgers, and Clark's nutcrackers were also potential predators on this species in the Tioga Pass area. Predation on eggs was the greatest cause of mortality in this study, and nests on the ground suffered the most. There was no known predation on nestlings after their sixth day. Some nests were apparently abandoned because of human interference. "The Belding ground squirrel was probably the most important predator. It was observed eating eggs and nestlings and was abundant in the study area. Long-tailed weasels may also have been an important predator, especially in 1969 and 1970 when they seemed to be more numerous than in 1968."

B. Parasitism

Lavers (1974) added to Lewis' 1973 first record of cowbird parasitism on Z. l. pugetensis three more cases, all occurring on Samish Island in western Washington. Lewis (1973) noted the first case of brown-headed cowbird parasitism on the race pugetensis was reported from Camano Island, western Washington. However, earlier host records ascribed to the race gambelii by Friedmann in 1971 probably refer instead to pugetensis, and there may be no recorded instances of cowbird parasitism on gambelii. Baptista (1972) noted the first instance of cowbird parasitism on the race nuttalli was reported from Berkeley, California and indicated an unusually heavy frequency of parasitism there. The cowbird is a relatively recent arrival in the area. Petrinovich and Patterson (1978) reported numerous instances of cowbird parasitism on the race nuttalli were discovered in the San Francisco Bay region and near Point Reyes between 1970 and 1976. There was great variability in the incidence of cowbird parasitism on the sparrows over different years, but this may be due to differences in observational techniques. Parasitized white-crowns do not abandon nests, appear to suffer no greater loss of eggs or nestlings through predation, and are just as likely to produce a fledgling.

Z. l. oriantha - King, Mahoney, and Maxwell (1976) noted although the white-crowned sparrow is an infrequent victim of the brown-headed cowbird, seven instances of cowbird parasitism on the sparrow were recorded on the eastern slope of Hart Mountain, Oregon in 1974 and 1975. The race of the parasite there is Molothrus ater artemisiae.

C. Hybridization

McCaskie (1978) noted a possible white-crowned sparrow x Harris' sparrow hybrid was photographed in Death Valley, California on 12 November 1977. Abbott (1959) reported an apparent hybrid between Z. leucophrys and Z. albicollis was collected in Fairfax County, Virginia. Miller (1940) noted an apparent hybrid between Z. l. gambelii and Z. coronata was captured at Berkeley, California on 19 April 1939.

IX STATUS

A. Present population status

Bent (1968), "The eastern white-crown has apparently been extending its winter range both eastward and northward since about 1950. The climatic amelioration of the first half of the century may have facilitated this range expansion, but such new land-use practices as the planting of multiflora (Rosa multiflora) hedges and the great number of bird-feeding stations that have come into vogue during this period have unquestionably helped tide over individual birds."

B. Population limiting factors

Z. l. oriantha - Morton et al. (1972a) noted mortality on the nesting grounds was due to three main causes: predation, human interference, and weather. Among effects from the latter were losses from a hail-storm, an unseasonable snowstorm, and flooding of ground nests. Mortality from weather effects varied greatly from year to year. Most of the losses due to human interference occurred because the females abandoned eggs or young (one instance) when they were flushed from the nest. Bent (1968), "in marginal areas minor vegetative changes, such as those brought about by a series of unusually dry or wet years or by the interference of man, may render a suitable locality unsuitable for nesting white-crowns, or vice-versa."

C. Potential for endangered status

This species appears to be abundant throughout its normal range, and I encountered no mention of declining populations anywhere (ed.).

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BLACK-THROATED SPARROW
Amphispiza bilineata

I TAXONOMY

A. Type description

Amphispiza - AOU (1957) Coues, Birds Northwest, 1874.

Emberiza bilineata - AOU (1957) Cassin, type by original designation.

Amphispiza bilineata deserticola - AOU (1957) Ridgway, Auk, 15, no. 3, 1898. From Tucson, Arizona.

B. Current systematic treatments

Mayr and Short (1970) noted A. bilineata is merged into Aimophila comprising a species group within Aimophila.

Synonomies - Poospiza bilineata, Amphispiza bilineata (Grinnell and Miller, 1944); Emberiza bilineata, Poospiza bilineata, Amphispiza bilineata, Amphispiza bilineata pacifica (Ridgway, 1901). Desert sparrow (Dixon, 1943); desert black-throated sparrow, black-throated finch, black-throated sparrow, desert sparrow (Grinnell and Miller, 1944).

II DESCRIPTION

A. External morphology of adults

A. b. deserticola - Ridgway (1901) gives detailed description and measurements of adult, young, male, and female. Bent (1968) noted field marks: white facial stripes and jet-black throat plus the white tips of the outer tail feathers are identifying marks.

B. External morphology of subadult age classes

A. bilineata - Down on young was white, slightly grayish and very fluffy (Linsdale, 1936).

A. b. deserticola - Nestlings may have pale or pallid plumages which reflect and counteract the harmful effects of the sun (Bent, 1968).

C. Distinguishing characteristics

Interspecific - A. b. deserticola - Banks (1969) noted as being darker than A. b. cana but lighter than A. b. bangsi in this area (Sonora). Ridgway (1901) reported similar to A. b. belli but averages larger, upper parts are paler and browner, and white spot at end of inner web of outermost tail feather much smaller. Desert sparrow is larger than A. bilineata (Cassin) with upper parts lighter and browner and white spot at tip of inner web of lateral tail-feather is much smaller (Ridgway, 1898).

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

A. bilineata - AOU (1957), "Northeastern California, northern Nevada, northern Utah, southwestern Wyoming, western and southern Colorado, northwestern Oklahoma, and central northern Texas south to southern Baja California, northern Sinaloa, interior Jalisco, Hidalgo, and southern Tamaulipas. Winters from the deserts of southern United States southward in the breeding range."

A. b. deserticola - AOU (1957), "Breeds from northwestern California (Alturas), northern Nevada, northern Utah, southern Wyoming, and western Colorado south through desert areas to central Baja California, northern Sonora, and northwestern Chihuahua. Winters from southeastern California (Providence Mountains), southern Nevada, central Arizona, and southern New Mexico south to central Baja California and central Sonora. Casual in Oregon." Peters (1970) reported in northeastern California, northern Nevada, northern Utah, southwestern Wyoming, and western Colorado, south through desert of Great Basin to 27° N in Baja to northwestern Chihuahua. Winters in southern part of above breeding range and south to Sonora. Bull (1963) noted eastern limits: western Oklahoma and central Texas. Has been seen at least 5 times east of this eastern limit, usually at feeding stations.

B. California distribution of the species

A. b. deserticola - Grinnell and Miller (1944) noted breeding in desert and Great Basin regions in entire length of state east of Sierras and southern mountains; in winter in Mojave and Colorado deserts, north at least through San Bernardino County.

C. Desert distribution of the species

A. bilineata - Williams (1938) noted seen at Twenty-nine Palms, breeding. Wauer (1962) listed the species in Death Valley.

A. b. deserticola - Hollister (1908) reported fairly common at Goffs and Ivanpah Valley, California. Seen March to May at Twenty-nine Palms, California (Carter, 1937). Grinnell (1904) noted common on desert and up lower slopes of mountains in flocks of 6-20 or more.

A. bilineata - Raitt and Pimm (1976) reported it is a non-breeding seed-eater in the Chihuahuan desert. Found in Great Basin (Utah), Mojave desert (California), Sonoran desert (California), Chihuahuan desert (Texas to Mexico), and Tamaulipas thorn scrub (Texas) (Dixon, 1959). Guillion, Pulich, and Evenden (1959) noted common spring, winter, fall resident in southern Nevada.

A. b. deserticola - Swarth (1905) noted very common along foothills and in mesa.

Amphispiza bilineata (con't.)

D. Seasonal variations in distribution

A. b. deserticola - Grinnell and Miller (1944) reported a summer resident (April to August) and locally abundant. In winter leaves segment of breeding range lying north of Mohave desert. "Presumed to be partly migratory elsewhere." Van Rossem (1936) noted species more common in fall. Seems more common in Virgin Mountains when there is cactus present (in Nevada).

IV HABITAT

A. Biotopic affinities

A. bilineata - Dixon (1959) noted in limestone hills, dry arroyo; vegetation: 2-6 feet consisting of Larrea sp., acacia, Porlieria sp., and agave (in Brewster County, Texas). Grinnell (1951) reported black-throated sparrow found in sagebrush formation in desert scrub also in desert scrub formation.

A. b. deserticola - Grinnell and Miller (1944) noted in sparsely vegetated strongly isolated desert terrain. Avoids sinks and riparian areas. Favors desert uplands, i.e., alluvial fans and slopes. Plant associations with cholla, creosote, catclaw, small mesquite, artemesia, sages, and rabbitbush. Marshall and Leatham (1942) reported seen in Atriplex confertifolia. Linsdale (1936) gave as summer resident, not above 5000 feet. Found in sagebrush in northern half of state and in deserts in southern half of state. Johnson, Bryant, and Miller (1948) listed a variety of habitats: open brushland, rocky brush-covered slope, cholla cactus, and mixed grass and bush. Grinnell, Dixon, Linsdale (1930) reported in driest and hottest areas in rock-covered exposed and sparsely vegetated areas, on the ground and in bushes. Other plants: scattered plants of antelope bush, Salvia sp., sagebrush, and rabbitbush.

B. Altitudinal range

A. bilineata - Wauer (1964) noted in Panamint Mountains from 1000-7500 feet from valley alluvial fans to lower canyons to upper canyons and open sage flats and valleys with pinon-juniper woodlands.

A. b. deserticola - Found up to 4500 feet in mountains in Nevada (Van Rossem, 1936). Linsdale (1951) noted as summer resident below 500 feet in northern Nevada. Grinnell and Miller (1944) reported life zones: lower Sonoran and lower part of upper Sonoran; altitudinal range: -280 feet (Death Valley) to 7500 feet (Grapevine, Inyo County). Johnson, Bryant, and Miller (1948) noted breeding in lower Sonoran zone in Joshua trees, catclaw, desert willow with highest elevation of 6300 feet on Clark Mountain. Upper boundary usually corresponds with that of Joshua trees. "Seems to be fewer in winter and it seems that part of the population has migrated outside the area."

Amphispiza bilineata (con't.)

C. Territory requirements

Perch site - A. b. deserticola - Grinnell et al (1930), "any perch within acres seemed to be satisfactory" (within sage brush association).

Nest site - A. bilineata - Osgood (1903) reported most common bird on mesquite. Found nest with 3 eggs in mesquite 4-20 inches from ground. Raitt and Maze (1968) noted in arroyos mainly in creosotebush. Occasionally graythorn or apache plume. Average: approximately 1 foot off ground. Jaeger (1947) reported nest in Larrea sp. in Palm Springs 4 feet from ground. Wauer (1964) noted in open sage flats.

A. b. deserticola - Nest above ground among cactus joints (Grinnell and Miller (1944). Bailey (1906) reported in junipers, in tree cacti, and in yucca. Brandt (1951) noted nesting in Cochise County, at 4300 feet in upper Austral zone in mesquite, blackbrush, Coleogyne ramosissima, and willow, 18 inches up in center of dense blackbrush on 5/16/47. Lee (1920) found in cactus in Arizona. Bancroft (1930) reported eggs taken in semi-desert, semi-riparian association. Eggs were placed well inside bush at 30 inches off the ground. Johnson, Bryant, and Miller (1948) noted one in the center of small dense cholla cactus and another in Purshia bush. Nests are usually 2 feet from ground.

D. Special habitat requirements

A. b. deserticola - Grinnell et al (1930), "Found in sagebrush as is A. belli (sage sparrow), but appears to be less restricted to that plant."

V FOOD

A. Food preferences

A. b. deserticola - Bent (1968), "During late spring and early fall stomachs contain almost exclusively seeds and gravel and birds drink regularly at waterholes. As soon as grass and herbs appear (after first rains) the birds are no longer seen at waterholes; in fact, can be found far from them." Young are fed grasshopper abdomens. Seed and "rocks" found in one specimen taken in Arizona. Probably eats seeds in winter and small insects during nesting. Free water is not necessary where insects are available. Raitt and Pimm (1976) reported species feeds on smaller insects. Tends to nest early, coincidentally with the peak of smaller insects there.

B. Foraging areas

A. b. deserticola - Grinnell and Miller (1944) noted run and forage extensively on ground, use bushes for foraging, and lookouts and shelter.

C. Energy requirements

A. bilineata - Austin and Smith (1974) reported seen flying out of burrow at midday. Air shade temperature at height of 1.5 meter was 41.5° C;

Amphispiza bilineata (con't.)

burrow temperature 34.0° C. This behavior allows dissipation of heat and reduces water requirements. Bartholomew and Cade (1963) stated nothing is known about (the obvious) water economy of A. bilineata. A. bilineata seldom seen or never visits surface water.

A. b. deserticola - Visher (1910) reported species go for long intervals without water since there is no rain or dew from March to end of June.

VI REPRODUCTION

A. Nesting phenology

A. b. deserticola - Tended to nest early coincident with peak of smaller insects there (Raitt and Pimm, 1976). Bent (1968) noted breeding season March to August although extreme months are rarely used. Height of season is April, May, and June. California egg dates: April 15th to June 6th. Pair formation begins in February and young leave nest by early June. Although begging for food has been observed until August. No second broods have been recorded.

VII POPULATION PARAMETERS

A. Clutch size

A. bilineata - Osgood (1903) reported nest: 3 eggs in one in mesquite on May 20 and 3 eggs in one on ground on April 28.

A. b. deserticola - Clutch: 2 eggs (Bancroft, 1930). Clutch 3-4 eggs (Bent, 1968).

B. Seasonal abundance

A. b. deserticola - Grinnell (1908) reported most abundant bird on desert around Cushenbury Springs at 4000 feet on August 10-14; also at 6000 feet. Types found: full grown juveniles, young and adults in all stages of molt.

C. Habitat density figures

A. bilineata - Kubik and Remsen () reported 7 black-throated sparrows per 100 acres (17/km²) in creosote-burrobush desert scrub (San Bernardino County, California) during a breeding census. Found 3 males in 33 acre plot (Dixon, 1959). Equivalent territories ranging from 1-2 acres in a study conducted 1956-1958 in Brewster County, Texas at an altitude of 2200 feet. Raitt and Maze (1968) noted in 1964: 3.9/100 acres where n = 25. In 1965: 10.5/100 acres where n = 63.

A. b. deserticola - Marshall and Leatham (1942) estimate: requirements of approximately 40 acres per nest for feeding. Three nests found in about 16 acres. Johnson, Bryant, and Miller (1948) estimate 1 pair/5 acres. Seen more frequently than any other birds in the area.

Amphispiza bilineata (con't.)

VIII INTERSPECIFIC INTERACTIONS

A. Competition

A. b. deserticola - Bent (1968) reported when A. b. deserticola and Amphispiza belli nest in the same area they may compete for territory. In Bent (1968), Anthony, 1912, "A. belli takes the place to a large extent of A. bilineata on the coast, crowding it further inland."

B. Parasitism

A. bilineata - Friedman (1963), "The black-throated sparrow has been recorded only a few times as a victim of the brown-headed cowbird... found eggs of the cowbird in nests of the western race, A. b. deserticola" (Tucson, Arizona).

C. Miscellaneous

A. bilineata - Fed on ground with small groups of Brewer, white-crowned, and rufous-winged sparrows near Tucson, Arizona (Anderson, 1965).

IX STATUS

A. Past population trends

A. bilineata - Osgood (1903) reported taken April 28; most common bird in mesquite.

A. b. deserticola - Stephens (1903) noted rather common at base of Providence Mountains. Bailey (1923) reported seen in October in mesquite and catsclaw where it is one of the commonest birds.

B. Population limiting factors

A. bilineata - Guillion et al (1959) noted ubiquitous species of creosote-bush and desert shrub environments. Distribution is independent of available drinking water.

A. b. deserticola - Swarth (1918) reported certain peculiarities in local distribution. "None was seen about Phoenix and Tempe, though character of country was apparently as well suited to the bird as were the sections about Roosevelt Lake and Groble where it was seen in numbers." Brandt (1951), "obligate of hot, little-watered areas."

Amphispiza bilineata (con't.)

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SAGE SPARROW
Amphispiza belli

I TAXONOMY

A. Type description

Amphispiza belli canescens - AOU (1957) Grinnell, Condor 7, No. 1, 1905. Seymour Creek Meadow, 5500 feet, Mount Pinos, Ventura County, California.

Amphispiza belli nevadensis - Poospiza belli var. nevadensis - AOU (1957) Ridgway, Bull. Essex Inst. 5, No. 11, 1873. West Humboldt Mountains, Nevada.

B. Current systematic treatments

Mayr and Short (1970), "The western (belli) and eastern (nevadensis) groups are morphologically divergent and long have been treated as separate species." AOU (1957) lists 5 races of A. belli, including nevadensis and canescens; another race, A. b. belli, also occurs in California (coast ranges). Paynter and Storer (1970) recognized 5 races in A. belli, as does the AOU (1957).

Synonomies - A. b. canescens - Poospiza belli (part); Amphispiza belli nevadensis (part); Amphispiza belli (part); Amphispiza nevadensis (part); Amphispiza nevadensis canescens; Amphispiza n. nevadensis (part); and bell bunting (part); bell finch (part); bell sparrow (part); sage sparrow (part); California sage sparrow; Nevada sage sparrow (part); intermediate bell sparrow (Grinnell and Miller, 1944). California sage sparrow (Arnold, 1937).

A. b. nevadensis - Poospiza belli (part); Poospiza belli var. nevadensis; Amphispiza nevadensis (part); Amphispiza n. nevadensis (part); (Grinnell and Miller, 1944). Poospiza belli; Poospiza belli var. nevadensis; (Ridgway, 1901). Bell sparrow (Miller, 1945). Bell bunting; bell finch (part); Artemesia sparrow; sage sparrow (part); Nevada sage sparrow; northern sage sparrow; Nevada bell sparrow; (Grinnell and Miller, 1944).

C. Recent taxonomic revisions

Grinnell (1905) reported a difference between A. b. nevadensis and A. b. canescens and the reason for the new subspecies. This form had previously been recorded as nevadensis. All three forms, A. b. canescens, A. b. belli, and A. b. nevadensis breed within short distances from each other.

II DESCRIPTION

A. External morphology of adults

A. belli - Peterson (1969) gave descriptive field marks as: "single breast spot and dark 'whiskers' on sides of throat. Dark cheek, white eye-ring, and whitish line over eye".

A. b. nevadensis - Bent (1968) gave the field marks as: dark narrow moustache marks and small black spot in center of breast, also white

Amphispiza belli (con't.)

frontal spot and eye ring, coupled with the gray back and contrasting black tail. Also tail flipping and its elevated position are distinguishing marks.

B. External morphology of subadult age classes

Ridgway (1901), "Young: pileum, hindneck, chest, and sides, as well as back, streaked with dusky; otherwise essentially like adults."

C. Distinguishing characteristics

Interspecific - A. b. canescens - Bent (1968), "this race is closest in color and size to A. b. nevadensis with which it intergrades in the northern part of the Inyo district of California. It is smaller and slightly darker than A. b. nevadensis; the back streaking is reduced and the moustache marks and streaking of the flanks are more prominent."

A. b. nevadensis - Grinnell (1905) reported it resembles A. b. canescens but larger in size and lighter in color. Also contains comparative measurements in his report. Swarth (1910) noted 28 specimens were taken showing every degree of variation from canescens to nevadensis. Bent (1968) reported this inland race is lighter than the coastal races.

Intraspecific - A. belli nevadensis - Linsdale (1938) noted they are smaller and grayer toward the southwestern part of the state.

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

AOU (1957), "Center interior Washington, southern Idaho, southwestern Wyoming, and southwestern Colorado south to central Baja California, southern Nevada, northern Arizona, and northwestern New Mexico. Winters from central California, central Nevada, southwestern Utah, northern Arizona, and central New Mexico south to central Baja California, northern Sonora, northeastern Chihuahua, and western Texas."

A. b. canescens - AOU (1957), "Breeds in central interior California, in the southern San Joaquin Valley (including bordering mountains, southwestern Merced County to Tulare, Kern, and Ventura Counties), Inyo district (Benton southward) and western and southern borders of the Mojave desert (east to San Bernardino Mountains); also adjoining central western Nevada. Winters in breeding range, and extends south to southwestern California (Riverside), northeastern Baja California, and southwestern Arizona." Paynter and Storer (1970) reported in south-central California in southern San Joaquin Valley, Inyo region, and on south and western edge of Mojave desert, and in adjacent western Nevada. Winters at lower elevations in breeding area and west to southwestern California, east to southern Nevada and south to northeastern Baja California.

A. b. nevadensis - AOU (1957), "Breeds east of Cascade Range and Sierra Nevada and west of the Rocky Mountains from central eastern Washington,

Amphispiza belli (con't.)

southwestern Wyoming, and northwestern Colorado south to northeastern California (Sierra Valley, Mono Lake), south-central and southeastern Nevada, southwestern Utah, northeastern Arizona and northwestern New Mexico. Winters from central California (Los Banos, Raisin), central Nevada, southwestern Utah, northern Arizona, and central and southeastern New Mexico south to northern Baja California, northern Sonora, northwestern Chihuahua, and western Texas. Casual west of Cascade Range in British Columbia, Washington, and Oregon and east of the Rocky Mountains, in Montana and Wyoming. Migrates along east base of Rocky Mountains in Colorado." Grinnell and Miller (1944), "Range: breeds in northeastern plateau region from Oregon south to Sierra County, and at Mono Lake basin. Winters from Owens and Death Valleys, Inyo County, south throughout Mojave and Colorado deserts to Mexico and west in San Joaquin Valley to Walker Basin in Kern County and to interior parts of coastal slopes of southern California." Paynter and Storer (1970) noted at the Great Basin from eastern Utah south to central eastern California, southwestern Nevada, northeastern Arizona, and northwestern New Mexico. Winters from central California, central Nevada, southwestern Utah, and northern Arizona, and central New Mexico south to northern Baja, northern Sonora, northern Chihuahua, and western Texas.

B. California distribution of the species

Grinnell and Miller (1944) reported nevadensis and canescens intergrade near Benton, Mono County, California.

A. b. canescens - Willett (1912) reported as a summer resident of elevated upper Sonoran and Transition zones in sage valleys of the southern Sierras. Bent (1968), "ranges from Inyo area and bordering Nevada south to San Joaquin Valley and adjacent brushlands of upper levels of coastal mountains. Also encircles Mojave desert basins on the north, west, and south from which it is absent in the breeding season." Grinnell and Miller (1944), "Breeds in Inyo region north to southern Mono County and east to Nevada, then south to rim of Mojave desert in southern Sierra Nevada to upper Kern Basin, San Joaquin Valley and San Benito County, and Carrizo Plains and south to Mount Pinos to northeastern side of San Bernardino Mountains. Winters in Mojave and Colorado deserts east to Colorado River."

A. b. nevadensis - Miller (1945) noted the range extension (northwesterly) of known winter range in Merced County (Los Banos).

C. Desert distribution

Wheelock (1920) listed Sonoran and Transition zone east of Sierra Nevada in arid desert of southeastern California. Wauer (1962) listed in Death Valley (winter).

A. b. canescens - Carter (1937) saw at Twenty-nine Palms, California in January.

A. b. nevadensis - Van Rossem (1911) noted abundant in dry brush and in associations with A. b. canescens in the Salton Sea region in winter.

Amphispiza belli (con't.)

Lamb (1912) reported most numerous on open desert during November and December in Mojave desert. Maillard and Grinnell (1905) noted fairly common on desert and sage flats near the river. Out of 18 specimens, 9 were A. b. nevadensis and 9 were A. b. canescens. A. b. canescens evidently comes from the southern Sierras to the westward side while A. b. nevadensis must come from almost due north. A. b. nevadensis does not breed south of the 36° latitude in the Mojave desert region.

A. b. canescens - Linsdale (1938) noted both races are present in Nevada.

A. b. nevadensis - Johnson (1965) listed as a resident in southern Nevada.

D. Seasonal variations in distribution

A. b. canescens - Grinnell (1905) reported slight migration to lower levels in winter in California. Smith (1919) noted not seen until March 21, thereafter were common in Inyo County, California. Bent (1968), "partly resident in nearly all sections of its breeding range. It may also move locally from the higher nesting areas. Also migrates south and east of the summer range into lowland areas."

A. b. nevadensis - Grinnell and Miller (1944) reported as summer resident of Great Basin from April to September; some may winter in breeding range. Migrant and winter visitant to southward region. Bent (1968) noted this race is the most wide-ranging and most migratory of the sage sparrows. Migration is neither extensive or conspicuous. Not all parts of breeding range are vacated by all individuals. Grinnell (1928) reported regular winter visitant in extreme northeastern corner of Baja; along western side of Colorado desert.

IV HABITAT

A. Biotopic affinities

Grinnell and Storer (1924) reported found in Transition zone. Wauer (1964) noted found in Panamints from 5500 to 9000 feet from pinon-juniper to limber pine associations to bristle cone pine associations.

A. b. canescens - Grinnell (1905) noted abundant in valley and occurs coextensively with Artemesia tridentata and Chrysothamus mohavensis; also Ribes cereum. (These observations led to descriptions of new subspecies). Van Rossem (1922), "despite absence of sage, the bird adheres closely to Atriplex polycarpa." Bent (1968) noted along southwestern border of range it enters the heavier brushlands of Adenostoma and scrub oak. This type of habitat further west is immediately occupied by A. b. belli; here A. b. canescens occurs regularly in open Artemesia sp., Atriplex sp., Haplopappus sp., and in Eriodictyon. Grinnell (1908), "in habitat of Artemesia tridentata and pinon" (in San Bernardino Mountains, California).

A. b. nevadensis - Grinnell (1928) reported lower Sonoran life zone (common in north half of Baja). Hardy (1947) noted is common in sagebrush

Amphispiza belli (con't.)

areas of pygmy conifers and in greasewood in spring. Abundant from March 17 to April 7. Bent (1968) reported a ground dweller, in sand or gravel pavement, alkali hardpan, between and beneath branches or bare ground or leaf littered ground. Artemesia tridentata, the dominant sagebrush association is most favored. Johnson, Bryant, and Miller (1948) noted bunch grass interspersed with low bushes. Grinnell, Dixon, and Linsdale (1930) reported in pure stands of sagebrush both at the tips and on the ground; found chiefly in upper Sonoran zone.

B. Altitudinal range

A. b. canescens - Grinnell and Miller (1944) reported life zone (summer) upper Sonoran, somewhat lower Sonoran zone also. Altitude (200 to 8000); midsummer as far as 8500 feet. Grinnell (1908) noted seen sparingly 6700-7000 feet in San Bernardino Mountains.

A. b. nevadensis - Grinnell and Miller (1944) noted life zone: upper Sonoran in summer. Altitude: 4000 to 6800 feet. Bent (1968) reported up to 8000 feet in Colorado but still remains in sagebrush. In upper Sonoran and Transition life zones, sometimes even ranges up to conifers. Swarth (1924) noted young in juvenal plumage collected at timberline (10,406 feet) near Kearsarge Pass on September 13, 1916.

C. Territory requirements

Perch site - Rich (1977) reported no perches were favored in homogenous sagebrush habitat. This suggests that perches are randomly distributed from physical center of territory. There is a concentration of perches at some annulus away from perch center. Size of territory is due almost wholly to progress of breeding.

A. b. nevadensis - Bent (1968) noted song posts on bush tops.

Nest site - Wheelock (1920) reported nests in hollow on ground in lower branches of sage.

A. b. nevadensis - Willett (1919) noted in sagebrush 18 to 30 inches up. Grinnell, Dixon, and Linsdale (1930) reported in pure stands of sagebrush both at tips and on ground. Hendee (1929) noted nest in sagebrush, one foot from ground. Others on ground under bushes. Also nesting near a spring in Colorado. Bent (1968) noted in Artemesia or a depression on ground. Most nests are 6-18 inches from ground or up to 40 inches from ground, with average being 16½ inches from ground.

D. Seasonal changes in habitat requirements

A. b. nevadensis - Bent (1968) reported in winter frequent sparse desert scrub which contains tree yuccas, Atriplex sp., mesquites, and Chrysothamnus. Also in open bunch grass and creosote bush association in Mohave desert and Providence Mountains.

Amphispiza belli (con't.)

V FOOD

A. Food preferences

A. b. nevadensis - Knowlton (1948) reported grasshoppers found in only 1 of 16 birds collected in Utah. Bent (1968), "fifteen stomachs held the following: 4 grasshoppers; 18 Hemiptera; 68 Homoptera; 6 Coleoptera in 4 stomachs; 1 lepidopterous caterpillar; 14 Hymenoptera, 9 being ants; 2 spiders; 301 weed seeds; plant fragments."

B. Foraging areas

A. b. nevadensis - Grinnell (1904) noted fairly common in deserts feeding usually singly beneath bushes.

C. Foraging strategies

A. b. nevadensis - Bent (1968), "on the ground, scratching and apparently securing food from the litter left in the dropped leaves of desert plants ... saw a bird picking off objects from the lower leaves of sage bushes."

D. Feeding phenology

A. b. nevadensis - Bent (1968), "Insects are probably taken rarely, or not at all in winter. In New Mexico... stomachs of four birds contained only small seeds and coarse gravel."

E. Energy requirements

A. b. nevadensis - Moldenhauer (1969) noted cannot survive without drinking water in captivity; in habitat probably is able to exist in xeric habitats die to succulent vegetation as a source of water. Thermal neutral zone range: 28-37° C. Standard metabolic rate: 7.24 kcal/degree. Mean body weight: 18.8 grams. Sage sparrows are able to dissipate all their metabolic heat production by evaporative cooling. Physiological adaptations to water and heat stress are not unusual for small passerine birds and A. b. nevadensis were considered intermediate in relation to various species of desert and non-desert birds investigated for water/heat stress. The successful existence of A. b. nevadensis in desert environments is probably dependent upon the utilization of succulent foods to satisfy their demands for water and in temperature-dependent behavioral responses which may reduce heat stress, thereby minimizing the need for evaporative cooling. Moldenhauer and Wiens (1970), "are able to reduce water losses to survive long periods on a dry diet of seeds without drinking. It can survive indefinitely on a salt solution." This is a detailed quantitative study.

VI REPRODUCTION

A. Territorial behavior

Rich (1977), "Singing is primary means by which males space themselves in breeding habitat. Displays and fighting observed, but there is no singing at peripheries of territory."

Amphispiza belli (con't.)

B. Nesting phenology

A. b. nevadensis - Bent (1968) reported a case of possibly late nesting or double brooding (July 17, nest with 3 eggs in Nevada). Nesting dates March 29 to June 6; height of season April and May.

C. Length of incubation period

A. b. nevadensis - Bent (1968), "The incubation period was... about 13 days."

D. Post-breeding behavior

A. b. nevadensis - Bent (1968), "congregate in late summer in loose flocks right after nesting, and wander in the fall. Not all migrate outside breeding ground." Linsdale (1936) noted resident in flats and valleys over most of state; gathers in flocks in fall and wanders over same (summer) habitat.

VII POPULATION PARAMETERS

A. Clutch size

Wheelock (1920) reported 3-4 eggs per clutch. Light green or dull white, speckled all over with reddish brown with darker blotches at larger end.

A. b. canescens - Arnold (1937) noted nest with 3 eggs found by D. DeGroot on March 29, 1936.

A. b. nevadensis - Bent (1968) reported eggs = 3-4 per clutch; rarely 5.

B. Seasonal abundance

A. b. nevadensis - Johnson, Bryant, and Miller (1948) noted small flocks of 5-10 up to 5400 feet in winter.

VIII INTERSPECIFIC INTERACTIONS

A. Predation

A. b. nevadensis - Bond (1940) noted predated by Bubo virginianus occidentalis.

B. Parasitism

Friedmann (1963), "The sage sparrow is a very uncommon victim of the brown-headed cowbird. Only a single record."

Amphispiza belli (con't.)

IX STATUS

A. Past population trends

Richardson (1904) noted is the commonest bird in the foothills; most numerous near water in Piute Mountains, California.

A. b. canescens - Tyler (1912) noted most common winter sparrow in semi-arid regions. Van Rossem (1911) reported associates with and is in slightly larger numbers than A. b. nevadensis.

A. b. nevadensis - Van Rossem (1936) noted rare in summer, but common in fall when it is the most frequently seen bird on the desert.

B. Population limiting factors

A. b. nevadensis - Moldenhauer (1970), "found nesting under high temperature and aridity far from any sources of surface water. The heat dissipating characteristics and evaporative cooling efficiency of the sage sparrow are somewhat less than in other desert birds which may explain the failure to occupy the more extreme desert habitats."

C. Environmental quality: adverse impacts

Conservation Committee (1976) reported forages and nests in sagebrush communities and are obligates (almost entirely dependent upon) of this community. Sagebrush communities are still being altered today although at a reduced rate.

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CHIPPING SPARROW
Spizella passerina

I TAXONOMY

A. Type description

Spizella passerina arizonae - AOU (1957).

Spizella socialis var. arizonae - AOU (1957) Coues, Key North American Birds, 1872. (Fort Whipple), Arizona.

B. Current systematic treatments

Hellmayr (1938) recognizes five races of Spizella passerina including arizonae.

Synonymies - Wheelock (1904) reported known as "hair bird".

II DESCRIPTION

A. External morphology of adults

Ridgway (1901) gives detailed descriptions of plumages and measurements of adults and nestlings. Listed as Spizella socialis arizonae.

B. Distinguishing characteristics

Interspecific - Peterson (1961), "Spring: a small gray-breasted sparrow with a bright rufous cap, a black line through the eye, and a white line over it. Winter adults are browner, not so gray-breasted; cap and eyebrow line duller. Immatures are buffier with a light stripe through crown."

Intraspecific - S. p. arizonae, Bent and collaborators (1968), "The western race of the chipping sparrow differs from the nominate eastern subspecies chiefly in being slightly larger in size and paler in color..."

III GEOGRAPHICAL DISTRIBUTION

A. Overall distribution of the species

S. p. arizonae - AOU (1957), "Breeds from Washington and Oregon south to southern California, northern Baja California, central western and southeastern Arizona, northeastern Sonora, northwestern Chihuahua, and western and central Texas. Winters from central California, southern Nevada, central Arizona, central New Mexico, and western and central Texas south to southern Baja California, Vera Cruz, Guerrero, and Oaxaca."

B. California distribution of the species

Small (1974), "Range in California - length of state for breeding, except eastern and southeastern deserts."

Spizella passerina (con't.)

S. p. arizonae - Grinnell and Miller (1944), "Geographic range - as breeding all sections of state except Mojave and Colorado deserts. In winter San Joaquin Valley, rarely, and coastal southern California and Mojave and Colorado deserts." Wheelock (1904), "California breeding range: upper Sonoran to Boreal zone, nearly throughout the state." Dawson (1923), "Distribution in California - breeds locally in upper Sonoran zone west of the Sierras, and almost everywhere in Transition zones up to limit of trees in Boreal. Also found attendant upon culture in valleys, even in lower Sonoran. Occurs regularly upon the timbered islands of the Santa Barbara group. Winters sparingly in the San Diego district."

C. California desert distribution

Price (1899), "... specimen was shot on the mesa at Yuma November 27." Listed as Spizella socialis arizonae.

S. p. arizonae - Carter (1937) first noted March 24, still present May 17. Found in pinon woodland at 7800 feet elevation (Wauer, 1964).

D. Seasonal variations in distribution

Small (1974), "Seasonal status - resident within state, but some are transient, some are summer visitors to the mountains, and birds from northern California move south and down-mountain for the winter."

IV HABITAT

A. Biotopic affinities

Small (1974), "Habitat - for breeding, varied; oak woodland, orchards, mixed coniferous and deciduous forest, montane and subalpine forest from Transition to Hudsonian life zones; otherwise lowland areas with brush and open forest in winter." Phillips, Marshall, and Monson (1964), "Abundant summer resident in open parts of the Transition and Boreal zones, and rather common in open wooded parts of the upper Sonoran zone. Also breeds locally in upper Sonoran woods of the Huachuca and Chiricahua Mountains; supposed June or breeding records farther west not substantiated." Marshall (1957), "Chipping sparrows seem to require level, bare or grassy ground near or between widely spaced trees."

S. p. arizonae - Grinnell and Miller (1944), "Habitat - of great variety, but in summer seemingly always includes the following elements: trees, scattered or in open stands through which much light penetrates to the ground;... preference for the more exposed sunny parts of forest and woodland is shown in the high mountains and near the coast. Habitat requirements are met by orchards and oak woodland at lower elevations and in coniferous forests of all zones up to timber line. Life zones in summer, lower Sonoran up through Hudsonian; greatest numbers occur in upper Sonoran and Transition." Behle (1944), "Common summer resident from the valleys up to the mountains in Utah." Noted nesting in junipers at Sunnyside in the summers from 1916-1937 (Monson, 1942). Twelve pairs found in an area approximately $\frac{1}{4}$ mile square in pinon woodland at 7800 feet (Wauer, 1964). The birds follow the water courses into the mountains in spring and nest from the belt of yellow pines to timberline (Twomey, 1942). Arvey (1947),

Spizella passerina (con't.)

"... very common resident in the Transition life zone..." Linsdale (1951), "Common on middle slopes of most mountain ranges in the state" (Nevada). Nest containing 4 fresh eggs was found on a juniper branch about 5 feet above the ground on June 1 (Hendee, 1929). Observed in yellow-pine forest (Stevenson, 1936). Swarth (1924), "Seen from the lower part of the yellow pine belt downward."

B. Altitudinal range

S. p. arizonae - Grinnell and Miller (1944) reported altitudinal range: near sea level to 11,000 feet.

C. Territory requirements

Nest sites - Barlow (1901) noted nest in the top of black oak thirty feet up. Nest height: 1 to 30 feet. Nests noted four or five feet up in cedars and pines. Dawson (1923) reported nest 4 feet up in a wild rose thicket in Yosemite Valley not 5 feet from the main road. Woodbury (1939) found nest May 26, 1935 on a branching limb of a Utah juniper, about 4½ feet above the ground. Juniper was located in author's back yard. Stevenson (1936) noted nest in yellow pine at 6200 feet. Saunders (1910) noted nest situated two feet above the ground on a low limb of a lodgepole pine. (S. p. arizonae).

D. Seasonal changes in habitat requirements

Phillips, Marshall, and Monson (1964), "Winters abundantly in oak-grasslands (upper Sonoran zone) of central-southern Arizona, and commonly in farmlands and the moister parts (grassy or wooded) of the lower Sonoran zone throughout southern Arizona... May winter casually in the Transition zone of White Mountains..."

V FOOD

A. Food preferences

Marshall (1957), "Eight stomachs of chipping sparrows included seeds, gravel, and green material from a flowering oak, with insects appearing only in a breeding bird and a juvenile."

S. p. arizonae - Woodbury (1939) reported food: insects including "lepidopterous caterpillars and small green measuring worms".

B. Foraging areas

S. p. arizonae - Grinnell and Miller (1944), "Ground forage area essentially bare or covered with sparse or dense grass, but usually not with continuous tall grass; the ground usually is not heavily shaded or extensively bush covered. Foraging is carried on principally on the ground, but also in spring in the foliage of the trees when insect food and buds are there readily available."

Spizella passerina (con't.)

C. Foraging strategies

Marshall (1957), "Feeding is mostly upon the ground near edges of fields and meadows. One pair spent much time each day at an open stretch of damp creek bed, where there were many insects; here they hopped over the gravel and among the rocks. One flew after a flying insect." Based upon data from Glen Oaks Canyon, Los Angeles, California this species is classified in both "ground-seed" and "ground-insect" feeding groups. "From April through August the diet of this species is over 50% insects. In September the percentage of plant food is over 50% (Salt, 1953).

D. Feeding phenology

S. p. arizonae - Wheelock (1904), "The nestlings were fed by regurgitation for the first few days. After that insects of many sorts, and seed, were brought to the nest at surprisingly short intervals..."

E. Energy requirements

Salt (1957) reported in 13 acres of spruce-fir habitat the standing crop biomass = 34 grams/100 acres and consuming biomass = 16 grams/100 acres.

VI REPRODUCTION

A. Nesting phenology

S. p. arizonae - Bent (1968) reported egg dates in California as March 24 to July 8. Wheelock (1904), "Breeding season: May and June." Dawson (1923), "Nesting season: April - July; two broods." Nest building starts in May, Fyffe (Barlow, 1901).

B. Length of incubation period

S. p. arizonae - Incubation period: 10 days (Wheelock, 1904). Dawson (1923), "Incubation lasts only ten days." Incubation - 9 days (Woodbury, 1939).

C. Length of nestling period

S. p. arizonae - Woodbury (1939), "Feeding and training outside the nest at least 29 days..." Nestlings - 10 days (perhaps 11).

VII POPULATION PARAMETERS

A. Clutch size

Clutch size = 4 eggs (Woodbury, 1939). Eggs: 3 to 5; commonly 4 (Dawson, 1923). Wheelock (1904), "Eggs: 3 to 5..." Clutch size - 4 eggs (Stevenson, 1936). (S. p. arizonae).

Spizella passerina (con't.)

B. Habitat density figures

Salt (1957) reported in lodgepole-spruce-fir habitat (15 acres) the standing crop biomass was 135 grams/100 acres and the consuming biomass was 64 grams/100 acres. In 13 acres of spruce-fir habitat there were 2.8 birds/100 acres. In 15 acres of lodgepole-spruce-fir habitat there were 11.1 birds/100 acres. In lodgepole pine habitat the standing crop biomass was 21 grams/100 acres and the consuming biomass was 10 grams/100 acres. In 10 acres of lodgepole pine habitat there were 1.7 birds/100 acres.

VIII INTERSPECIFIC INTERACTIONS

Phillips, Marshall, and Monson (1964), "... one of the commonest sparrows at many times and places, particularly in association with yellow-rumped warblers and bluebirds in parks in the pines in summer."

S. p. arizonae - Woodbury (1939) noted when disturbed at nest, nestlings would jump out of nest and "scatter" in different directions seeking cover.

IX STATUS

Grinnell and Miller (1944), "Status - summer resident, migrant and winter visitant; in some lowland localities in southwestern section present throughout the year. Appears in areas of summer residence in April, or at higher elevations in May; leaves in September and early October. Usually common on nesting grounds, sometimes abundant; in winter sparse to fairly common; numbers vary greatly according to area within the extensive and diversified range." (S. p. arizonae).

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