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DRAFT REPORT

ECOLOGICAL LIFE HISTORIES AND BIBLIOGRAPHIES
FOR SELECTED CALIFORNIA DESERT MAMMALS.

PREPARED FOR:

Bureau of Land Management
California Desert Plan Staff
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INTRODUCTION

The major objective of this report is to provide the Desert Plan Staff of the Bureau of Land Management with adequate annotated information on the mammals of the California desert to assist them in preparing a master plan for management of this important ecosystem. A great deal of information has been published on the species composition, relative abundance, functional roles, and ecological life histories of mammals indigenous to the California desert area. Unfortunately, there is presently no single source for this information, and syntheses must be prepared by each agency or individual working with the fauna. The citations are scattered through numerous journals, proceedings, agency topical reports, and similar publications, and they extend back in time well over a century.

Since annotated life history information and relevant citations are an important element in a proposed permanent data bank to be used by the BLM for management planning, there is a need for timely collection of this information. It will then be possible for the Bureau staff to assess proposed future management plans in the context of the significant aspects of the life histories, critical habitats, and sensitivities of the important native mammals of the desert. The information will also provide supportive documentation for the preparation and evaluation of Environmental Impact Assessments, and Environmental Impact Statements, that will be increasing in numbers with increased use of the California desert.

The animals are arranged in taxonomic order. The first 27 species have complete life histories and bibliographies. The remaining species, which have information on the first six major headings of their life histories, follow the first group in taxonomic order. Since their bibliographies are incomplete they are not presented.

Only the major sources of taxonomic information are included in the species bibliographies, even though additional references, especially those to the original descriptions, are cited under the NOMENCLATURE heading.

References to sources of information usually follow at the end of the sentence in which the data first appear. If several sentences or a paragraph were derived from a single source, the citation appears at the end of all the material. Citations for each species follow the life history of that species rather than at the end of the report in a comprehensive literature cited listing. This was done to assist the reader in finding specific material in a timely way, and to insure that bibliographies would not be separated from any of the species. It is anticipated that future funding will provide the support necessary to complete other life histories, at which time they can be inserted in place of partial material in this report.

We made every effort to find readily available, contemporary sources of information for the ecological life histories. This was done to reduce the cost of library searches, and to provide the reader with material that would be more easily retrievable. There is a wealth of information in masters' theses, dissertations, internal topical reports of agencies, and publications of organizations such as the NSF-sponsored International Biological Program. We avoided citing this material for two reasons: first, much of the material in these sources is preliminary in nature and usually requires the permission of the author or agency before it can be cited; second, it is very difficult to obtain copies of many of these documents, which precludes the user of this report from verifying information. In a few cases the data were most important and references to internal documents were used.

The authors also made every attempt to obtain and check original copies of the material cited. This was done to allow us to evaluate the appropriateness of the original article for our goals. It also allowed us to check for errors in citations that are often perpetuated by abstracting services, review articles, or authors who cite material in their publications.

There is little doubt that some important references were missed during this initial survey of the mammalian literature. We did not attempt to develop a definitive bibliography for each species, but concentrated our efforts on completing as many of the annotated life histories as possible within the budgetary and time constraints of the contract. It is our hope that this document will be dynamic in nature, and that, as new information is found or published, it will be incorporated in future revisions.

LIFE HISTORY SUMMARY

Sorex tenellus - Inyo Shrew

NOMENCLATURE AND SYNONYMY

Sorex tenellus Merriam 1895. Type from along Lone Pine Creek, at upper edge of Alabama Hills at about 5,000 ft., near Lone Pine, Owens Valley, Inyo Co., California.

Synonyms: None.

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains no subspecies.

DIAGNOSIS

Tail more than a third of the total length; five unicuspid teeth between the front bicuspid incisors and the large premolars on each side of the upper jaw (though only three or four may be seen from a lateral view); one lower incisor on each side; tail usually more than 60 but less than 80 percent of head and body length; at least four of the unicuspid teeth (upper jaw) clearly visible in lateral view; hind foot usually less than 18 mm; toes and sides of feet without a comblike fringe of stiff hairs; third unicuspid smaller than the fourth; tail bicolored; gray dorsally; foramen magnum extending about halfway to the top of the skull; condylobasal length less than 15.8 mm; 1st and 2nd unicuspid noticeably larger than the 3rd and 4th (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 85-116 mm; tail 36-43 mm; hind foot 9-13 mm; weight 3.4 g (Hall, 1946; Jorgensen and Hayward, 1963; Ingles, 1965).

Skull characteristics. Condylobasal length 14.8-15.2 mm; palatal length 5.8-6.1 mm; cranial breadth 7.0-7.3 mm; least orbital 2.9-3.2 mm (Hall, 1946; Jorgensen and Hayward, 1963; Ingles, 1965).

Pelage. Dorsally dark gray with pale smoky gray underparts; tail bicolored (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 3-1-3-3/1-1-1-3 (Hall and Kelson, 1959; Ingles, 1965).

GEOGRAPHIC RANGE

The range of the Inyo shrew extends along the California/Nevada border from Inyo County, California to southern Nevada (Hall, 1946; Ingles, 1965).

HABITAT

Life zone. The Inyo shrew is found in the Upper Sonoran Life Zone (Ingles, 1965).

Vegetation association. This shrew has been trapped in: pinon/juniper, Nevada (Jorgensen and Hayward, 1963); and *Artemisia/Ephedra/Chrysothamnus*, Nevada (Burt, 1934). It is usually found in shaded, damp situations near decaying logs and along the bases of cliffs in the bottoms of canyons, less than 300 m from flowing water (Burt, 1934).

Sorex tenellus - Inyo Shrew

HABITAT (Cont'd)

Elevation. It has been taken in Nevada at elevations between 5,500 and 10,000 ft (Burt, 1934; Hall, 1946; Jorgensen and Hayward, 1963).

SYMBIOSES

Parasites. The Inyo shrew is host to at least 2 species of mite (Allred and Goates, 1964).

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LIFE HISTORY SUMMARY

Sorex merriami - Merriam's Shrew

NOMENCLATURE AND SYNONYMY

Sorex merriami Dobson 1890. Type from Little Bighorn River, about 1 mi. above Fort Custer, Bighorn Co., Montana.

Synonyms:

Sorex merriami Dobson 1890

Sorex leucogenys Osgood 1909

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains two subspecies as defined by Hall and Kelson (1959):

S. m. leucogenys Osgood 1909. Type from mouth of canyon of Beaver River, about 3 mi. E Beaver, Beaver Co., Utah.

S. m. merriami Dobson 1890. See above.

DIAGNOSIS

Five unicuspid teeth on upper jaw; third unicuspid not smaller than fourth; posterior border of infraorbital foramen even with or anterior to, plane of space between M1 and M2; maxillary breadth 5.0 mm or more; condylobasal length less than 17.5 mm; cranial breadth no more than 8.5 mm; maxillary tooth row 6.1 mm or less; palatal length more than 6.0 mm; hind foot less than 13 mm; tail more than a third of total length (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length, 88-107 mm; tail, 33-41 mm; hind foot, 11-13 mm; weight 4.4 to 6.5 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Condylobasal length, 15.7-17.1 mm; palatal length, 6.3-7.3 mm; cranial breadth, 7.8-8.8 mm. interorbital breadth, 3.3-4.0 mm; maxillary breadth, 4.9-5.5 mm (Hall, 1946).

Pelage. Upper parts grayish drab or light brownish gray above, becoming paler on the flanks. Underparts, including feet, nearly white but faintly tinged with buff. Tail markedly bicolored and sparsely haired (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Molts. Two annual molts were observed in Washington (Johnson and Clanton, 1954). The spring molt took place between March and June, while the winter molt occurred from late September to early November.

Dentition. Dental formula is 3-1-1-3/1-1-1-3 (Hall and Kelson, 1959).

Glands. Merriam's shrew has flank glands 3 to 7 mm in diameter that are second only to those of *Notiosorex crawfordi* in size compared with other North American shrews (Hoffman, 1955; Johnson and Clanton, 1954).

GEOGRAPHIC RANGE

Merriam's shrew has a range that extends from 100° west longitude to the east side of the Cascade Range, and from southern Arizona north to the Canadian border (Hall and Kelson, 1959).

GEOGRAPHIC RANGE (Cont'd)

In California this shrew is restricted to the northeastern counties and parts of Inyo and Mono counties (Ingles, 1965).

HABITAT

Life zone. Upper Sonoran and lower portions of the Transition life zones (Ingles, 1965).

Vegetation associations. This shrew occupies the most xeric habitats used by North American shrews. The greatest numbers have been taken in *Artemisia/Agropyron* and related associations of shrub-steppe vegetation in Washington (James, 1953; Johnson and Clanton, 1954; Hudson and Bacon, 1956). It has been taken in similar vegetation types in California (Hoffman, 1955), Colorado (Starrett and Starrett, 1956), Montana (Hooper, 1944), Utah (Osgood, 1909), and Wyoming (Long and Kerfoot, 1963). Other vegetation associations where it has been trapped include: grasslands in Wyoming (Brown, 1967) and Nebraska (McDaniel, 1967); stands of *Cercocarpus* in Wyoming (Brown, 1967) and Colorado (Spencer and Pettus, 1966); pinon woodlands in Colorado (Hoffmeister, 1956); and *Pinus-Pseudotsuga-Populus* woodlands in Arizona (Hall, 1933; Hoffmeister, 1955).

Elevation. Merriam's shrews have been trapped between 650 ft in Washington to 9,500 ft in California (James, 1953; Johnson and Clanton, 1954; Hoffman, 1955).

POPULATION CHARACTERISTICS

Patterns of abundance. This shrew has always been considered to be rare within its range (Hall, 1946); Hall and Kelson, 1959; Ingles, 1965) although this may reflect more of a lack of trapping effort than scarcity of the species (Hudson and Bacon, 1956).

Predators. The only documented cases of predation on the species was by owls (Bond, 1939; Long and Kerfoot, 1963).

Behavior. Merriam's shrew uses the runways and burrows of microtine rodents during their foraging activities (Johnson and Clanton, 1954; Hooper, 1944; Brown, 1967).

REPRODUCTION AND GROWTH

Breeding season. In Washington pregnant females have been taken between mid-March through early July. Males with enlarged testes were trapped between March and early June (Johnson and Clanton, 1954).

Litter size. Three females had an average litter size of 6 (range 5-7) in Washington (Johnson and Clanton, 1954).

TROPHIC RELATIONS

Foods eaten. Stomach contents of shrews from Washington included spiders, adult and larval beetles, cave crickets, larval lepidopterans and ichneumonid wasps. Caterpillars appeared to be the most common food item during the warmer months (Johnson and Clanton, 1954).

SYMBIOSES

Interactions with other species. *Sorex merriami* has a close association with *Lagurus curtatus*, a species that shares its major habitats (Johnson and Clanton, 1954; Brown 1967).

Sorex merriami - Merriam's Shrew

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SYMBIOSES (Cont'd)

Parasites, pathogens, diseases. In Washington this shrew is parasitized by fleas, nematodes, and cestodes (Johnson and Clanton, 1954).

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Sorex merriami - Merriam's Shrew

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LIFE HISTORY SUMMARY

Notiosorex crawfordi - Crawford's Desert Shrew

NOMENCLATURE AND SYNONYMY

Notiosorex crawfordi (Coues 1877). Type from near old Fort Bliss, approximately 2 mi. above El Paso, El Paso Co., Texas.

Synonyms:

Sorex crawfordi Coues 1877

Notiosorex crawfordi Merriami 1895

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains two subspecies as defined by Hall and Kelson (1959):

N. c. crawfordi (Coues 1877). See above.

N. c. evotis (Coues 1877). Type from Mazatlan, Sinaloa.

DIAGNOSIS

Tail about a third of the total length; three upper unicuspid teeth between the front bicuspid incisors and the large premolars on each side of the upper jaw; gray dorsally; ears project conspicuously out of fur; tail 45-52 percent of body length; skull relatively broad, especially across rostrum, flattened; posterior border of P4, M1 and M2 "excavated" (deeply concave) when viewed from occlusal surface (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length, 80-92 mm; tail, 22-31 mm; hind foot, 10-11 mm; ear from notch, 8 mm; weight, 4.5 g (Hall, 1946; Ingles, 1965).

Skull measurements. Condylobasal length, 16-17 mm; palatal length (1), 6.9 mm; cranial breadth (1), 8.2 mm; least interorbital breadth (1), 3.8 mm (Hall, 1946; Ingles, 1965).

Axial skeleton. Vertebral formula is: 7 cervical, 13 thoracic, 16 lumbar, 5 sacral, 11 to 13 caudal. There is a single pair of floating ribs (Hoffmeister and Goodpaster, 1954).

Pelage. Adults: lead gray with brownish wash dorsally; underparts pale gray. Juvenile: light silver gray overall (Hall, 1946; Ingles, 1965). Dorsal hairs of adults are about 3 mm long; those on the venter 1.5 to 2 mm. Hair of subadults is shorter and sparser, as well as being paler. A single (spring) molt is thought to occur each year (Dixon, 1924; Hoffmeister and Goodpaster, 1962).

Dentition. The dental formula has been reported as 3-1-1-3/2-0-1-3 (Hall and Kelson, 1959; Ingles, 1965) or 3-1-1-3/1-1-1-3 (Repenning, 1967).

Karyology. Chromosomal polymorphism has been reported within the species. An Arizona specimen showed a diploid number of 62 and a fundamental number of 94. It had 34 biarmed and 26 acrocentric autosomes. Three specimens from Texas had a diploid number of 68 and a fundamental number of 102. They showed 36 biarmed and 30 acrocentric autosomes (Baker and Hsu, 1970).

Senses. Olfaction is not remarkably acute. Vision is thought to be effective but not especially keen. The vibrissae are prominent and the snout twitches continually while the animal forages. The tail may also serve as a tactile function (Hoffmeister and Goodpaster, 1962).

Sleep. The desert shrew has an especially deep sleep such that arousal in the laboratory is difficult. This deep sleep has been interpreted as reflecting a metabolic "down-shifting" or the behavioral response of an animal accustomed to security within its burrow (Hoffmeister and Goodpaster, 1962; Coulombe and Banta, 1964).

Locomotion. Movements are rapid and nervous. A captive ran in zig-zag courses in spurts of about 250 mm each. When running the tail is carried in a stiff curve or more limply (Brach, 1969; Cunningham, 1956; Dixon, 1924; Hoffmeister and Goodpaster, 1962).

Glands. Lateral skin glands are prominent. In mature males they appear as an elliptical patch of bare, glandular, thickened skin about 5 mm long. In females the presence of the gland is indicated by a pattern caused by conspicuous thinning of the hairs (Hoffmeister and Goodpaster, 1962).

GEOGRAPHIC RANGE

The range of Crawford's desert shrew includes all of Baja California and extends from Central Mexico northward to southern Colorado, and from central Texas and western Arkansas to coastal southern California. A subspecies is also found in the states of Sinaloa, Nayarit, and Jalisco, Mexico (Hall and Kelson, 1959).

In California it has been taken rarely in arid scrub of the Sonoran Life Zone in the southern three counties (Ingles, 1965).

HABITAT

Life zones. Lower Sonoran and lower part of Upper Sonoran life zones (Hall, 1946; Ingles, 1965).

Vegetation associations. The vegetation community most commonly occupied by the desert shrew is a semidesert scrub characterized by such plants as mesquite, agave, and scrub oaks (Hoffmeister, 1959; Hooper, 1961; Ryan, 1968; Wauer, 1965). Permanent water is not required, but these shrews will drink if water is available (Dixon, 1924). It has been trapped in the following associations: Nevada, saltbush-saltcedar-reedgrass slough (Bradley and Moor, 1958); Arizona, riparian woodland of oak, sycamore, cottonwood, walnut, and juniper trees (Carothers, 1968); Arkansas, mesic ravine (Clark, 1953); New Mexico, ponderosa-pine woodland (Lindeborg, 1960) and grassy desert wash (Blair, 1947); California, desert gravel (Fisher, 1941); Nevada, dry, rocky areas (Jorgensen and Hayward, 1963).

Elevation. From near sea level in California (Huey, 1936) to more than 6,900 ft in Colorado (Douglas, 1967).

POPULATION CHARACTERISTICS

Patterns of abundance. Considered to be rare throughout much of its range (Ingles, 1965).

Predators. Great-horned Owls and Barn Owls are known to prey upon desert shrews (Anderson and Ogilvie, 1957; Anderson and Long, 1961; Baker, 1953; Baker and Alcorn, 1953; Bradshaw and Hayward, 1960; Cunningham, 1960; Twente and Baker, 1951).

 

Nesting sites. Nesting sites are probably associated with the types of cover used by the shrews. These include: brush piles (Baker, 1966; Vaughan, 1954); rubbish (Turkowski and Brown, 1969); tree logs (Blair, 1954); weeds and thorny scrub (Jones et al., 1962); and in bee hives (Willett, 1939). They are commonly associated with woodrats and have been taken frequently in their dens (Preston and Martin, 1963; Davis, 1941; Baker and Hsu, 1970). Nests are built by both sexes and are usually less than 50 mm in diameter. Construction materials have included: web-silk of the bee moth (Dixon, 1924); cornsilk, fine grass and feathers (Dixon, 1924); grass (Preston and Martin, 1963); inner bark or leaves of cottonwood (Hoffmeister and Goodpaster, 1962).

Activity pattern. Dixon (1924) reported that desert shrews were nocturnal, but Hoffmeister and Goodpaster (1962) found captive animals to be active both day and night.

Behavior. Desert shrews have an even temperament and can be caged together with little antagonism if sufficient food is available (Hoffmeister and Goodpaster, 1962). They emit a high-pitched squeak during rough handling, fighting, or when food is taken from an individual (Dixon, 1924; Hoffmeister and Goodpaster, 1962). Desert shrews deposit their feces in conspicuous ways, usually on elevated objects within their habitat. Regular latrines are used (Huey, 1936; Brach, 1969). It is unclear whether they are coprophagous (Cunningham, 1956; Hoffmeister and Goodpaster, 1962). They are not fossorial (Hoffmeister and Goodpaster, 1962).

REPRODUCTION AND GROWTH

Reproductive season. Desert shrews breed during most of the warmer months of the year. In Arizona nestlings were found in April (Turkowski and Brown, 1969); a pregnant female was trapped in California in early April (Stephans, 1906); in Oklahoma pregnant females were trapped in mid-November (Baker and Spencer, 1965). Additional breeding dates have been recorded for May, July, August, and September.

Litter size. Limited data indicate a litter size of 3 to 5 young.

Growth and development. Neonates are altricial. They are blind, naked, the ears are undeveloped and the digits are rudimentary. Fine hairs are sparsely present by day three and the toes are clawed, the eyes are about to open, and the ears are evident. The young are still nidicolous 11 days after birth, but the hair is thicker over most of the body. At day 40 the young are weaned and leave the nest, having attained 90% of their adult size and weight. At about 90 days after birth wear shows on a few teeth and a molt from subadult to adult pelage occurs (Hoffmeister and Goodpaster, 1962).

TROPHIC RELATIONS

Foods eaten. In the laboratory desert shrews eat a wide variety of foods including: mealworms, cut-worms, crickets, cockroaches, house flies, grasshoppers, moths, beetles, earwigs, centipedes, carcasses of dead birds and mammals, and an alligator lizard. Live rodents, salamanders, scorpions, and earthworms are refused (Hoffmeister and Goodpaster, 1962; Huey, 1936; Dixon, 1924).

SYMBIOSES

Interactions with other populations. The desert shrew is commonly associated with species of *Neotoma* although a functional relationship has not been

SYMBIOSES (Cont'd)

identified. It may be that woodrat nests and dens produce excellent cover for the shrews (Preston and Martin, 1963; Davis, 1941; Baker and Hsu, 1970; Brach, 1969; Gander, 1928).

Parasites, pathogens, and diseases. Desert shrews in Nevada are hosts for the cestode, *Railletina*, and an unknown spiruroid nematode (Fisher, 1941).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Nuisance. Desert shrews have been trapped in bee hives, but it is not known whether they pose a threat to apiaries (Willett, 1939; Hall and Kelson, 1959).

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LIFE HISTORY SUMMARY

Myotis californicus - California Myotis

NOMENCLATURE AND SYNONYMY

Myotis californicus (Audubon and Bachman 1842). Type from "California"; subsequently restricted to Monterey, Monterey Co., California.

Synonyms:

Vespertilio californicus Audubon and Bachman 1842

Myotis californicus Miller 1897

Vespertilio nitidus H. Allen 1862

Vespertilio oregonensis H. Allen 1864

Vespertilio exilis H. Allen 1866

Vespertilio tenuidorsalis H. Allen 1866

Vespertilio mexicanus Saussure 1860

Vespertilio agilis H. Allen 1866

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains four subspecies as defined by Hall and Kelson (1959):

M. c. californicus (Audubon and Bachman 1842). See above.

M. c. caurinus Miller 1897. Type from Massett, Graham Island, Queen Charlotte Islands, British Columbia.

M. c. mexicanus (Saussure 1860). Type from unknown locality.

M. c. stephensi Dalquest 1946. Type from Vallecito, San Diego Co., California.

DIAGNOSIS

Tail nearly all enclosed within the interfemoral membrane; six cheek teeth behind the canine on each side of the upper and lower jaws; maxillary cheek teeth not small relative to palatal area; head and body less than 50 mm; tragus slender, pointed; ears when laid forward exceed nose by 1-3 mm; posterior edge of interfemoral membrane naked (except for scattered hairs); underside of wing not furred to level of elbow; foot, not including calcar, 5-8 mm and less than half the length of the tibia (about 40-45 percent of its length); calcar keeled; forearm more than 18 mm; face brown; fur dorsally reddish brown frequently with palest portion centrally on the hairs; hairs on back dull tipped; 3rd metacarpal usually as long as forearm; skull delicate and slender; braincase rising abruptly from rostral level; sagittal crest obsolete or absent (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 74-85 mm; tail 36-42 mm; hind foot 5.5-7.0 mm; ear (notch) 11.0-14.6 mm; forearm 29-36 mm; weight 2.6-3.9 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length of skull 12.6-14.2 mm; zygomatic breadth 7.4-8.6 mm; breadth of braincase 5.8-7.0 mm; length of upper

MORPHOLOGICAL CHARACTERS (Cont'd)

tooth row, 4.8-5.2 mm (Hall and Kelson, 1959).

Pelage. Ears and membranes dark, contrasting with bright tawny brown dorsal fur with dark gray at base of hairs; underparts usually paler; hairs extending sparingly onto upper side of uropatagium to a line connecting knees, extending half as far on ventral side of membrane (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Hall and Kelson, 1959).

Locomotion. Flight is highly erratic; abrupt changes of direction are both vertical and lateral (Barbour and Davis, 1969; Burt, 1934; Grinnell, 1914, 1937; Hall, 1946; Hall and Kelson, 1959).

Karyology. The diploid chromosome number for this species is 44 and the fundamental number is 50. There are 4 pairs of metacentric to submetacentric, and 17 pairs of acrocentric autosomes. The X and Y chromosomes are both submetacentrics (Baker and Patton, 1967).

GEOGRAPHIC RANGE

The range of the California myotis extends from central Mexico to southeastern Alaska, and west of the Rocky Mountains to the Pacific Coast. It is found throughout California (Hall and Kelson, 1959; Barbour and Davis, 1969).

HABITAT

Life zones. This species is primarily associated with the Lower Sonoran Life Zone, but it has been collected or observed in all but the highest life zones within its distribution (Barbour and Davis, 1969; Black, 1974; Bradley and Deacon, 1971; Burt, 1934; Hall, 1946; Ingles, 1965; Miller and Stebbins, 1964).

Vegetation associations. In Nevada Jorgensen and Hayward (1965) did not observe any association between this species and any particular vegetation type. Collections have taken place in habitats dominated by: pinon/juniper, pine/oak, mixed conifers, in New Mexico (Black, 1974); *Larrea/Ambrosia* to pinon/juniper in Nevada (Burt, 1934); *Coleogyne/Larrea/Atriplex* around a water tank surrounded by *Tamarix* and *Phragmites* in Nevada (O'Farrell et al., 1967).

Elevation. This species ranges from below sea level (Grinnell, 1937) to at least 6,000 ft (Barbour and Davis, 1969).

Topographical characteristics. This species seems to prefer rock-walled canyons that have open water and shrubs or trees to forage around (Barbour and Davis, 1969).

POPULATION CHARACTERISTICS

Abundance. This species is characteristically common, but not abundant in the areas in which it is observed (Burt, 1934).

Roosting sites. California myotis roost during the day in mines and caves (Barbour and Davis, 1969; Hall, 1946; Hall and Kelson, 1959; Jorgensen and Hayward, 1965). Between 2100 and 2400 hours it uses night roosts that are often some type of man-made structure (Barbour and Davis, 1969; Krutzsch, 1954). They do not appear to habitually use the same hiding places, but

 

POPULATION CHARACTERISTICS (Cont'd)

use any readily available, suitable roost at the end of the foraging period (Krutzsch, 1954).

Nursery roosts. Nursery roosts have been found in a variety of natural and man-made environments and there does not appear to be any preferred nursery site (Barbour and Davis, 1969; Krutzsch, 1954).

Activity patterns. California myotis are active throughout the year although the number of animals is greatly reduced during the winter months, especially December (Barbour and Davis, 1969; O'Farrell and Bradley, 1970; O'Farrell et al., 1967). Their daily activity commences at sunset and peaks 1 to 1½ hours after sunset (O'Farrell et al., 1967). They are best described as dusk to late-dusk fliers (Burt, 1934; Grinnell, 1914). There is a lull in flying between 2100 and 2400 hours in some areas (Krutzsch, 1954). In Nevada there is some activity after midnight, and may be some in early morning (O'Farrell et al., 1954), but others have reported that this species is not active after midnight (Jones, 1965; Mumford et al., 1964). There is no apparent relationship between air temperature and activity patterns of this species in Nevada: they were observed flying or were netted at air temperatures between 2-27° C and almost half of their activity took place at temperatures between 2-6° C (O'Farrell et al., 1967). Wind velocities in excess of 10 mph have been reported to inhibit activity (O'Farrell et al., 1967), but Jones (1965) reported that it was unimportant as an environmental variable effecting activity.

Behavior. *M. californicus* flies low, seldom over 4 m above the ground, and usually does not get up to the skyline (Barbour and Davis, 1969; Burt, 1934; Grinnell, 1914, 1937). It uses man-made structures more than any other species studied (Barbour and Davis, 1969).

REPRODUCTION AND GROWTH

Breeding season. In California males had enlarged testes in September-October (Krutzsch, 1954). Young are born in late May to mid-June (Barbour and Davis, 1969) and perhaps as late as July (Hall and Kelson, 1959).

Litter size. One (Barbour and Davis, 1969; Hall and Kelson, 1959).

Litter frequency. One litter per year (Barbour and Davis, 1969).

Growth. The young are able to fly by July 20 (Barbour and Davis, 1969).

TROPHIC RELATIONS

Food preferences. California myotis are insectivorous. Beetles were a common food item in New Mexico (Black, 1974).

Foraging techniques. This species forages low in the sky and flies near the ground, around shrubs, and beneath trees (Barbour and Davis, 1969; Grinnell, 1937).

SYMBIOSES

Parasites and diseases. This species is host to at least two species of mite (Krutzsch, 1954) and two species of trematode (Ubelaker, 1966).

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Myotis californicus - California Myotis

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LIFE HISTORY SUMMARY

Pipistrellus hesperus - Western Pipistrelle

NOMENCLATURE AND SYNONYMY

Pipistrellus hesperus (H. Allen 1864). Type from Old Fort Yuma, Imperial Co., California, on right bank of Colorado River, opposite present town of Yuma, Arizona.

Synonyms:

Scotophilus hesperus H. Allen 1864
Pipistrellus hesperus Miller 1897
Vesperugo merriami Dobson 1866

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains six subspecies as defined by Hall and Kelson (1959):

- P. h. australis* Miller 1897. Type from Barranca Ibarra, Jalisco.
P. h. hesperus H. Allen 1864. See above.
P. h. maximum Hatfield 1936. Type from Dog Spring, Hidalgo Co., New Mexico.
P. h. merriami (Dobson 1866). Type from Red Bluff, Tehama Co., California.
P. h. potosinus Dalquest 1951. Type from Presa de Guadalupe, San Luis Potosi.
P. h. santarosae Hatfield 1936. Type from Santa Rosa, Guadalupe Co., New Mexico.

DIAGNOSIS

Tail nearly all enclosed within the interfemoral membrane; forearm less than 35 mm; five cheek teeth on each side of both jaws; yellowish gray, smoke gray, or whitish gray; face ears, and membranes blackish; tragus blunt, with tip bent forward; ears short and, when laid forward, do not reach to the end of the nose; skull nearly straight in dorsal profile; inner upper incisors unicuspidate; outer upper incisor with accessory cusp on anterointernal face; lower, third premolar lower than anterior cusp of canine; distance between canine and first molar less than length of second lower molar; palate extending far beyond the molars; foot less than half as long as the tibia (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 60-86 mm; forearm 25-33 mm; tail 5-8 mm; ear 10-12 mm; tragus 4-5.5 mm; weight 2.7-5.0 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 11.3-12.7 mm; zygomatic breadth 7.6-7.9 mm; breadth of braincase 6.3-6.8 mm; interorbital constriction 3.0-3.3 mm (Hall, 1946).

Pelage. Ears, feet, nose, and membranes blackish; buffy gray or smoke gray coloration on the back and whitish on the belly (Ingles, 1965).

There is a positive correlation between the color intensity of this species and the precipitation/evaporation ratios throughout its distribution. There is a negative correlation between color intensity and climatic severity. The more arid the region, the paler are the bats within the species (Findley and Traut, 1970).

MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. The baculum of this species has a long shaft, length 2.5-3.0 mm, that is broad, slightly convex above and concave below. It terminates distally in a rather abrupt high knob. The proximal end is broad and there is a rough and constricted portion that extends backward from the median section of the proximal end. The attached end is similar in appearance to the basal portion of the baculum in many mustelids. It greatly exceeds in size and form the baculum of *P. subflavus* which suggests that they may not be close taxa (Hamilton, 1949).

Locomotion. Flight is erratic and weak (Barbour and Davis, 1969; Burt, 1934; Hall and Kelson, 1959); usually above the horizon (Grinnell, 1937).

Karyology. The diploid chromosome number is 28 and the fundamental number is 46. There are 10 pairs of metacentric to submetacentric and 3 pairs of acrocentric autosomes. The X chromosome is a submetacentric, and the Y chromosome is acrocentric (Baker and Patton, 1967).

Dentition. The dental formula is $2-1-2-3/3-1-2-3$ (Ingles, 1965).

Sexual dimorphism. Males are smaller than females in all dimensions other than least interorbital breadth (Findley and Traut, 1970). Western pipistrelles taken in the eastern part of their distribution show a negative correlation between size and climatic severity. Those from the western part of the distribution show a positive relationship. Specimens from warmer deserts are smaller, and those adapted to more severe (colder) areas are larger (Findley and Traut, 1970). The size of males is more strongly correlated with climate than females. The thesis has been posed that this may be due to the fact that males are most likely to be active in the colder months than females; hence, the males have been exposed to selective pressures during this period more than females (Findley and Traut, 1970).

GEOGRAPHIC RANGE

The range of the western pipistrelle extends from central Mexico and Baja California northwesterly to eastern Oregon and southeastern Washington. The southwestern corner of Colorado and the panhandle of Oklahoma are included in its range (Hall and Kelson, 1959).

In California they range from the southern to the north-central counties (Ingles, 1965).

HABITAT

Life zones. This species is normally found in the Lower Sonoran and the lower part of the Upper Sonoran life zones (Burt, 1934; Hall, 1946).

Vegetation associations. Western pipistrelles have been taken or observed in vegetation associations dominated by: *Larrea/Ambrosia* in Nevada (Burt, 1934); *Coleogyne/Larrea/Atriplex* near a well surrounded by *Tamarix/Phragmites* in Nevada (O'Farrell and Bradley, 1970; O'Farrell et al., 1967); yellow pine belt in Nevada (Burt, 1934).

Elevation. From 280 ft below sea level in California (Grinnell, 1937) to at least 8,500 ft in Nevada (Burt, 1934).

HABITAT (Cont'd)

Topographical characters. This species is most often associated with rock canyons and cliff faces (Barbour and Davis, 1969; Burt, 1934; Cross, 1965; Miller and Stebbins, 1964).

POPULATION CHARACTERISTICS

Patterns of abundance. Throughout its range this is usually the most common and abundant bat observed (Barbour and Davis, 1969; Bradley and Deacon, 1971; Burt, 1934; Grinnell, 1937; Hall, 1946; Jorgensen and Hayward, 1965; Miller and Stebbins, 1964; O'Farrell and Bradley, 1970; O'Farrell et al., 1967). Numbers observed flying range between 1-10 (Miller and Stebbins, 1964) to several hundred (Barbour and Davis, 1969).

Migration patterns. This species is thought to migrate in winter from more northern areas to mines, caves, and rock crevices in scattered locations from Texas to California (Barbour and Davis, 1969).

Roosting areas. Day roosts are most often in rock crevices (Barbour and Davis, 1969; Burt, 1934; Cross, 1965) although some day roosts have been found under the dead leaves of date palms (Grinnell, 1937), in sedge swamps (Moor, et al., 1965), under rocks (von Bloeker, 1932), and they may even enter mammal burrows on the ground surface (Barbour and Davis, 1969). Preferred night roosts are unknown, but Cross (1965) has suggested that they too may be on cliff faces. They rarely use man-made structures as night roosts (Barbour and Davis, 1969).

Nursery sites. Nursery sites also appear to be in rock crevices. Females usually remain solitary, but nurseries of up to 12 total bats (nursing females and young) have been found (Barbour and Davis, 1969).

Activity patterns. Western pipistrelles begin to fly earlier in the evening than any other species of bat (Barbour, and Davis, 1969; Bradley and O'Farrell, 1969; Burt, 1934; Hall, 1946; Hall and Kelson, 1959; Miller and Stebbins, 1964; O'Farrell and Bradley, 1970; O'Farrell et al., 1967). Some individuals begin to fly 30 to 45 minutes before sunset (Barbour and Davis, 1969; Burt, 1935; Miller and Stebbins, 1964; O'Farrell et al., 1967). They are most active 1 to 2½ hours after sunset, and the duration of activity seems to be related to warmer air temperatures (Bradley and O'Farrell, 1969; O'Farrell et al., 1967). The peak in activity occurs 1 to 2 hours after sunset (Cockrum and Cross, 1964; Bradley and O'Farrell, 1969; Jones, 1965; Mumford et al., 1964; O'Farrell and Bradley, 1970). During the fall and winter the peak in activity comes at the peak air temperature (Bradley and O'Farrell, 1969), while in the warmer months the air temperature is optimal throughout most nights (Bradley and O'Farrell, 1969). Some bats are observed to be active throughout the night during warm weather (Bradley and O'Farrell, 1969; Jorgensen and Hayward, 1965). They also fly after dawn (Barbour and Davis, 1969; Miller and Stebbins, 1964) except during the fall and winter (Bradley and O'Farrell, 1969; Cross, 1965; O'Farrell et al., 1967). Some have been observed flying in the afternoon (Hall and Kelson, 1959). Western pipistrelles are most active during the spring and summer (O'Farrell and Bradley, 1970; O'Farrell et al., 1967), but activity persists even in the fall and winter (Barbour and Davis, 1969; Miller and Stebbins, 1964; O'Farrell and Bradley, 1970; O'Farrell et al., 1967). It has been reported that only males fly during the winter in Arizona (Cross, 1965), more males than females fly during the winter (Findley and Traut, 1970), while both

POPULATION CHARACTERISTICS (Cont'd)

sexes fly in about equal numbers in Nevada (O'Farrell et al., 1967). More females than males are netted over water in June, July and August (Bradley and O'Farrell, 1969) and many lactating females are taken throughout the night in July (Barbour and Davis, 1969; Cox, 1965). It has been suggested that lactating females may be under water stress during this period (Cox, 1965). This species is active through a temperature range of -5°C to 33°C , although the numbers flying are greatly reduced at temperatures between -5°C and 10°C (Bradley and O'Farrell, 1969; O'Farrell and Bradley, 1970; O'Farrell et al., 1967). The optimum temperature for activity is between 16 and 30°C (Bradley and O'Farrell, 1969; Cross, 1965; Jones, 1965; O'Farrell et al., 1967). Although Jones (1965) thought wind was an unimportant variable effecting activity, winds, especially those greater than 9 mph, have been shown to inhibit or curtail activity in this species (Barbour and Davis, 1969; O'Farrell et al., 1967).

Behavior. This species usually flies above the horizon (Barbour and Davis, 1969; Grinnell, 1937). In Nevada they seem to segregate according to sex so that unbalanced sex ratios may be sampled during the year (Hall, 1946).

REPRODUCTION AND GROWTH

Breeding season. Pregnant females have been taken in May and June (Burt, 1934; Hall, 1946) and the young are usually born during the latter month (Barbour and Davis, 1969; Burt, 1934). Lactation occurs during June and July (Cox, 1965).

Litter size. Two is the most common litter size (Barbour and Davis, 1969; Hall, 1946); some females have litters of one (Burt, 1934).

Litter frequency. One litter is conceived each year (Barbour and Davis, 1969).

Growth. The young begin to fly by early July (Cross, 1965).

TROPHIC RELATIONS

Foods eaten. This species is insectivorous and its principal food item is moths (Black, 1974).

Foraging techniques. Although western pipistrelles forage over most areas within their range, they seem to concentrate their activities around the walls of rock canyons (Miller and Stebbins, 1964). They drink water by skimming over the surface of ponds and stock tanks (Burt, 1934; Miller and Stebbins, 1964).

SYMBIOSES

Parasites and diseases. *P. hesperus* is host to at least one species of mite (Allred and Goates, 1964), 3 species of flea (Beck and Allred, 1966), and 2 species of chigger (Brennan, 1965).

GENERAL LIFE HISTORY INFORMATION

The western pipistrelle is physiologically adapted to remain active at body temperatures that range between 24.8°C and 35.5°C , and some animals in the laboratory have remained active at body temperatures down to 22.2°C .

GENERAL LIFE HISTORY INFORMATION (Cont'd)

They are not effective thermoregulators, but this may be an effective strategy that permits this small mammal to survive cold weather. By lowering its body temperature rather than increasing its intake of food it can reduce its energy requirements during cold weather when food might be reduced in abundance (Bradley and O'Farrell, 1969). In the laboratory males enter hypothermia at 4° C but females do not. It has been hypothesized that females have evolved to remain nearly homeothermic during gestation, hence, they are active at the lower temperature. Once they enter torpor, females remain hypothermic longer than males and this is thought to be an adaptation for conserving energy in the nonbreeding season (Findley and Traut, 1970).

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LIFE HISTORY SUMMARY

Euderma maculatum - Spotted Bat

NOMENCLATURE AND SYNONYMY

Euderma maculatum (J. A. Allen 1891). Type from near Piru, Ventura Co., California; probably at mouth Castac Creek, Santa Clara Valley, Los Angeles Co., 8 mi. E Piru.

Synonyms:

Histiotus maculatus J. A. Allen 1891

Euderma maculata H. Allen 1894

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains no subspecies (Hall and Kelson, 1959).

DIAGNOSIS

Skull with low, rounded, exceptionally elongated, and large braincase; rostrum markedly reduced; supraorbital region sharply ridged; lacrimal region of the skull raised to form a ridge; temporal ridges not coalescing posteriorly to form a sagittal crest; zygoma relatively heavy, with post-orbital expansion in middle third of the arch; median postpalatal process a bifid prominence; auditory bulla roughly elliptical in outline, somewhat specialized, and much enlarged; upper incisors in line with tooth row; fewer than six cheek teeth on each side of the upper jaw; the anterior portions of the tooth rows show great specialization; tail nearly all enclosed within the interfemoral membrane; metacarpal of the fifth digit is longer than that of the fourth and about equal to that of the third; without a nose-leaf; black with three white spots dorsally (Hall, 1946; Handley, 1959; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 107-115 mm; tail 47-50 mm; hind foot (1) 10 mm; ear from notch 37-50 mm; tragus (1) 7 mm; forearm 48-51 mm (Hall, 1946; Handley, 1959; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 18.8-19.0 mm; zygomatic breadth (1) 10.3 mm; interorbital constriction (1) 4.3 mm; breadth of braincase 10.0-10.3 mm; (Hall and Kelson, 1959; Ingles, 1965).

Axial skeleton. This species has a presternum of unusual length and shape, and the acromion process of the scapula has a sharp angle. The second phalanx of the third digit is longer than the first (Hall, 1934).

Pelage. Upper parts black or nearly so with two white "saddle marks" and a white spot at the base of the tail; underparts white; basal halves of hair making up white spots are black as are the hairs of the underparts; the ears and membranes are light yellowish when dry (Hall, 1946; Hall and Kelson, 1959). There is a circular, non-glandular, naked area, about 10 mm in diameter, on the throat (Easterla, 1971).

MORPHOLOGICAL CHARACTERS (Cont'd)

Karyology. The spotted bat has a diploid chromosome number of 30 and a fundamental number of 52. There are 11 pairs of metacentric and sub-metacentric, one pair of subtelocentric, and two pairs of small acrocentric autosomes. The X chromosome is submetacentric, and the Y is a small acrocentric chromosome (Williams et al., 1970).

Dentition. The dental formula is 2-1-2-3/3-1-2-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the spotted bat extends from central Mexico north to central Montana and west to eastern California and south-eastern Oregon (Hall and Kelson, 1959).

In California they have been observed or taken in the eastern third of the state to as far west as Friant in Fresno County (Ingles, 1965; Medeiros and Heckmann, 1971).

HABITAT

Life zone. Sonoran and Transition life zones (Ingles, 1965).

Terrain. The spotted bat has been observed in a number of habitats including: forests (Vorhies, 1935); caves or cave-like situations (Hardy, 1941; Parker, 1952; Vorhies, 1935); and in dry, rough, desert terrain (Easterla, 1973).

Elevation. It has been observed or taken from 120 ft below sea level (Grinnell, 1910) to the high transition zone of Yosemite National Park (Ashcraft, 1932).

POPULATION CHARACTERISTICS

Predators. Predators of the spotted bat include the Kestrel, Peregrine Falcon, Red-tailed Hawk (Easterla, 1973; Black, 1976).

Roosting sites. Daytime roosts of the spotted bat are in rock crevices (Easterla, 1970, 1973).

Activity patterns. This species is a late flyer and most specimens are taken after midnight (Easterla, 1970, 1973).

Behavior. Spotted bats move across flat surfaces with ease and it has been suggested that this may be an adaptation to its habit of roosting in rock crevices (Parker, 1952; Easterla, 1970). Its voice has been described as a high-pitched, metallic squeak or as a series of high-pitched squeaks (Parker, 1952; Jones, 1961; Medeiros and Heckmann, 1971). There is a high injury rate for this species that may be due to its delicate nature or a greater than average flight speed (Easterla, 1970).

REPRODUCTION AND GROWTH

Breeding season. Parturition has been reported in mid-June in Texas (Easterla, 1971). Females in post-partum condition have been observed in: June-July in New Mexico (Jones, 1961; Findley and Jones, 1965); August in Utah and Texas (Easterla, 1965).

REPRODUCTION AND GROWTH (Cont'd)

Litter size. Limited data suggest a litter size of 1 (Findley and Jones, 1965; Easterla, 1971).

Growth. A single record indicates a birth weight of 4 g in Texas (Easterla, 1971).

TROPHIC RELATIONS

Foods eaten. Spotted bats have a diet that consists principally of noctuid moths (Ross, 1967) which they consume after pulling their wings and heads off (Easterla, 1965). They may take June beetles in nature (Easterla and Whitaker, 1972), and captives will eat flies (Durrant, 1935), cottage cheese (Parker, 1952), mealworms (Constantine, 1961), katydids and grasshoppers (Easterla, 1970).

Foraging techniques. Unpublished data of Poché indicates that spotted bats will land on the ground and pursue food items.

SYMBIOSES

Parasites and diseases. Spotted bats are hosts for at least three species of tick (Whitaker and Easterla, 1975; Poché and Keirans, 1975). Rabies has been confirmed in a specimen taken in California (Mediros and Heckmann, 1971).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Disease vectors. As mentioned above, this species may carry rabies, but its rarity and habitat choice would seem to reduce its importance as a potential vector.

Endangered and threatened status. Fewer than 50 spotted bats have been reported in the literature since 1891 and this species is presently in the IUCN Red Data Book (1969) of endangered or threatened wildlife, but it is not on the List of Threatened or Endangered Wildlife of the United States prepared by the Secretary of the Interior.

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LIFE HISTORY SUMMARY

Sylvilagus bachmani - Brush Rabbit

NOMENCLATURE AND SYNONYMY

Sylvilagus bachmani (Waterhouse 1839). Type from California, probably between Monterey and Santa Barbara.

Synonyms:

Lepus bachmani Waterhouse 1839

Sylvilagus bachmani Lyon 1904

Lepus townsendi Baird 1855

Lepus cerrosensis J. A. Allen 1898

Lepus cinerascens J. A. Allen 1890

Lepus peninsularis J. A. Allen 1898

CONTEXT AND CONTENT

Order Lagomorpha; Family Leporidae. This species contains 13 subspecies as defined by Hall and Kelson (1959):

S. b. bachmani (Waterhouse 1839). See above.

S. b. cerrosensis (J. A. Allen 1898). Type from Cerros (=Cedros) Island, Baja California.

S. b. cinerascens (J. A. Allen 1890). Type from San Fernando, Los Angeles Co., California.

S. b. exiguus Nelson 1907. Type from Yubay, central Baja California.

S. b. howelli Huey 1927. Type from 10 mi. SE Alamo, Baja California.

S. b. macrorhinus Orr 1935. Type from Alpine Creek Ranch, $3\frac{1}{2}$ mi. S and 2 $\frac{1}{3}$ mi. E Portola, 1,700 ft., San Mateo Co., California.

S. b. mariposae Grinnell and Storer 1916. Type from McCauley Trail, 4,000 ft., near El Portal, Mariposa Co., California.

S. b. peninsularis (J. A. Allen 1898). Type from Santa Anita, Baja California.

S. b. riparius Orr 1935. Type from west side San Joaquin River, 2 mi. NE Vernalis, in Stanislaus Co., California.

S. b. rosaphagus Huey 1940. Type from 2 mi. W Santo Domingo Mission, Baja California.

S. b. tehamae Orr 1935. Type from Dale's, on Paine Creek, 600 ft., Tehama Co., California.

S. b. uericolor (Miller 1899). Type from Beaverton, Washington Co., Oregon.

S. b. virgulti Dice 1926. Type from Soledad, Monterey Co., California.

DIAGNOSIS

Two small upper incisors behind the two larger outer ones. Antorbital extension of supraorbital process less than $\frac{1}{2}$ of posterior extension or entirely absent. First upper cheek tooth with more than 1 (Usually 3) reentrant angles on anterior face. Reentrant angle of second upper cheek tooth crenate. Anterior extension of supraorbital process present and posterior extension free of braincase or leaving a slit between the process and braincase. Tympanic bullae small. Hind foot less than 81 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 300-375 mm; tail 20-43 mm; hind foot 64-81 mm; ear from notch 50-64 mm; weight (males) 511-797 g, (females) 517-915 g (Orr, 1940; Hall and Kelson, 1959; Ingles, 1965; Chapman, 1971a).

Skull characteristics. Basilar length 49.0-55.4 mm; zygomatic breadth 31.7-34.3 mm; length of molar series 13.1-14.3 mm; diameter of external auditory meatus 4.0-4.6 mm (Orr, 1940).

Pelage. Body uniformly dark brown or brownish gray, but tail whitish beneath. Hairs on underside mostly lead-colored with short white tip. Ears sparsely haired all over with uniformly colored hairs lacking dark tips. Vibrissae all black (Hall and Kelson, 1959; Ingles, 1965).

Locomotion. Individuals move like other members of the genus. The hind legs never move in an alternating manner and the forelegs do so only on occasions when the animal is moving forward slowly (Orr, 1940).

Karyology. The brush rabbit has a diploid chromosome number of 48. There are four metacentric, 13 submetacentric, and six acrocentric pairs of autosomes. The X and Y chromosomes are a large submetacentric and a small "dot-like" chromosome, respectively (Worthington, 1970).

Dentition. The dental formula is 2-0-3-3/1-0-2-3 (Hall and Kelson, 1959; Ingles, 1965).

Sexual dimorphism. Females have larger linear measurements than males (Chapman, 1971a).

Mammae. There are four pairs of mammae: one pair pectoral; two pairs abdominal; and one pair inguinal (Dice, 1926).

GEOGRAPHIC RANGE

Range of species. This species is restricted to the Pacific Coast of North America. It extends from the Columbia River south to the tip of Baja California, and from the western slopes of the Cascade-Sierra Nevada mountains to the Pacific Ocean (Orr, 1940; Hall and Kelson, 1959).

HABITAT

Life zone. Chaparral in the Upper Sonoran Life Zone (Ingles, 1965).

Vegetation associations. This cottontail is found exclusively in dense, brushy cover that often includes bramble patches (Orr, 1940; Chapman, 1971b).

Elevation. From sea level to 6,200 ft (Hall and Kelson, 1959; Orr, 1940).

POPULATION CHARACTERISTICS

Predators. Brush rabbits are preyed on by bobcat, coyote, gray fox, long-tailed weasel; Red-tailed Hawk, Cooper's Hawk; Barn Owl, Great Horned Owl, rattlesnakes, and gopher (bull) snakes (Bryant, 1918; Dixon, 1925; Foster, 1927; Hall, 1927; Orr, 1940; Sumner, 1929).

Nest. The species uses burrows and "forms" (cleared depressions the size of a rabbit). The forms are connected by a maze of runways. They also use the runways of voles and harvest mice, and have been flushed from pack rat

POPULATION CHARACTERISTICS (Cont'd)

houses (Dice, 1926; Gander, 1929; Orr, 1940; Pearson, 1959). The maternal nest is a cavity about 75 by 150 mm lined with fur and dried grass. It is plugged with grass (David, 1936; Orr, 1940, 1942).

Home range. In a stand of dense brush in Oregon the ranges of home range standard diameters (root mean square of the measured distance of the rabbit locations from the calculated center of activity) were: adult males, 63.5-237.2 ft; juvenile males, 35.7-306.4 ft; adult females, 30.4-233.6 ft; juvenile females, 41.3-158.3 ft. Adult males had larger home ranges than adult females, and subadult males had larger estimated home ranges than adult males. Rabbits trapped and then displaced up to 350 m were able to return to their original home range. The homing time increased logarithmically with increased distance displaced, and rabbits with larger home ranges homed better (Chapman, 1971b).

Activity patterns. Brush rabbits are crepuscular and nocturnal, being most active between sunset and 0200, and again from 0600 to 1030 (Orr, 1940; Pearson, 1959). They are active throughout the year (Orr, 1940).

Behavior. Brush rabbits seldom use open areas to avoid pursuit (Orr, 1940). In enclosures they have been observed 1.2 to 1.5 m above the ground in small Douglas fir trees. This species spends considerable time sunning, especially following heavy rains or fog (Orr, 1940). They thump their hind feet on the ground when frightened (Orr, 1940). Young brush rabbits have been heard squealing, and all age classes emit distress cries (Orr, 1940; Chapman and Verts, 1969). The minimum distance individuals can approach one another without precipitating a chase is 0.3 to 7.5 m (Zoloth, 1969). After feeding brush rabbits return to a form where they groom themselves and then remain "basking" in the sun (Zoloth, 1969).

REPRODUCTION AND GROWTH

Age at reproductive maturity. There is no evidence to indicate that this species breeds in the year of its birth (Mossman, 1955; Chapman and Harman, 1972).

Breeding season. In California the breeding season lasts from December through May or June (Mossman, 1955). In Oregon the breeding season lasted from February through August (Chapman and Harman, 1972; Verts, 1967).

Length of gestation. The gestation period is about 27 days (Mossman, 1955; Chapman and Harman, 1972).

Litter size. The average litter size has been reported as: 2.87 in Oregon (Chapman and Harman, 1972); 3.5 for northern and central California (Orr, 1940); and 4.0 for west-central California (Mossman, 1955).

Litter frequency. The brush rabbit can breed at parturition (Mossman, 1955; Chapman and Harman, 1972). In the Willamette Valley of Oregon females produced an average of 15 young per year in 5.29 litters (Chapman and Harman, 1972).

Growth and development. The young are born covered with fine thin hair, but are altricial in all other ways (Orr, 1940). They are fed only at night, grow rapidly, and spend two weeks in the nest (Davis, 1936; Orr, 1940). About four to five months elapse between birth and maturity (Orr, 1940).

TROPHIC RELATIONS

Foods eaten. Edible grasses are the most important food and include the following species: *Eragrostis hypnoides*, *Eleocharis palustris*, *Hordeum murinum*, *Bromus hordeaceus*, *Avena fatua*. They also eat *Rosa californica*, *Chenopodium ambrosioides*, *Sonchus asper*, *Cirsium lanceolatum*, *Baccharis douglasii*, *Juncus* spp., *Conium maculatum*, *Rubus vitifolius*, and green clover (Orr, 1940).

Foraging techniques. Brush rabbits rarely feed in the open. When they do, they remain for a while just inside dense, brush cover before venturing into the open to feed. Several rabbits may feed in the same area simultaneously. They prefer the newly grown tips of plants and rise up on their hind legs, bite off a tip, and draw it into their mouth with their teeth (Orr, 1940; Zoloth, 1969).

LIMITING FACTORS

Environmental constraints. The range of this species appears to be restricted by the availability of suitable dense, brushy habitat that is not occupied by other members of the genus.

SYMBIOSES

Parasites and diseases. Brush rabbits are host to at least two fleas (Fox, 1926), the adults and cysticerci of two tapeworms, and pinworms.

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Game animals. Brush rabbits are a game species in Oregon and California, but their contribution to the take of hunters is unknown. Many of those taken are used for food.

Nuisance animals. This species might be a pest in clover, alfalfa, or other types of silage fields. However, their reluctance to feed in the open probably limits their impact on agricultural crops.

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Sylvilagus bachmani - Brush Rabbit

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LIFE HISTORY SUMMARY

Sylvilagus nuttalli - Nuttall's Cottontail

NOMENCLATURE AND SYNONYMY

Sylvilagus nuttalli (Bachman 1837). Type locality, probably eastern Oregon near mouth of Malheur River.

Synonyms:

Lepus nuttalli Bachman 1837

Sylvilagus nuttalli Lyon 1904

Lepus sylvaticus J. A. Allen 1895

Lepus perpallidus Elliot 1904

CONTEXT AND CONTENT

Order Lagomorpha; Family Leporidae. This species contains two subspecies as defined by Hall and Kelson (1959).

S. n. grangeri (J. A. Allen 1895). Type from Hill City, Black Hills, Pennington Co., South Dakota.

S. n. nuttalli (Bachman 1837). See above.

DIAGNOSIS

Anterior extension of supraorbital process present. Antorbital extension of supraorbital process less than $\frac{1}{2}$ of posterior extension or absent. First upper cheek tooth with more than 1 (usually 3) reentrant angles on anterior face. Reentrant angle of second upper cheek teeth crenated. Posterior extension of supraorbital process free of braincase. Supraorbital shield posteriorly pointed. Diameter of external auditory meatus more than crown length of last three cheek teeth. Tympanic bullae small. Hind foot greater than 81 mm. Ears less than 72 mm from notch (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 350-390 mm; tail 44-50 mm; hindfoot 88-100 mm; ear from notch 55-56 mm; weight 678-1,032 g (Orr, 1940; Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basilar length 48.1-51.7 mm; zygomatic breadth 30.7-33.6 mm; diameter of external auditory meatus 4.1-5.4 mm (Orr, 1940; Ingles, 1965).

Pelage. Grayish brown dorsally and white ventrally. Tail hairs pure white to the roots. Vibrissae black with some entirely white hairs. Feet densely covered with long hairs. Ears densely haired on inner surface (Ingles, 1965). There appears to be a single annual molt during the summer (Borell and Ellis, 1934).

Karyology. Nuttall's cottontail has a diploid chromosome number of 42 (Worthington and Sutton, 1966). There is no evidence indicating that *S. nuttalli* and *S. floridanus* integrate along the Rocky Mountains (Hall and Kelson, 1951).

Dentition. The dental formula is 2-0-3-3/1-0-2-3 (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

Nuttall's cottontail is found in the intermountain region of North America. It is distributed between the eastern slopes of the Rocky Mountains to the eastern slopes of the Cascade and Sierra Nevada mountains on the west, and from the Canadian border to lower New Mexico and Arizona in the south (Hall and Kelson, 1959).

In California this species is found in habitats from the northeastern counties south along the east front of the Sierra Nevada to eastern San Bernadino County (Ingles, 1965).

HABITAT

Life zone. Upper part of the Upper Sonoran, Transition, and lower parts of the Canadian life zones (Hall, 1946; Ingles, 1965).

Vegetation associations. In the northern part of its range *S. nuttalli* is found in shrub-steppe dominated by *Artemisia*, but in its southern range it is found in timber (Hall and Kelson, 1951). In Nevada it has been observed or trapped in the following associations: pinon/juniper (Burt, 1934; Deacon et al., 1964; Jorgensen and Hayward, 1965); yellow pine (Burt, 1934; chaparral along the canyon bottoms and slopes usually consisting of *Quercus*, *Cercocarpus* and *Manzanita* (Burt, 1934).

Elevation. In California it ranges between 4,500 and 10,500 ft (Orr, 1940). It can be found as low as 400 ft in southeastern Washington to over 10,000 in its southern range (Hall, 1946; Burt, 1934; Hall and Kelson, 1951; Hall and Kelson, 1959).

POPULATION CHARACTERISTICS

Predators. This species is preyed upon by bobcats, coyotes, great-horned owls, long-eared owls, marsh hawks, Swainson hawks, golden eagles, and rattlesnakes (Borell and Ellis; 1934; Orr, 1940; Hall, 1946; Grinnell et al., 1930).

Nesting sites. Both burrows and forms are used depending upon the nature of the habitat. Rabbits living in riparian vegetation or dense shrub-steppe spend most of their time on the surface. Animals living in less dense vegetation nest in crevices or rock piles, or burrow to some extent (Grinnell et al., 1930; Orr, 1940). An excavated burrow had two entrances at right angles to each other for 1 m before they joined in a small pocket containing dried grass. Feces were found to be in the burrow (Orr, 1940). A surface nest containing four leverets consisted of a cuplike cavity lined with dried grass and rabbit fur and was covered with fur, grass and a twig (Orr, 1940; Hall, 1946).

Activity patterns. Cottontails feed during the early morning and evening (Orr, 1940). Heavy rain and wind reduce activities, but cold has little observable effect (Orr, 1940).

Behavior. Nuttall's cottontails appear to be more solitary than other members of the genus (Orr, 1940). When disturbed they run 5 to 15 meters away, then pause motionless behind screening vegetation or other objects (Orr, 1940).

REPRODUCTION AND GROWTH

Age of reproductive maturity. A female 90 days old bred, but this was considered to be a rare occurrence (Powers and Verts, 1971).

Litter size. The litter size varies throughout the geographic range as follows: British Columbia, 2.0 (Cowan and Guiquet, 1956); Washington/Oregon, 4.7, range 4-5 (Dice, 1926); Oregon, 4.3, range 1-6 (Powers and Verts, 1971); Nevada, 5.0, range 4-6 (Borell and Ellis, 1934; Hall, 1946); California/Nevada, 6.1, range 4-8 (Orr, 1940). The species has a mean ovulation rate of 5.0, a mean implantation rate of 4.6 and an average of 0.3 embryos are resorbed (Powers and Verts, 1971).

Breeding season. Oregon, February to July (Powers and Verts, 1971); Nevada, March to September (Hall, 1946); northeastern California, April through July (Orr, 1941).

Gestation. The length of gestation in British Columbia was 28-30 days (Cowan and Guiquet, 1956).

Litter frequency. Oregon, 4-5 litters per year (Powers and Verts, 1971); northeastern California, 2 or fewer litters per year (Orr, 1940). Powers and Verts (1971) calculated that females having five litters throughout a breeding season would produce an average of 22 young, while those restricted to four litters would produce about 17 young.

TROPHIC RELATIONS

Foods eaten. In northeastern California the most important food item was sagebrush. Cottontails also ate western juniper, and preferred grass to all other vegetation in the spring and summer (Orr, 1940).

Foraging sites. Cottontails feed under the cover of shrubs or in clearings a few meters from shelter. Clearings near cover seem to be preferred along streams and near springs (Orr, 1940).

SYMBIOSES

Parasites and diseases. Nuttall's cottontail is host to at least: one species of tick (Beck et al., 1963); 2 fleas (Beck and Allred, 1966); 5 cestodes; 4 nematodes; and coccidia (Erickson, 1947; Honess, 1935, 1939; Hall, 1908; Dikmans, 1937; Scott, 1943).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Game animals. This species is regarded as a game animal in all states within its distribution.

Human food. Hunters consume cottontails, but their importance to man's diet is unknown and probably inconsequential.

Nuisance animals. There are no available records of this species as a pest. It occurs in areas with winter wheat, other grains, alfalfa, and similar cultivated crops and may pose a minor problem during population peaks.

Sensitivity to human activities. There is at least one record that Nuttall's cottontails suffer mortality in areas where poisoned baits, especially grain, are spread for pest control purposes (Hall, 1946).

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LIFE HISTORY SUMMARY

Ammospermophilus leucurus - White-tailed Antelope Squirrel

NOMENCLATURE AND SYNONYMY

Ammospermophilus leucurus (Merriam 1889). Type from San Geronimo Pass, Riverside Co., California.

Synonyms:

Tamias leucurus Merriam 1889

Ammospermophilus leucurus Mearns 1907

Citellus leucurus Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains nine subspecies as defined by Hall and Kelson (1959):

A. l. canfieldae Huey 1929. Type from Punta Prieta, Baja California.

A. l. cinnameus (Merriam 1890). Type from Echo Cliffs, Painted Desert, Coconino Co., Arizona.

A. l. escalante (Hansen 1955). Type from 2 mi. SE Escalante, 5,400 ft., Garfield Co., Utah.

A. l. extimus Nelson and Goldman 1929. Type from Saccaton (15 mi. N Cape San Lucas), Baja California.

A. l. leucurus (Merriam 1889). See above.

A. l. notom (Hansen 1955). Type from Notom, Wayne Co., Utah.

A. l. peninsulæ (J. A. Allen 1893). Type from San Telmo, Baja California.

A. l. pennipes A. H. Howell 1931. Type from Grand Junction, Colorado.

A. l. tarsus Goldman 1929. Type from lower end of Prospect Valley, 4,500 ft., Grand Canyon, Hualpai Indian Reservation, Arizona.

DIAGNOSIS

This species is a small, ground-dwelling squirrel with a white stripe on either side of its body. Upper parts are grayish-brown with no black border to the stripes. The underside of the tail is pure white. The cranium is subrectangular when viewed from the dorsal aspect, and the zygomatic breadth is less than 25 mm.

MORPHOLOGICAL CHARACTERS

Standard measurements. The total length of the animal ranges from 194 to 239 mm; tail length 54 to 87 mm; hind foot length 35 to 43 mm; ear from the notch 8 to 10 mm. Body weight 80 to 115 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965; Yousef et al., 1973; Fisler, 1977).

Skull characteristics. Skull length ranges from 37 to 42 mm; palatilar length 16.7 to 18.0 mm; zygomatic breadth 21.5 to 22.7 mm; cranial breadth 17.0 to 18.3 mm; interorbital breadth 8.1 to 8.8 mm; postorbital breadth 12.9 to 14.2 mm; length of nasals 10.1 to 11.7 mm; maxillary tooth row 6.8 to 7.5 mm (Hall, 1946; Ingles, 1965).

Pelage. This species has distinct winter and summer pelages. The winter pelage has extensive underfur, while the summer pelage consists almost entirely of sparse, coarse, short guard hairs. Summer pelage is retained from about May to early September (Miller and Stebbins, 1964). In summer the upper parts are vinaceous buff and the underparts white or creamy white.

MORPHOLOGICAL CHARACTERS (Cont'd)

The front and hind legs are light pinkish cinnamon changing to buffy white on the feet. The upper part of the tail is mostly black with some white hairs. In winter the upper parts have a more grayish tone (Hall, 1946).

Locomotion. The gait of this species is primarily quadrupedal. They do exhibit some scansorial habits.

GEOGRAPHIC RANGE

Range of species. The northernmost extent of this species is found in southeastern Oregon and southwestern Idaho. From there it extends to central Nevada and eastward across Utah and northern Arizona into western Colorado and northwestern New Mexico. The species extends south from California to the tip of Baja California. Its western margin is delimited by the western boundary of the deserts of California and Nevada (Hall and Kelson, 1959).

Distribution within California desert. This species is common throughout the Sonoran Life Zone of the California desert (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zone. The species occurs predominantly in the Lower and Upper Sonoran Life Zones with some intrusion into the Transition (Hall, 1946).

Vegetation associations. This species is found in a number of vegetation associations including: creosote scrub, sagebrush scrub, shadscale scrub, Joshua tree woodland, pinon/juniper woodland, mesquite flats, and pine forest (Hall, 1946; Grinnell and Dixon, 1918; Miller and Stebbins, 1964; Bradley and Mauer, 1973; Chew and Butterworth, 1964). Jorgensen and Hayward (1965) and Allred and Beck (1963a) found this ground squirrel in a number of vegetation associations in south-central Nevada: *Larrea*, *Larrea*/*Ambrosia*, *Grayia*/*Lycium*, *Lycium*, *Coleogyne*, *Atriplex*/*Koeberlinia*, pinon/juniper, and unclassified associations.

Soil characters. This species is found on soils that range from rocky bajadas and rock outcroppings to sandy flats and washes (Grinnell and Dixon, 1918; Hall, 1946; Miller and Stebbins, 1964).

Elevation. This species has been sighted at elevations reaching 8,500 ft (Grinnell and Dixon, 1918).

POPULATION CHARACTERISTICS

Survivorship. Allred and Beck (1963b) noted that one individual survived on their study plot for 377 days. Bradley (1967) found that about 47% of the population was trappable for more than 50 days and only 4% was trappable for more than 400 days, the longest being 637 days.

Patterns of abundance. Bradley (1967) estimated that densities reached 90 per mi² in the fall and 16.5 per mi² in the summer in a creosote scrub habitat in southern Nevada.

Patterns of movement. Bradley (1968a) found that this species was capable of homing from distances up to one mile.

POPULATION CHARACTERISTICS (Cont'd)

Home range. Bradley (1967) made several different estimates of the average home range in a population from southern Nevada. Estimates were between 8 and 20.6 acres. He estimated a daily range of 4 acres.

Nesting sites. Burrows of this species are found both in the open and under shrubs. Most of these burrows have been abandoned by the animals that constructed them. An individual may use several burrows within its home range. Two types of burrows are apparent: nesting and escape burrows. Nesting burrows have two to three entrances of about 75 mm in diameter. The entrance tends to be triangular in shape and is not plugged. The burrow system is shallow, less than two feet below the surface. A single, enlarged spherical area with a diameter of 12 to 18 cm is found near the center of the burrow system. Nests consist of dried vegetation, hair, and other soft material. Small food caches may be found at the end of blind side runways. Escape burrows are simple systems that are used to avoid predators or temperature extremes (Grinnell and Dixon, 1918; Bradley, 1967).

Predators. Presumably the major predators include hawks, coyotes, kit foxes, badgers, bobcats, weasels, and snakes (Grinnell and Dixon, 1918).

Patterns of activity. This species is diurnal and active all year round. Activity is highest in mid-day. The preferred temperatures at which this species is active are probably between 15 and 30° C, however, they can be active at temperatures in excess of 40° C. Activity is greatly reduced in inclement weather. Peak activity occurs in the summer months and early fall (Grinnell and Dixon, 1918; Bradley, 1967).

Behavior. The antelope ground squirrel is very nervous and hyperactive. They tend to be solitary but may forage together in small groups. They form linear hierarchies among the members of the population, although the rankings may change with time. These squirrels use tactile and visual signals to establish, maintain, and change hierarchial rankings. Olfaction may be of less importance. Weanlings do not respond to agonistic signals for two to three weeks after leaving the nest. Most encounters do not involve fights but culminate in a chase-retreat interaction. This species is dominant to other species that are smaller in size and subordinate to larger species at feeding stations. The most characteristic behavior of this species is to carry its tail over its back when fleeing disturbance, exposing the white underparts of the tail. This may also serve to reflect radiant heat and reduce the heat load upon the animal (Grinnell and Dixon, 1918; Hudson, 1962; Bradley, 1967; Fisler, 1976, 1977).

REPRODUCTION AND GROWTH

The breeding season in this squirrel can last from February through June. They probably rarely have more than one litter per year with embryo counts ranging from 5 to 14 per female (Grinnell and Dixon, 1918; Bradley, 1967; Hall, 1946).

TROPHIC RELATIONS

Food habits. In southern Nevada, the diet was variable (Bradley, 1968). Greens ranged from 20% of the diet in autumn to 60% in spring. Seeds and fruits ranged from 65% in autumn to 20% in spring. Shrubs provided most of the seeds and fruits. Species that provided most of the seeds and fruits

TROPHIC RELATIONS (Cont'd)

were *Ephedra*, *Yucca*, *Opuntia*, *Prosopis*, *Acacia*, *Coleogyne* and *Bromus*. Arthropods compose 30 to 35% of diet in summer to early winter, and less than 5% in the spring. Vertebrate food ranged from less than 5% to 20% in the summer. This latter food was probably obtained both as prey and as carrion.

Hall (1946) reported that seeds of *Opuntia* and *Shepherdia* have been found in the cheek pouches of this species. Grinnell and Dixon (1918) reported that this species consumed cactus seeds and pears, yucca seeds, juniper seeds, salt grass seeds, *Ephedra* stems, *Sarcobatus* leaves, and carrion.

Foraging techniques. This species may spend periods of over 20 minutes searching for food items. The area is searched in an irregular pattern and seeds examined as they are encountered. The seeds may be placed in the internal cheek pouches and carried to the burrow food cache. Green vegetation is largely eaten as it is gathered. Individuals may climb into shrubs to consume leaves, flowers, or fruits (Bradley, 1967).

LIMITING FACTORS

This species is well adapted for life in arid and semi-arid habitats (Bartholomew and Hudson, 1961; Hudson, 1962). It may be limited by cold temperatures from exploiting more mesic habitats. Its smaller size may also result in the larger ground squirrels of the more mesic habitats aggressively preventing successful invasion by the antelope ground squirrel. This species tends not to be abundant in very sandy soils (Grinnell and Dixon, 1918).

SYMBIOSES

Parasites. For this species, the following ectoparasites have been recorded: three species of mites, five species of ticks, and ten species of fleas (Allred, 1962; Beck et al., 1963; Furman and Radovsky, 1963; Beck and Allred, 1966).

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Ammospermophilus leucurus - White-Tailed Antelope Squirrel

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LIFE HISTORY SUMMARY

Spermophilus mohavensis - Mohave Ground Squirrel

NOMENCLATURE AND SYNONYMY

Spermophilus mohavensis Merriam 1889. Type from near Rabbit Springs, about 15 mi. E Hesperia, San Bernardino Co., California.

Synonyms: None

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains no subspecies.

DIAGNOSIS

Skull short and broad; postorbital region wider than interorbital region; postorbital processes of skull projecting backward and downward, sides of zygomata flattened from side to side posteriorly but twisted anteriorly until they are flattened from top to bottom before reaching the notch in the zygomatic plate; rostrum not constricted at base or expanded at tip; infraorbital foramen passing between the zygomatic plate and rostrum; atlantoscapularis dorsalis muscle absent; large cheek pouches; plain colored upper parts, not variegated, mottled, flecked or spotted; dorsal hairs very short, cinnamon, or tipped with white; without stripes on side of head; tail hairy, whitish underneath; hind foot usually less than 39 mm (Grinnell and Dixon, 1918; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 210-230 mm; tail 57-72 mm; hind foot 32-38 mm (Grinnell and Dixon, 1918; Hall and Kelson, 1959); weight 104-150 g (Grinnell and Dixon, 1918; Bartholomew and Hudson, 1961).

Skull characteristics. Greatest length 38.1-39.0 mm; zygomatic breadth 23.6-25.3 mm; interorbital width 8.2-9.2 mm (Grinnell and Dixon, 1918).

Pelage. Dorsally pinkish cinnamon without stripes or fleckings; underparts white; under surface of tail white, upper cinnamon; cheeks brownish (Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. None (Grinnell and Dixon, 1918).

GEOGRAPHIC RANGE

The range of the Mohave ground squirrel is limited to the southwestern corner of Inyo County, through eastern Kern and western San Bernardino counties to the northeastern corner of Los Angeles County in California (Ingles, 1965; Wessman, 1977).

HABITAT

Life zone. Upper parts of the Lower Sonoran (Grinnell and Dixon, 1918; Ingles, 1965).

HABITAT (Cont'd)

Vegetation association. Mohave ground squirrels have been trapped in vegetation associations dominated by: *Larrea*; *Larrea/Ambrosia*; *Atriplex*; *Coleogyne/Yucca brevifolia* (Grinnell and Dixon, 1918; Wessman, 1977).

Soil characteristics. This species has been taken in soils characterized as sandy to gravelly (Grinnell and Dixon, 1918; Burt, 1936; Bartholomew and Hudson, 1961; Wessman, 1977).

Elevation. Mohave ground squirrels have been trapped at elevations between 2,500 and 5,000 ft (Grinnell and Dixon, 1918; Wessman, 1977).

POPULATION CHARACTERISTICS

Patterns of abundance. Limited personal observations yielded an estimated density of 15-20 per square mile (Burt, 1936).

Nesting site. Nests are maintained in a burrow system that is generally dug in the shade of a plant that also provides the animal with some of its food. The burrow is 5-7 cm in diameter, has more than one opening that enters the ground at a 35° angle, and is up to 6 m long and 1 m below the surface (Burt, 1936; Bartholomew and Hudson, 1961). Excavated dirt is scattered so that it is inconspicuous (Burt, 1936). It is plugged during periods of torpor, and the resident animal seldom ventures far from its home burrow (Bartholomew and Hudson, 1961). One female entered four burrow systems in a 6-hour period (Burt, 1936).

Activity patterns. The Mohave ground squirrel is diurnal, but concentrates its aboveground activities in March through July (Bartholomew and Hudson, 1961). It is less active on the surface on cloudy days (Burt, 1936).

Behavior. By temperament this animal is placid, docile, and sedentary (Bartholomew and Hudson, 1961). They rarely run rapidly, preferring to escape to nearby burrows (Burt, 1936). The tail is carried over its back as in *Ammospermophilus*, but the tail is not twitched (Burt, 1936). The voice is a shrill whistle (Burt, 1936).

REPRODUCTION AND GROWTH

Breeding season. In California a pregnant female was trapped in March, and a lactating female was trapped in April (Burt, 1936).

Litter size. In a single sample 6 embryos were counted (Burt, 1936).

Growth. After emerging from winter torpor this species can add as much as 100 g to its body weight before retreating underground for the remainder of the year (Bartholomew and Hudson, 1961).

TROPHIC RELATIONS

Foods eaten. In spring Mohave ground squirrels were observed eating "almost all green vegetation" including "alfilaria" (Burt, 1936).

Foraging techniques. Animals move slowly and cautiously among vegetation, sampling a bit of food here and there. They climb small bushes less than 3 dm high (Burt, 1936).

LIMITING FACTORS

Physiological constraints. This species has a lower critical temperature near 88°F which would limit its physiological adaptability to environments with cooler temperatures (Bartholomew and Hudson, 1961).

Behavioral constraints. This ground squirrel is relatively docile and non-aggressive which would seem to put it at a disadvantage when competing with other more assertive species (Bartholomew and Hudson, 1961).

Environmental constraints. The habitat requirements of this species have not been defined. However, it occupies a narrow geographic range which suggests that it has specialized environmental needs.

SYMBIOSES

Interactions with other species. The Mohave ground squirrel lives sympatrically with the white-tailed antelope ground squirrel, and its overall range abuts that of the round-tailed ground squirrel. Adaptations that permit the sympatric association have been reported (Bartholomew and Hudson, 1961), and further research is needed to define the factors that separate the ranges of the Mohave and round-tailed ground squirrels.

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Sensitivity to human activity. Recent trapping information suggests that the loss of historical range of this species may be due to expanded agricultural and urban development with an associated intrusion of the range of the more dominant Beechey and round-tailed ground squirrel populations (Wessman, 1977).

Endangered and threatened status. Bartholomew and Hudson (1961) suggested that the Mohave ground squirrel may be a species on its way to extinction. Their judgment was based on the narrow geographical distribution and relatively low densities of the species. There is little field data to evaluate their speculation.

GENERAL LIFE HISTORY INFORMATION

Physiology. The Mohave ground squirrel is capable of entering long periods of torpor (estivation/hibernation) during which its metabolic functions are greatly reduced. In the laboratory from September to February it is intermittently torpid for periods lasting several hours to several days, whether food is present or not. If food and water are present it will eat during periods of wakefulness. Animals lose considerable body weight during dormancy. Stored body fat is the major energy source during torpor. During normal activity the body temperature of the species may be as low as 88°F or as high as 107°F without apparent ill effects. Metabolism begins to rise at ambient temperatures of 98°F or above. The tolerance for high body temperatures is of major adaptive significance. Dormancy appears to act as an adaptation to: conserve energy; adapt to seasonal aridity (this species must have preformed water); and to minimize competition with the more active antelope ground squirrel (Bartholomew and Hudson, 1961).

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Spermophilus mohavensis - Mohave Ground Squirrel

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LIFE HISTORY SUMMARY

Spermophilus tereticaudus - Round-tailed Ground Squirrel

NOMENCLATURE AND SYNONYMY

Spermophilus tereticaudus Baird 1858. Type from Old Fort Yuma, Imperial Co., California.

Synonyms:

Spermophilus tereticaudus Baird 1858
Citellus eremomomus Elliot 1904
Citellus tereticaudus Grinnell 1913
Citellus chlorus Elliot 1904
Spermophilus neglectus Merriam 1889
Spermophilus sonoriensis Ward 1891

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains four subspecies as defined by Hall and Kelson (1959):

- S. t. apricus* (Huey 1927). Type from Valle de la Trinidad, Baja California.
S. t. chlorus (Elliot 1904). Type from Palm Springs, Riverside Co., California.
S. t. neglectus Merriam 1889. Type from Dolans Spring, 12 mi. NW Chloride, Mohave Co., Arizona.
S. t. tereticaudus Baird 1858. See above.

DIAGNOSIS

Skull short and broad; postorbital region wider than interorbital region; postorbital processes of skull projecting backward and downward; rostrum not constricted at the base or expanded at the tip; infraorbital foramen passing between the zygomatic plate and the rostrum; sides of zygomatic flattened from size to side posteriorly but twisted anteriorly until they are flattened from top to bottom before reaching the notch in zygomatic plate; antlantoscaphularis muscle absent; large cheek pouches, plain colored upper parts, not variegated, mottled, flecked or spotted; dorsal hairs very short, cinnamon, or tipped with white; whitish underparts; tail rounded, not flattened, hairy, and buffy or cinnamon underneath; without stripes on the side of the head (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERISTICS

Standard measurements. Total length 204-266 mm; tail 60-107 mm; hind foot 33-40 mm; weight about 150 g (Grinnell and Dixon, 1918; Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 34.4-39.3 mm; cranial breadth 17.0-18.0 mm; zygomatic breadth 21.2-24.4 mm; interorbital breadth 7.0-8.3 mm (Grinnell and Dixon, 1918; Hall, 1946; Ingles, 1965).

Pelage. There are two color phases: dorsally drab gray (winter); pinkish cinnamon (summer); without stripes or fleckings; underparts, cheek, eye ring, legs and feet whitish; long tail that is round and not bushy has

MORPHOLOGICAL CHARACTERISTICS

distal third blackish in winter pelage, buff below and colored like upper parts in summer pelage (Grinnell and Dixon, 1918; Hall, 1946; Ingles, 1965). There are two molts per year (Grinnell and Dixon, 1918; Hall, 1946; Hall and Kelson, 1959). These occur in April and October in California (Grinnell and Dixon, 1918). At least one molt takes place in June-July in Nevada (Burt, 1934).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. Males "seem to be" larger than females (Grinnell and Dixon, 1918).

GEOGRAPHIC RANGE

The range of the round-tailed ground squirrel extends from the extreme northwestern corner of Mexico and the northeastern corner of Baja California through southwestern Arizona and southeastern California to the southern tip of Nevada (Hall and Kelson, 1959).

HABITAT

Life zone. Lower Sonoran (Grinnell and Dixon; Hall and Kelson, 1959).

Vegetation associations. This species has been trapped in vegetation associations dominated by: *Larrea/Ambrosia*; *Larrea/Ambrosia/Atriplex/Prosopis*; *Suaeda/Distichlis* (Bradley, 1968; Bradley and Deacon, 1971; Burt, 1934; Drabek, 1973; Grinnell and Dixon, 1918; Jorgensen and Hayward, 1965; Reynolds and Turkowski, 1972).

Soil characteristics. Round-tailed ground squirrels seem to be partial to fine textured soils, especially wind-blown sand although they have also been taken in coarse gravel over a caliche layer in Arizona (Bradley, 1968; Bradley and Deacon, 1971; Burt, 1934; Drabek, 1973; Grinnell and Dixon, 1918; Hall, 1946; Hall and Kelson, 1959).

Elevation. This species is found at elevations between 180 ft below sea level (Grinnell, 1937) and 2,900 ft (Wessman, 1977).

Topographical characteristics. This species seems to prefer level, low-lying areas on the plains and lower bajadas (Grinnell and Dixon, 1918; Drabek, 1973).

POPULATION CHARACTERISTICS

Nesting sites. Round-tailed ground squirrels occupy burrows that have entrances that are usually below some part of the periphery of a mesquite or *Larrea* (Hall and Kelson, 1959).

Home range. Estimated home range size in Arizona was 0.74 hectare: there were no apparent sex- or age-specific differences in home range size. Sizes and shapes of home ranges shifted to include summer annual plants, and one female increased her range when her litter was weaned. Once established, however, home ranges were constant in location over two years. Animals spent time exploring up to 200 m beyond their range but always returned to it after being disturbed (Drabek, 1973). A total of 38% of the ground squirrels released $\frac{1}{2}$ mile from their home range returned within 1-2 weeks. Of these, 45% returned after a second displacement of $\frac{1}{2}$ mile but none returned from one mile (Bradley, 1968).

POPULATION CHARACTERISTICS (Cont'd)

Activity patterns. Some round-tailed ground squirrels are active on the surface almost every month of the year in Nevada and California (Hall, 1946; Bradley and Deacon, 1971), but their numbers are greatly reduced during the colder months of fall and winter (Hall and Kelson, 1959). Field data indicate that some *S. tereticaudus* enter torpor during periods of environmental extremes (Neal, 1965a). This species is diurnal in its aboveground activities (Drabek, 1973; Grinnell and Dixon, 1918). The amount of activity and numbers of squirrels on the surface are influenced by air temperatures. Summer activities follow a bimodal distribution with peaks of activity at 0700-0900 and 1700-1900. During the winter surface activities peak at midday. Surface activities in the summer commence one hour after sunrise with staggered emergence of individual animals. Activities stop one hour before sunset. In Arizona animals were active in cloudy (cooler) weather and after rains. Strong winds at beginning of day delayed activity periods but did not stop them. Foraging seems to be the most important surface activity of this species (Drabek, 1973).

Behavior. Round-tailed ground squirrels climb trees up to 1-2 m high (Grinnell and Dixon, 1918; Hall, 1946). Their voice is a ventriloquial high pitched squeak or shrill whistle (Grinnell and Dixon, 1918).

REPRODUCTION AND GROWTH

Breeding season. Females in Arizona first breed in late-February (Neal, 1965b). Pregnant females are trapped between March and April (Grinnell and Dixon, 1918; Neal, 1965b; Reynolds and Turkowski, 1972), and parturition takes place during mid-March to mid-April (Neal, 1965b). Lactating females are trapped in April through May (Reynolds and Turkowski, 1972). There are two records of pregnant females in June-July, but this is not the norm (Neal, 1965b). Males exhibit active spermatogenesis between January and April; by September their testes are completely regressed (Neal, 1965b).

Length of gestation. The gestation period requires 28-35 days (Neal, 1965a, b; Reynolds and Turkowski, 1972).

Litter size. The mean litter size using data from most of the range of the species is 6.5, with a range of 1-12 (Grinnell and Dixon, 1918; Hall, 1946; Hall and Kelson, 1959; Neal, 1965b; Reynolds and Turkowski, 1972).

Frequency of litters. There is one litter per year (Grinnell and Dixon, 1918; Neal, 1965b; Reynolds and Turkowski, 1972).

Age at reproductive maturity. No round-tailed ground squirrels breed during the year of their birth (Neal, 1965a, b).

Onset of reproductive activity. The appearance of scrotal testes in male round-tailed ground squirrels in Arizona is correlated ($r = 0.95$) with the amount of precipitation during December and January prior to their emergence on the surface (Reynolds and Turkowski, 1962). Litter sizes are correlated with the amount of precipitation falling between October and February (Reynolds and Turkowski, 1972).

REPRODUCTION AND GROWTH (Cont'd)

Growth and development. Neonates born in an Arizona laboratory colony weighed an average of 3.7 g (2.7-4.7) at birth. They are naked and their eyes and ears are closed. Four days after birth fine hairs appear on the head. At day 7 they can crawl and dark pigment appears. By day 14 the dorsal side of the head is haired and the back is covered with fine hairs that resemble those of adult squirrels. At day 21 the neonates are fully haired and their incisors erupt. By day 25-27 their eyes open; at day 28 they run well, and are still nursing; and by day 35 they are weaned. They have a comparatively rapid rate of development and grow at rates of: 11% per day between birth and day 21; 4.5% up to 60 days after birth; and 2% to 3 months. They reach 90% of their adult weight within 79 days after birth (Neal, 1965a).

TROPHIC RELATIONS

Foods preferred. Round-tailed ground squirrels eat green vegetation, seeds, and some insects. Stephens (1906) reported that they eat seeds most of the year, and grass when it is available. Grinnell and Dixon found that they consumed the stems of *Ephedra*, leaves of *Prosopis*, leaves of alfalfa, oats, and some dates. In Nevada they are known to eat "seeds and greens" (Hall, 1946). At Saratoga Springs, California round-tailed ground squirrels had green vegetation in their stomach contents throughout the year. They had seeds in their stomachs all seasons but summer, and insects were observed in spring and fall (Bradley and Deacon, 1971).

Foraging technique. Foraging for food is the main surface activity of this species (Drabek, 1973). They also climb trees and shrubs up to 1-2 m high to obtain food items (Grinnell and Dixon, 1918; Hall, 1946).

LIMITING FACTORS

Environmental constraints. The preferred habitat of this species includes fine textured soils on flat topography. Since these areas are also suitable for land reclamation there is a possibility that increased and expanding development may eventually threaten the preferred habitat of this species in the California desert.

SYMBIOSES

Diseases and parasites. The round-tailed ground squirrel is host to at least one species of mite (Allred and Goates, 1964) and one species of flea (Beck and Allred, 1966).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Nuisance animals. Grinnell and Dixon (1918) speculated that this species might become a nuisance around agricultural areas because it included crops in its diet where they occurred near squirrel populations.

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LIFE HISTORY SUMMARY

Perognathus longimembris - Little Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus longimembris (Coues 1875). Type from Old Fort Tejon, Tehachapi Mountains, Kern Co., California.

Synonyms: This species is also known as the silky pocket mouse. Scientific synonyms for this species include (cf. Hall and Kelson 1959):

Octognosis longimembris Coues 1875
Perognathus longimembris Merriam 1889
Perognathus elibatus Elliot 1904
Perognathus pericalles Elliot 1904
Perognathus bombycinus Osgood 1907
Perognathus panamintinus Osgood 1900
Perognathus nevadensis Merriam 1894
Perognathus pacificus Mearns 1898

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains 18 subspecies as defined by Hall and Kelson (1959):

- P. l. aestivus* Huey 1928. Type from Sangre de Cristo, Valle San Rafael, western base of Sierra Juarez, Baja California.
- P. l. arcus* Benson 1935. Type from Rainbow Bridge, San Juan Co., Utah.
- P. l. arizonensis* Goldman 1931. Type from 10 mi. S Jacobs Pools, 4,000 ft., Houserock Valley, N side Marble Canyon of Colorado R., Arizona.
- P. l. bangsi* Mearns 1898. Type from Palm Springs, Colorado Desert, Riverside Co., California.
- P. l. bombycinus* Osgood 1907. Type from Yuma, Yuma Co., Arizona.
- P. l. brevinasus* Osgood 1900. Type from San Bernardino. San Bernardino Co., California.
- P. l. gulosus* Hall 1941. Type from near ($\frac{1}{2}$ mi. S) Smith Creek Cave, 5,800 ft., Mt. Moriah, White Pine Co., Nevada.
- P. l. internationalis* Huey 1939. Type from Baja California side of international boundary at Jacumba, San Diego Co., California.
- P. l. kinoensis* Huey 1935. Type from Bahia Kino (N end of sand-dune peninsula that borders bay and forms northern arm of estuary), Sonora.
- P. l. longimembris* (Coues 1875). See above.
- P. l. nevadensis* Merriam 1894. Type from Halleck, East Humboldt Valley, Elko Co., Nevada.
- P. l. pacificus* Mearns 1898. Type from Mexican boundary monument No. 258, short of Pacific Ocean, San Diego Co., California.
- P. l. panamintinus* Merriam 1894. Type from Perognathus Flat, 5,200 ft., Panamint Mts., Inyo Co., California.
- P. l. pimensis* Huey 1937. Type from 11 mi. W Casa Grande, Pinal Co., Arizona.
- P. l. psammophilus* von Bleker 1937. Type from W side Arroyo Seco, 150 ft., 4 mi. S Soledad, Monterey Co., California.
- P. l. saltensis* Bole 1937. Type from 1 mi. N Salt Camp, 1,060 ft., west edge of the salt lake, Saline Valley, Inyo Co., California.

CONTEXT AND CONTENT (Cont'd)

P. l. tularensis Richardson 1937. Type from 1 mi. W Kennedy Meadows, 6,000 ft., South Fork Kern River, Tulare Co., California.

P. l. venustus Huey 1930. Type from San Agustín, Baja California.

P. l. virginis Huey 1939. Type from St. George, 2,950 ft., Washington Co., Utah.

DIAGNOSIS

Hind foot less than 20 mm; antitragus not lobed; occipitonasal length usually more than 24 mm; lower premolar distinctly larger than last molar; mastoidal bullae moderate, extending well beyond occiput; occiput without lateral indentation by mastoid (Merriam, 1889; Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 110-151 mm; tail 53-86 mm; hind foot 15-20 mm; ear from notch 5-7 mm; weight 7-11 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Occipitonasal length 20-23 mm; mastoidal breadth 8-9 mm; interorbital breadth 5.0-5.5 mm (Hall, 1946).

Pelage. Pelage is soft and silky with no spines or bristles. The upper parts are approximately pinkish- or ochraceous-buff, overlaid with black or blackish hairs to a greater or lesser extent so that some subspecies appear quite dark and others are distinctly buffy in overall tone. The underparts appear tawny to buffy or white, or sometimes the pectoral region alone is white and the remainder tawny or buffy. The tail is usually bicolored (Hall and Kelson, 1959).

Baculum. The length is approximately 4.5 mm; dorsoventral diameter of base is approximately 0.35 mm; lateral diameter of base is approximately 0.4 mm. The proximal end of the baculum is enlarged. Distally it has a laterally compressed cross-section (Burt, 1936).

Karyology. Diploid number is 56 and the fundamental number is 88. There are 17 banded and 10 unbanded autosomes. The X chromosome is large, submetacentric; while the Y chromosome is small and metacentric. One pair of autosomes has a terminal satellite on its long arm (Patton, 1967).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Hall and Kelson, 1959).

Locomotion. The mode of locomotion is exclusively quadrupedal. Individuals walk or trot with alternating legs. Moderate speed is achieved with a quadrupedal hop. When startled they can leap less than 2 ft vertically and about 3 ft horizontally. Escape involves erratic and ricochetal movement. The tail serves to balance and steer. Individuals maintain a bipedal stance while foraging and handling food (Bartholomew and Carey, 1954).

Sexual dimorphism. Sexual dimorphism is slight, males being somewhat larger (Hall, 1946).

GEOGRAPHIC RANGE

The geographic range of the little pocket mouse extends through a number of arid and semi-arid habitats of southwestern North America. Its westernmost extent is into the coastal sage scrub communities of southern California and the Salinas Valley of central California. It extends northward to the

GEOGRAPHIC RANGE (Cont'd)

shrub-steppe deserts of southeastern Oregon. To the east, this species reaches into Utah to the western margin of the Pleistocene Lake Bonneville in the north and along the Colorado River in the south. Southward, the range extends into Baja California. Isolated populations are located in Pinal Co., Arizona (Hall and Kelson, 1959).

Within the California desert, the little pocket mouse is widespread from desert scrub communities through pinon/juniper communities.

HABITAT

Life zones. Lower to Upper Sonoran (Ingles, 1965).

Vegetation associations. Creosote scrub (Chew and Butterworth, 1964; Miller and Stebbins, 1964); pinon/juniper woodland (Miller and Stebbins, 1964); Joshua-tree woodland (Miller and Stebbins, 1964); sagebrush scrub (Bailey, 1936; O'Farrell, 1974); shadscale scrub (Kenagy, 1973); coastal sage scrub (Meserve, 1976). Jorgensen and Hayward (1965) and Beatley (1976) found the little pocket mouse widespread through several vegetation zones from creosote scrub through shadscale scrub in south central Nevada.

Soil characters. Hall (1946) found little pocket mice abundant on the firm, sandy bajadas of Nevada. He also captured some in the loose sands of valley floors. Miller and Stebbins (1964) found this species on soils ranging from sand and light silt to gravel washes and bajadas. Beatley (1976) found them less common on stony soils.

Elevation. Hall (1946) captured specimens at an elevation of 6,500 ft in Nevada.

POPULATION CHARACTERISTICS

Survivorship. In the laboratory little pocket mice have survived for up to 8.5 years. Of 216 individuals, 7% survived for more than 4 years and 50% survived more than 2.7 years (Hayden and Linberg, 1976). The survivorship curve for this species was very elongated, with survival decreasing at the rate of 0.8% per month in the first two years of life. In the field, this species survived for a maximum of 3 to 5 years. Average life span was 2.5 to 5 months in fenced study plots in the creosote scrub of Nevada (French et al., 1967).

Mortality. In a fenced population in the creosote scrub of Nevada, the instantaneous rate of death was calculated as 0.097 individuals per month per individual in the population (French et al., 1974).

Natality. In a fenced population in Nevada, the instantaneous rate of birth was calculated as 0.4483 individuals per month per individual in the population (French et al., 1974).

Patterns of abundance. French et al. (1974) found a maximum of 5.5 individuals per ha in their fenced sites in Nevada. Chew and Butterworth (1964) found a maximum of 1.7 individuals per ha in creosote scrub in Joshua Tree National Monument, California. Populations in Nevada monitored for about six years showed considerable fluctuations in abundance, from about 1 to 5.5 per ha over the study period (French et al., 1974). Chew and Butterworth (1964) found similar variability.

POPULATION CHARACTERISTICS (Cont'd)

Age distribution. In two different years, a population of little pocket mice from south-central Nevada had age distributions of 22.1 ± 8.9 and 21.6 ± 10.2 months (mean $\pm$ standard deviation) (Flake and Jorgensen, 1969).

Dispersal. Chew and Butterworth (1964) found that maximum movements of individuals ranged from 38.7 to 84.4 m during a three-day trapping period. Kenagy (1973) observed that little pocket mice rarely moved more than 50 m in a single night. However, French et al. (1968) found that displaced individuals moved an average distance of 360 m. Flake and Jorgensen (1969) found that this species readily reinvaded an area that had been trapped out.

Patterns of dispersion. Jorgensen (1968) found that males tended to have an aggregated distribution in a population in south central Nevada. All other age and sex groups tended to be randomly dispersed.

Nesting sites. Kenagy (1973) found that pocket mice tend to construct burrow systems under shrubs. Runway diameters ranged from 1.5 to 2.0 cm. Each burrow system contained several resting areas, some as shallow as 1 cm below the surface. Two nesting chambers were excavated at depths of 52 and 65 cm. Each chamber was 8 cm wide and 5 cm high, and the floor was covered with a loose bed of dry roots and leaves. The pocket mice almost always plugged their burrows.

Home ranges. Chew and Butterworth (1964) estimated that little pocket mice in Joshua Tree National Monument, California, had circular home ranges covering 0.12 to 0.56 ha. No differences between males and females were noted. In south-central Nevada, males had estimated areas of 0.29 to 1.88 ha in which they spent 95% of their time; for females, the area ranged from 0.48 to 3.09 ha (Maza et al., 1973). Similar calculations in a neighboring population (Burge and Jorgensen, 1973) yielded estimates of 0.39 ha for females and 0.45 for males.

REPRODUCTION AND GROWTH

Breeding season. Little pocket mice are reproductively active from January to August, with peak reproduction in March (Chew and Butterworth, 1964; Bradley and Mauer, 1973). Kenagy (1973) found that females were in estrus upon emergence from hibernation. Beatley (1976) stated that reproduction is less correlated with the germination of annual plants than in other species of heteromyids.

Litter size. Mean of 4.3; range 2 to 8 (Hall, 1946).

Frequency of litters. Usually one litter per year (Hall, 1946).

Length of gestation. Gestation requires 21 to 31 days (Hayden et al., 1966).

Age at weaning. 30 days (Hayden et al., 1966).

Age at reproductive maturity. Males do not exhibit descended testes until after 150 days of age. Females can become reproductively active as early as 60 days of age (Hayden et al., 1966).

REPRODUCTION AND GROWTH (Cont'd)

Growth. Weight at birth is less than 1.5 g. During the first 21 days after birth, the neonates grow at a rate of 7.4% of their body weight per day. Growth levels off after 50 to 60 days when the young have reached 90% of the adult weight. At birth, the young pocket mice are hairless and pink. On days 4 to 6 dark pigmentation appears on the head and thence spreads to the lateral line. Sparse, gray hair begins to appear upon the pigmented area by days 7 to 9. By days 13 to 15, full juvenile pelage appears, exhibiting gray above and white below. Adult coloration appears by days 29 to 40. The ears are closed at birth and remain closed until after the 13th day. The pinnae unfold by day 5. The eyes are sealed at birth. Eyelids appear at 6 to 7 days of age, and the eyes are open by the 14th to 15th days of age. Nurslings have the ability to right themselves at birth and are moving around by 8 days of age. They are eating carrots by 10 days of age, seeds by 14 days, and are apparently self sufficient by 18 days of age (Hayden et al., 1966).

Courtship behavior. There appear to be no specialized patterns of courtship in this species. Reproductively active individuals approach each other directly and commence copulation when placed together (Hayden et al., 1966).

Predators. Miller and Stebbins (1964) reported finding the remains of a little pocket mouse in a rattlesnake, *Crotalus mitchelli*. Other potential predators would include kit foxes, coyotes, owls, other snakes, and, in some instances, grasshopper mice.

Activity patterns. Little pocket mice tend to disappear from the trappable population from September-October through February-April (Chew and Butterworth, 1964; Bradley and Mauer, 1973; Kenagy, 1973; O'Farrell, 1974). These pocket mice do enter torpor and restrict their activity below the ground under conditions of cold and food restriction (Bartholomew and Cade, 1957; Chew et al., 1965; French, 1977). In one year of high food availability, some members of a population in the Owens Valley remained active for the entire winter (Kenagy, 1973). As are most desert rodents, little pocket mice are nocturnal. Peak activity tends to occur early in the night (Kenagy, 1973; O'Farrell, 1974). Kenagy rarely observed activity in the open. Individuals were active in the Owens Valley at temperatures around -100° C (Kenagy, 1973).

TROPHIC RELATIONS

Food habitats. Little pocket mice are predominantly granivorous. Brown and Lieberman (1973) found that individuals tended to select seeds with diameters of approximately 1.5 mm. Burt (1934) and Hall (1946) have found seeds of *Franseria*, *Plantago*, *Festuca*, *Eriogonum*, and *Chenopodium* in the cheek pouches of pocket mice from Nevada. Bradley and Mauer (1973) found that the diet of the little pocket mouse consisted of 82% seeds, 17% greens, and 1% insects. Greens were consumed in the spring when annual plants had germinated. Grasses, forbs, and shrubs contributed equally to the diet of the mice. In a coastal sage habitat, little pocket mice consumed mostly grass seeds during the year (Meserve, 1976). In the spring, the diet of this population was dominated by forb seeds. The intake of herbage ranged from 20 to 30% of the diet.

TROPHIC RELATIONS (Cont'd)

Foraging sites. Kenagy (1973) rarely observed little pocket mice foraging in open areas. However, Meserve (1976) found these pocket mice to be associated with open areas. The difference may be due to the difference in habitats for the two studies: coastal sage scrub (Meserve, 1976); and shadscale scrub (Kenagy, 1973).

Foraging techniques. These pocket mice maintain a bipedal stance when foraging and handling food (Bartholomew and Carey, 1954). While foraging they hold their body horizontal with their head close to the ground.

LIMITING FACTORS

Pocket mice are rarely found in rocky soils (Hall, 1946; Miller and Stebbins, 1964; Beatley, 1976). They tend to be restricted to sandy soils, although they may be found on areas with rocks scattered upon the surface. These pocket mice are highly adapted for life in the desert. They are probably prevented from successfully invading more mesic habitats by their low reproductive capacity relative to the inhabitants of these habitats. Thus their restriction to the desert is probably due primarily to their inability to outcompete the populations inhabiting mesic habitats.

SYMBIOSES

Little is known of the diseases and parasites of the little pocket mouse. They occur sympatrically with a large number of other rodent populations.

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LIFE HISTORY SUMMARY

Perognathus parvus - Great Basin Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus parvus (Peale 1848). Type from Oregon, probably near The Dalles, Wasco Co.

Synonyms:

Cricetodipus parvus Peale 1848
Perognathus parvus Cassin 1858
Perognathus monticola Baird 1858
Perognathus columbianus Merriam 1894
Perognathus laingi Anderson 1932
Abromys Lordi Gray 1868
Perognathus mollipilosus Coues 1875
Perognathus olivaceus Merriam 1889

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains 11 subspecies as defined by Hall and Kelson (1959):

- P. p. bullatus* Durrant and Lee 1956. Type from Ekker's Ranch, Robbers Roost, 25 mi. (airline) E Hanksville, 6,000 ft., Wayne Co., Utah.
- P. p. clarus* Goldman 1917. Type from Cumberland, Lincoln Co., Wyoming.
- P. p. columbianus* Merriam 1894. Type from Pasco, Franklin Co., Washington.
- P. p. idahoensis* Goldman 1922. Type from Echo Crater, 20 mi. SW Arco, Butte Co., Idaho.
- P. p. laingi* Anderson 1932. Type from Anarchist Mtn., near Osoyoos-Bridesville summit, about 8 mi. E Osoyoos Lake, 3,500 ft., British Columbia.
- P. p. Lordi* (Gray 1868). Type from southern British Columbia.
- P. p. mollipilosus* Coues 1875. Type from Fort Crook, Shasta Co., California.
- P. p. olivaceus* Merriam 1889. Type from Kelton, near north end of Great Salt Lake, Boxelder Co., Utah.
- P. p. parvus* (Peale 1848). See above.
- P. p. trumbullensis* Benson 1937. Type from Nixon Spring, 6,250 ft., Mt. Trumbull, Mohave Co., Arizona.
- P. p. yakimensis* Broadbooks 1954. Type from 16 mi. NW Naches, Rocky Flat (or Rocky Prairie), 3,800 ft., Yakima Co., Washington.

DIAGNOSIS

Hind foot more than 20 mm; antitragus lobed; occipitonasal length more than 24 mm; ears not clothed with white hairs; tail dark, neither crested nor markedly tufted; olivaceous lateral line present; supraoccipital without lateral indentations by mastoid; mastoids projecting posteriorly to the level of the occiput; interparietal bone usually not as wide as the interorbital width; auditory bullae nearly meeting anteriorly; pelage soft without stiff coarse hairs on flanks (Hall and Kelson, 1959; Ingles, 1965). They have relatively large, fur-lined, external cheek pouches (Dalquest, 1948).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 148-198 mm; tail length 77-107 mm; hind foot 19-27 mm; weight 16.5-31 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Occipitonasal length 27 mm; frontonasal length 18-18.8 mm; mastoid breadth 14-14.3 mm; length of mastoid bulla 9.0 mm; interparietal width 5.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Soft without stiff coarse hairs on flanks. Upper parts pinkish buff or ochraceous buff, thinly to heavily overlaid with blackish hairs. Underparts white to buffy. Olivaceous lateral line. Tail bicolored, its upper and lower colors corresponding to those on the body. Overall appearance is gray-olive above, white below with a reddish tinge, and a buffy lateral line (Hall, 1946; Hall and Kelson, 1959; Ingles, 1969).

Baculum. Length about 7.5 mm (Ingles, 1969).

Karyology. Diploid number (incomplete data from 1 specimen) is 54 and the fundamental number is apparently 70. A total of 10 pairs of banded and 17 pairs of unbanded chromosomes have been distinguished. The sex complement is unknown, but the X is presumed to be banded which is typical for the genus (Patton, 1967).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Hall and Kelson, 1959).

Locomotion. Although this species has not been studied, presumably its mode of locomotion is similar to four allied species observed in the laboratory. Their locomotion is exclusively quadrupedal, and individuals walk or trot with alternating legs. Moderate speed is achieved with a quadrupedal hop. They can leap less than 2 ft vertically and about 3 ft horizontally. Escape involves erratic and ricochetal movement. The tail serves to balance and steer. Individuals maintain a bipedal stance while foraging and handling food (Bartholomew and Carey, 1954).

Sexual dimorphism. Average weights of males are about 19% greater than those of females of comparable age (Hall, 1946).

GEOGRAPHICAL RANGE

The Great Basin pocket mouse is found through a broad latitudinal range extending from southern Nevada to the Okanogan River Valley of south-central British Columbia. Its range extends eastward to southern Idaho and the western half of Utah. Its westward range is confined to the arid and semi-arid habitats on the east side of the Cascade Range through Washington, Oregon and northeastern California (Hall and Kelson, 1959).

In California its range is primarily restricted to portions of the four northeastern counties as well as to areas within Mono and Inyo counties (Ingles, 1965).

HABITAT

Life zones. Upper Sonoran.

Vegetation associations. The Great Basin pocket mouse is primarily associated with shrub-steppe habitats and has been trapped in the following vegetation associations: *Artemisia rigida*/*Poa sandbergii*; *Artemisia tridentata*/*Agropyron spicatum*; *Agropyron spicatum*/*Poa sandbergii* (Rickard, 1960); *Artemisia tridentata*/*Poa sandbergii*; *Eurotia lanata*/*Poa sandbergii*; *Artemisia tridentata*/*Bromus tectorum*; *Artemisia*/*Grayia*/*Poa sandbergii*;

HABITAT (Cont'd)

Bromus / *Sisymbrium*; *Eriogonum* / *Poa* (O'Farrell, 1975a, b) *Agropyron cristatum*; *Artemisia tridentata* / *Festuca idahoensis* (Larrison and Johnson, 1973); *Coleogyne ramosissima*; *Artemisia* / Pinon / Juniper (Jorgensen and Hayward, 1965; Beatley, 1976).

Soil characters. The Great Basin pocket mouse is most commonly found in habitats with light-textured, deep soils (Hall, 1946; Rickard, 1960; Kritzman, 1974; O'Farrell, 1975a).

Elevation. In Washington this species has been trapped at elevations between 550 and 4,000 ft (O'Farrell, 1975a, b), while in Nevada they range between 3,900 and 10,000 ft (Hall, 1946).

POPULATION CHARACTERISTICS

Survivorship. The maximum life span observed in the field was five years. Survival of cohorts from weaning to the following breeding season (about 8 months later) ranged between 56% and 80% for years of average and poor food production, respectively. By the third year only 17%-19% of the cohorts remain alive, and only 2%-3% survive to the fourth year following weaning (O'Farrell et al., 1975).

Mortality. Field trapping records indicate that mortality is minimal during the winter when the animals are in torpor. The greatest declines in number occur in the period after the animals emerge from winter torpor (O'Farrell et al., 1975).

Patterns of abundance. In south-central Washington (*Artemisia* / *Poa*) estimated population densities ranged between 20 and 110 animals per hectare. Within years the greatest variation was a five-fold increase in numbers observed between the early breeding season and the fall population peak. Peak autumnal populations averaged 80 animals/hectare and there was only a two-fold variation between population estimates for the years with the lowest and highest densities (O'Farrell et al., 1975).

Age distribution. In south-central Washington populations of Great Basin pocket mice usually had at least four year-classes represented. However, the breeding populations (January to June) were dominated by 1-yr-old animals, and young-of-the-year usually dominated the age classes after July (O'Farrell et al., 1975).

Dispersal. In a shrub-steppe habitat this species rarely displayed dispersal movements although perimeter traps were operated. Only 12% of the animals ventured 50 m off the trapping grid, and fewer than 1% moved 100 m and returned. A 2.45-sigma recapture radius of 26.1 m was estimated for adult Great Basin pocket mice (O'Farrell et al., 1975). Animals moved 800 m were unable to return to their home ranges, and only one was able to return after being displaced 400 m (Broadbrooks, 1961).

Nesting sites. In undisturbed shrub-steppe burrows of pocket mice usually are at the bases of shrubs where roots furnish protection. Openings may be recognized by fan-shaped piles of fresh soil in front of the hole. Burrows are usually closed during the day by means of a fresh plug of soil. Burrows appear circular in outline and are less than 2.5 cm in diameter. They are normally less than 1.2 m in length although they may reach a depth of 2 m in

POPULATION CHARACTERISTICS (Cont'd)

sandy or silt loams. There are at least 2 to 4 branches within the burrow system, some of which terminate in surface exits. Nests are globular cavities about 75 mm in diameter that are made of finely broken weed twigs, perianths of tumbleweeds, and seed husks or bits of dried grass (Scheffer, 1938; Dalquest, 1948). Where shrubs have been removed burrow entrances are common on bare, wind-swept areas including cultivated fields (Scheffer, 1938).

Home range. Adult male pocket mice in Washington have larger home ranges (range of 0.16-0.40 ha) than females (0.05-0.23 ha); adults have larger home ranges than subadults. Home ranges are largest in years of average-to-excellent food production and moderate population densities; they are smaller either in years of poor resources and moderate population densities or in years of average resources and high animal densities. Centers of activity within home ranges shifted less than 16 m for males and 6 m for females, respectively, which indicates a high degree of stability and spatial partitioning of the habitat (O'Farrell et al., 1975). In British Columbia estimated home range sizes for adult male and female Great Basin pocket mice were 0.09 ha and 0.07 ha, respectively (Iverson, 1967) in areas dominated by *Artemisia tridentata*/*Furshia tridentata*. Jorgensen and Hayward (1965) estimated a home range of about 0.06 ha for *Coleogyne* and *Artemisia*/Pinon/Juniper associations in Nevada.

Predators. Scheffer (1938) listed the shrike, marsh hawk, red-tailed hawk, ferruginous rough-legged hawk, burrowing owl, short-eared owl, badger, striped skunk, weasel and coyote as potential predators on pocket mice. Although lacking direct evidence, O'Farrell et al., (1975) regarded owls and gopher (bull) snakes as the most important pocket mouse predators.

Activity patterns. Great Basin pocket mice terminate aboveground activities between November and March (Scheffer, 1938; Iverson, 1967; O'Farrell, 1975b; O'Farrell et al., 1975) when they are presumably in a state of torpor in their burrows. Data from some field studies (Iverson, 1967; Schreiber, 1973) indicate that females enter torpor before the males, but this is not reflected in other extensive data (O'Farrell et al., 1975). Pocket mice at higher elevations enter torpor earlier, and remain underground longer than mice at lower elevations (Iverson, 1967; O'Farrell, 1975b). Adults cease aboveground activities before subadults (Iverson, 1967; O'Farrell et al., 1975). Males exit torpor before females (Scheffer, 1938; Iverson, 1967; O'Farrell et al., 1975), usually in mid-March (Iverson, 1967; O'Farrell et al., 1975). The first females usually are trappable by mid-April (O'Farrell et al., 1975). All age classes are primarily crepuscular and nocturnal in their activity patterns and tend to be most active on the surface one hour after sunset (Scheffer, 1938). Once active on the surface, adults are trappable an average of 60 to 90 days in years of good and poor food resources respectively (O'Farrell et al., 1975). There is evidence to indicate that commencement of torpor and underground activities is linked to the amount of time required for an animal to store its winter food cache, while cessation from torpor in the spring is linked to changes in soil temperatures (O'Farrell et al., 1975).

Behavior. Pocket mice are solitary, and generally intolerant of other mice even members of the same species. They maintain a dispersed social organization (Kritzman, 1974).

REPRODUCTION AND GROWTH

Breeding season. Great Basin pocket mice are reproductively active from March through as late as August (Hall, 1946; Iverson, 1967; Speth et al., 1968; O'Farrell et al., 1975). Males display scrotal testes in March-April and remain reproductively active for an average of 4 months (Iverson, 1967; Speth et al., 1968; O'Farrell et al., 1975). Females become reproductively active later than males, usually showing the first signs of estrus in April (O'Farrell et al., 1975). The last pregnant females are found in either July or August (Iverson, 1967; O'Farrell et al., 1975). Breeding seasons at higher elevations are reduced in duration compared to those at lower sites of comparable vegetation types (Iverson, 1967; O'Farrell, 1975b). The duration of the breeding season, frequency of litters, and breeding success of juveniles is closely related to the production of food, particularly winter annual seeds (O'Farrell et al., 1975).

Litter size. Scheffer (1938) reported a range of 2 to 8 fetuses per female with an average litter size of 5.2. Other authors have reported similar findings in British Columbia (Iverson, 1967), Nevada (Hall, 1946) and Utah (Duke, 1957), but Schreiber (1973) and O'Farrell et al., (1975) observed average litter sizes of about 3.8 in south-central Washington.

Frequency of litters. In years of poor food production the average frequency of litters is 0.3 per female, while in years of excellent supplies it may reach 2 per female (Iverson, 1967; Schreiber, 1973; O'Farrell et al., 1975). There is no evidence to indicate that this species breeds at parturition (Iverson, 1967; O'Farrell et al., 1975).

Gestation length. Indirect evidence suggests a gestation period of 21 to 28 days (Scheffer, 1938; Iverson, 1967).

Age at weaning. Great Basin pocket mice are weaned at about 3 weeks (Iverson, 1967).

Age at reproductive maturity. In most years pocket mice do not become reproductively active until the spring following their birth. In years with unusually high food supplies subadults born in the first litters may breed (Iverson, 1967; Speth et al., 1968; O'Farrell et al., 1975).

Growth. Weight at birth averages 1.3 g (Schreiber, 1973).

Molt. Great Basin pocket mice molt twice per year: once in the summer, and once in late winter. The molt line begins behind the ears and progresses caudally on both sides of dorsal midline, fanning out laterally. The ventral molt is initiated around the bases of the forelegs, genitalia, and throat. Molt is arrested after successful breeding of females. Juveniles attain adult pelage in their first summer (Speth, 1969).

TROPHIC RELATIONS

Food habits. Great Basin pocket mice are primarily granivorous (Scheffer, 1938; Iverson, 1967; Hall, 1946; Kritzman, 1974). They do, however, supplement their diet with green vegetative material and arthropods (Jameson, 1954; Iverson, 1967; Kritzman, 1974). In April Jameson (1954) found insects in 78% of the stomachs examined, and 61% of these had only insects in them. Iverson (1967) found roughly equal parts of seeds, green vegetation and animal material in stomach contents examined in the summer, but seeds were

TROPHIC RELATIONS (Cont'd)

virtually the only item stored for the winter. Field and laboratory studies have suggested that the most commonly sought seeds are those from grasses, several species of mustard, buckwheat, and composites (Hall, 1946; Kritzman, 1974).

Energy requirements. Schreiber (1973) estimated an average annual energy requirement of 2,370 kcal per animal in eastern Washington shrub-steppe.

LIMITING FACTORS

Great Basin pocket mice are restricted to habitats within the shrub-steppe that have sufficient quantities of seeds, their primary winter food source, and are underlain by light-textured, deep soils (Hall, 1946; Iverson, 1967; Rickard, 1960; Kritzman, 1974; O'Farrell, 1975a). The northern limit of their distribution is restricted by prolonged cold winter temperatures, and a relatively brief potential breeding season (Iverson, 1967).

SYMBIOSES

Great Basin pocket mice serve as hosts for at least 6 species of mites (Allred, 1963; Allred and Goates, 1964), 3 species of flea (Beck and Allred, 1966; Egoscue, 1966; O'Farrell, 1975a), and 3 species of tick (Beck et al., 1963). In a sample of 80 animals from south-central Washington, 75% of the animals had positive pathologic diagnoses with the most common lesions being visceral nematodes, increased hemopoiesis, and focal leucocyte aggregates (O'Farrell, 1975a).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Great Basin pocket mice are considered to be a potential nuisance if large populations develop in agriculture areas, particularly around grain fields. They dig up germinating seeds along drill rows, cut heads from ripening stalks, and remove shattered seeds. Much of the grain used is waste gleaned from harvesting operations. No total crop losses have been observed due to pocket mouse activities, and no significant damage has been noted that would justify rigorous control measures (Scheffer, 1938).

Pocket mice serve a positive function in that they play an active role in the dispersal of caryopses and seeds of herbaceous and grass species in range lands. Their activities positively influence the grass populations and the diet of animals on range sites in the winter (La Tourrette et al., 1971).

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Perognathus parvus - Great Basin Pocket Mouse

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LIFE HISTORY SUMMARY

Perognathus xanthonotus - Yellow-eared Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus xanthonotus Grinnell 1912. Type from Freeman Canyon, 4900 ft., E slope Walker Pass, Kern Co., California.

Synonyms: None.

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains no subspecies.

DIAGNOSIS

Mastoids greatly developed and projecting beyond occipital plane; breadth of interparietal less than breadth of interorbital region; audital bullae meeting or nearly so anteriorly; mastoids not deeply indenting the supra-occipital; hind foot greater than 20 mm; pelage soft and without stiff hairs on flanks; soles of hind feet somewhat hairy; tail 95 mm or less, distinctly penicillate, with hairs on crest or tuft 15 mm or less; ears clothed with hairs and yellow hairs within ear; dorsal color ochraceous buff (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERISTICS

Standard measurements. Total length about 170 mm; tail about 85 mm; hind foot about 23 mm (Ingles, 1965).

Pelage. Upper parts between ochraceous-buff and cream-buff, almost perfectly clear on sides of body and head, and but slightly obscured middorsally with scanty dusky tipplings to the hairs. Feet and lower surface white. Tail well clothed with hairs, and distinctly penicillate, beneath white, above faint cream-buff with a slight dusky tinge on terminal fifth. All yellow hairs inside ears (Hall and Kelson, 1959; Ingles, 1965).

GEOGRAPHIC RANGE

Range of species. The yellow-eared pocket mouse is known only from California. It has been taken at: Freeman Canyon, East slope of Walker Pass, Kern County; west slope of Walker Pass; Kelso Valley, Kern County; Tehachapi Mountains (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zone. Upper Sonoran Life Zone (Ingles, 1965).

Elevation. 4,600 to 5,000 ft (Hall and Kelson, 1959).

LITERATURE CITED

Perognathus xanthonotus - Yellow eared Pocket Mouse

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LIFE HISTORY SUMMARY

Perognathus formosus - Long-tailed Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus formosus Merriam 1889. Type from St. George, Washington Co., Utah.

Synonyms:

Perognathus formosus Merriam 1889

Perognathus mesembrinus Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains nine subspecies as defined by Hall and Kelson (1959):

- P. f. cinerascens* Nelson and Goldman 1929. Type from San Felipe, north-eastern Baja California.
- P. f. domisaxensis* Cockrum 1956. Type from Houserock Valley, 15 mi. W of bridge, Coconino Co., Arizona.
- P. f. formosus* Merriam 1889. See above.
- P. f. incolatus* Hall 1941. Type from 2 mi. W Smith Creek Cave, Mt. Moriah, White Pine Co., Nevada.
- P. f. infolatus* Huey 1954. Type from 7 mi. W San Francisquito Bay, Gulf of California, Baja California.
- P. f. melanocaudus* Cockrum 1956. Type from lower end of Toroweap Valley, Mohave Co., Arizona.
- P. f. melanurus* Hall 1941. Type from 4,000 ft., 6 mi. E California boundary, Washoe Co., Nevada.
- P. f. mesembrinus* Elliot 1904. Type from Palm Springs, Riverside Co., California.
- P. f. mohavensis* Huey 1938. Type from Bonanza King Mine, Providence Mts., San Bernardino Co., California.

DIAGNOSIS

Mastoids projecting posteriorly to the level of the occiput; mastoids deeply indented supraoccipital; occipital length more than 24 mm; ear more than 10 mm from notch, not clothed with white hairs; antitragus narrow at the base and lobed; hind foot normally more than 20 mm; sole of hind foot usually with some hair near ankle or may be naked; tail normally 95 mm or more in length, with hair on its dark crest and tuft more than 15 mm long; tail bicolored; external, fur-lined cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 164-211 mm; tail 86-118 mm; hind foot 21-26 mm; weight 16.8-24.7 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Occipitonasal length 25.5-28.2 mm; frontonasal length 17.6-19.6 mm; mastoidal breadth 13.4-14.9 mm; length of mastoidal bulla 8.7-9.5 mm; interparietal width 6.4-7.5 mm (Hall, 1946).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Pelage soft; long hairs from the front edge of ear nearly reach across the ear; upper parts slate gray or brown; under parts white but sometimes faintly washed with buff; tail bicolored, sparsely haired, distally crested with tuft (Hall and Kelson, 1959; Ingles, 1965). There is at least one molt in Nevada that takes place in August (Burt, 1946).

Baculum. Length of baculum averages 8.8 mm (Ingles, 1965).

Karyology. The diploid chromosome number is 36 with a fundamental number of 52. There are 9 pairs of banded and 8 pairs of unbanded autosomes. The X chromosome is a medium submetacentric, and the Y chromosome is a small acrocentric (Patton, 1967).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Locomotion. Pocket mice are exclusively quadrupedal. They walk with alternating legs. At moderate speeds they use quadrupedal hops in which the forelegs move together and the hindlegs move together. At high speeds the forelegs act as a fulcrum to pivot the body for the strong forward leaps of the hindlegs. When startled they can leap 60 cm or more vertically and as much as a meter horizontally. The tail is used for balance (Bartholomew and Cary, 1954).

Sexual dimorphism. Males are larger than females: 3% larger in linear measurements; 6% heavier (Hall, 1946).

GEOGRAPHIC RANGE

The range of the long-tailed pocket mouse extends from central Baja California northward through southeastern California, southern and western Nevada to western Utah and northwestern Arizona (Hall and Kelson, 1959).

In California it is found only in the arid habitats of eastern Modoc, Lassen, Mono, Inyo, San Bernardino, and Riverside counties (Ingles, 1965).

HABITAT

Life zones. Lower Sonoran and lower part of Upper Sonoran life zones (Hall, 1946).

Vegetation associations. In Nevada this species has been trapped in a variety of habitats including: *Larrea/Ambrosia*; *Grayia/Lycium*; *Coleogyne*; *Atriplex/Kochia*; *Salsola*; pinon/juniper; and a few have been caught in *Artemisia/Grayia* (Allred and Beck, 1963a; Allred et al., 1963; Beatley, 1976; Bradley and Mauer, 1973; Burt, 1934; French et al., 1974; Jorgensen and Hayward, 1965). In California they have been trapped in sparse *Larrea* (Miller and Stebbins, 1964) and in a xeric habitat dominated by *Atriplex hymenolayra* (Bradley and Deacon, 1971).

Soil characters. This species is consistently trapped in areas having rocky or stony ground cover (Beatley, 1976; Bradley and Deacon, 1971; Burt, 1934; French et al., 1974; Grinnell, 1937; Hall, 1946; Hall and Kelson, 1959; Ingles, 1965; Jorgensen and Hayward, 1965; Miller and Stebbins, 1964).

Elevation. Long-tailed pocket mice have been trapped at elevations between 282 ft below sea level (Grinnell, 1937) to at least 6,500 ft (Hall, 1946).

HABITAT (Cont'd)

Topographical characters. *P. formosus* is most often associated with rocky washes, canyon mouths, and the upper parts of bajadas (Miller and Stebbins, 1964).

POPULATION CHARACTERISTICS

Longevity. In the laboratory individuals have lived as long as 7 years and 1 month (Egoscue et al., 1970). The mean life spans of animals in Nevada was 3.7 to 5 months for fenced populations, and 2.2 months for free-ranging populations (French et al., 1967). Estimated average life expectancy was $11.4-14.4 \pm 0.5$ months for penned populations (French et al., 1974). Yearlong monthly survival was estimated at 0.94 (French et al., 1975), and the intrinsic rate of natural increase was 0.38 to 0.42 (French et al., 1974).

Mortality. The instantaneous death rate for penned populations was between 0.07 and 0.10 (French et al., 1974).

Natality. The instantaneous birth rate for penned populations in Nevada was estimated at 0.49 (French et al., 1974).

Patterns of abundance. In Nevada penned populations of *P. formosus* fluctuated seasonally between densities of 12.7 to 27.8 per hectare. Between years they showed densities of 2.8 to 27.8 per hectare (French et al., 1974). Free-ranging populations of this species in the same area of Nevada were in densities between 0.04 and 1.3 per hectare (Jorgensen and Hayward, 1965). They appeared to be most abundant in the *Larrea/Ambrosia* vegetation associations (Allred et al., 1963; Jorgensen and Hayward, 1965) although one reference concludes that they are most abundant in *Lycium* associations (Allred and Beck, 1963a).

Age distribution. Because of their relatively long life, populations of long-tailed pocket mice are often composed of several age classes including some up to 3-4 years (French et al., 1974).

Patterns of dispersion. Allred and Beck (1963b) estimated that the average range of movements for this species in several vegetation associations was 63 m for males and 47 m for females. The maximum dispersal observed was 195 m for a male and 91 m for a female. French et al. (1968) determined that 25 to 30% of an unfenced population made dispersal movements within a year. Dispersal movements were measured from 160 to 853 m. They were non-random: most dispersals were to great distances. Both young and old animals made dispersal movements. Some individuals within the population have an instinct to disperse (French et al., 1968).

Home range. The 95% recapture radius for *P. formosus* in several vegetation associations in Nevada was estimated at 41-65 m for females and 67-108 m for males. Home ranges were estimated at 0.8 hectares for females and 2.4 hectares for males (Jorgensen and Hayward, 1965). Penned populations in Nevada demonstrated home ranges of 0.54 hectares for males and 0.36 hectares for females (Maza et al., 1973). Males have larger home ranges than females, and range size is inversely related to population density (Maza et al., 1973). Home range size is determined by intraspecific behavioral interactions rather than by resource availability (Maza et al., 1973). Only 5% of the animals shifted their home ranges in the enclosures, and 29% made long distance excursions. Both were more common in males, and they most often took place during the breeding season (Maza et al., 1973).

POPULATION CHARACTERISTICS (Cont'd)

Predators. Known or suspected predators include kit fox, red racers, Tong-nosed snakes and leopard lizards (French et al., 1967).

Activity patterns. Populations of long-tailed pocket mice are active on the surface in all months except late-fall through early spring (Bradley and Deacon, 1971; Bradley and Mauer, 1973; French et al., 1966, 1967, 1974; O'Farrell, 1974). Months when populations are below ground are: October to January (Bradley and Deacon, 1971); November to February (French et al., 1967) and December through January (French et al., 1974). The duration of below ground activity is related to the length of cold weather (French et al., 1967, 1974). Periods of activity on the surface increase gradually in the spring. By summer the animals spend 30-40% of their time on the surface (French et al., 1966). Daily activity begins with a burst shortly after sunset for about 2 hours, followed by a total cessation of activity at 6 hours after sunset (O'Farrell, 1974).

Behavior. Like many other members of the Heteromyidae, the long-tailed pocket mouse is solitary and intolerant of other small mammals including members of the same species. Their eyes are intermediate in size for the family and they have good visual coordination. Although not as well developed as *Dipodomys*, pocket mice have excellent auditory senses. Olfaction is also important in their behavior especially as it relates to food gathering (Eisenberg, 1963). They show a variety of agonistic responses including rushing, locked fighting, kicking, leaps, and sand-kicking. They also display tail flagging: the tail is raised at a right angle with the long axis of the body, the hind feet are lifted alternately causing the rump to move, and the tail is wagged with the rump (Eisenberg, 1963).

REPRODUCTION AND GROWTH

Breeding season. The breeding season in Nevada can last from March through September, but in most years it ends in May (French et al., 1974). Pregnant females have been trapped from April (Grinnell, 1937) to July (Hall, 1946) although most are observed in May and June (Burt, 1934).

Litter size. The average litter size is 5.6 ± 1.4 (French et al., 1974).

Onset of reproductive activity. During years of exceptional food supplies the young-of-the-year may breed, but in most years animals are 10-12 months old before becoming reproductively active (French et al., 1974). The abundance of winter annual plants is thought to cue reproduction in this species (French et al., 1974; Beatley, 1976).

TROPHIC RELATIONS

Food preferences. The long-tailed pocket mouse is primarily granivorous although it will eat some green vegetation and insects (Bradley and Mauer, 1973; Burt, 1934; French et al., 1974; Hall, 1946).

Foods eaten. Reported food items include: seeds of *Oryzopsis*, *Phacelia*, *Bromus*, *Plantago*, *Festuca*, *Larrea*, *Prosopis*, *Thalypodium*, *Plectocarya*; the fruits of *Oryzopsis*; and the green parts of *Phacelia* and *Erodium* (Bradley and Mauer, 1973; French et al., 1974; Hall, 1946; Burt, 1934).

TROPHIC RELATIONS (Cont'd)

Energy budget. It is estimated that long-tailed pocket mice require 10.8 kcal per day (French et al., 1974).

LIMITING FACTORS

Environmental constraints. This species is limited to the availability of rocky or stony soils. Its distribution and numbers do not appear to be related to the amount of shrub cover since it has been trapped in areas where this parameter varies between 7.2 and 45% (Beatley, 1976).

SYMBIOSES

Parasites and diseases. The long-tailed pocket mouse is host to at least 10 species of mite (Allred, 1963), 3 species of flea (Beck and Allred, 1966; Egoscue, 1966), and three species of tick (Beck et al., 1963).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Sensitivity to human activity. This species showed no immediate population responses to controlled off-road vehicle damage to its environment after one year. Animals were sampled only three times during this period and the results should be used with caution (Vollmer et al., 1976).

GENERAL LIFE HISTORY INFORMATION

Like other pocket mice this species has a 24-hour rhythm in oxygen consumption that reaches a peak in the dark. They become torpid at temperatures below 22° C when food is absent. They arouse daily at 22° C but go as long as 48-56 hours before arousing at temperatures near 10° C (Chew et al., 1965).

Their average daily metabolic rate has been estimated at 4.0 cm³O₂/g/hr (French et al., 1976). Their basal metabolic rate in the laboratory is 1.29 ml O₂/g/hr (Scott et al., 1972). In the field their average oxygen consumption has been measured at 3.71 ml/g/day. Their body water half-life is 3.8 to 6.5 days (Mullen, 1970; Mullen and Chew, 1973).

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LIFE HISTORY SUMMARY

Perognathus spinatus - Spiny Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus spinatus Merriam 1889. Type from 25 mi. below The Needles, Colorado River, San Bernardino Co., California.

Synonyms:

Perognathus spinatus Merriam 1889

Perognathus bryanti Merriam 1894

Perognathus evermanni Nelson and Goldman 1929

Perognathus margaritae Merriam 1894

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains 15 subspecies as defined by Hall and Kelson (1959):

- P. s. bryanti* Merriam 1894. Type from San Jose Island, Gulf of California, Baja California.
- P. s. evermanni* Nelson and Goldman 1929. Type from Mejia Island, near N end Angel de la Guarda Island, Baja California.
- P. s. guardia* Burt 1932. Type from Puerto Refugio, 30 ft., N end Angel de la Guarda Island, Gulf of California, Baja California.
- P. s. lambi* Benson 1930. Type from San Gabriel, Espiritu Santo Island, Baja California.
- P. s. latifugularis* Burt 1932. Type from San Francisco Island, Gulf of California, Baja California.
- P. s. magdalenae* Osgood 1907. Type from Magdalena Island, Baja California.
- P. s. macrosensis* Burt 1932. Type from San Marcos Island, Gulf of California, Baja California.
- P. s. margaritae* Merriam 1894. Type from Margarita Island, Baja California.
- P. s. occultus* Nelson 1912. Type from Hacienda La Parada, San Luis Potosi.
- P. s. peninsulae* Merriam 1894. Type from San Jose del Cabo, Baja California.
- P. s. prietae* Huey 1930. Type from 25 mi. N Punta Prieta, Baja California.
- P. s. pullus* Burt 1932. Type from Coronados Island, Gulf of California, Baja California.
- P. s. rufescens* Huey 1930. Type from mouth Palm Canyon, Borego Valley, San Diego Co., California.
- P. s. seorsus* Burt 1932. Type from Danzante Island, Gulf of California, Baja California.
- P. s. spinatus* Merriam 1889. See above.

DIAGNOSIS

Skull comparatively slender and flattened; mastoids small, not reaching to the posterior level of the occiput; mastoids deeply indenting the sides of the occiput; supraorbital ridge usually slightly trenchant; interparietal bone as wide as or wider than the interorbital width and anterior angle faintly expressed; auditory bullae separated anteriorly by nearly the full

DIAGNOSIS (Cont'd)

width of the basisphenoid; lower premolar and last molar approximately equal in size; fur-lined, external cheek pouches present; sole of hind foot usually naked to the heel; pelage harsh; white bristles on rump and frequently along sides to the shoulders; no buffy or fulvous lateral line along sides of the body; ear 6-9 mm from notch; tail crested with tuft 15-25 mm long (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 154-225 mm; tail 75-128 mm; hind foot 20-28 mm; ear 5-7 mm (Hall and Kelson, 1959; Ingles, 1965); weight 12.8-22 g (Miller and Stebbins, 1964; Ryser, 1964).

Skull characteristics. Greatest length 24-27 mm; interparietal length 7.6-7.7 mm (Ingles, 1965).

Pelage. Pelage harsh, with grooved, conspicuous white spines on the rump, sometimes extending to shoulder; upper parts brownish to pale buffy yellow; underparts white or buffy white; lateral line usually obsolete, and pale ecru when present; tail crested, brownish above, white below (Hall and Kelson, 1959; Ingles, 1965).

Baculum. Length 9.5-11.3 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the spiny mouse extends from southeastern California (San Bernardino, Riverside, Imperial, and San Diego counties) through Baja California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower Sonoran Life Zone (Ingles, 1965).

Habitat type. The few references to the spiny mouse agree that it is a mouse that inhabits rough, hot, low desert terrain, on rocky mesas and hills with some xerophilous plants. It has been trapped in the rocky wash at the mouth of Fortynine Palms Canyon, Joshua Tree National Monument, California (Miller and Stebbins, 1964). It has also been taken near a spring at the latter location, and by seeps in the extreme southern tip of Nevada (Ryser, 1964). The only vegetation mentioned in the literature were mesquite and tamarisk trees that were growing at the collection site in Nevada.

Elevation. The species has been collected between sea level (Hall and Kelson, 1959) and 3,000 ft in Joshua Tree National Monument (Miller and Stebbins, 1964).

SYMBIOSES

Parasites and diseases. The spiny mouse is host to at least two species of mite (Ryser, 1964).

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Perognathus spinatus - Spiny Pocket Mouse

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LIFE HISTORY SUMMARY

Dipodomys microps - Chisel-toothed Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys microps (Merriam 1904). Type from Lone Pine, Owens Valley, Inyo Co., California.

Synonyms:

Perodipus microps Merriam 1904

Dipodomys microps Grinnell 1921

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Dipodomysinae. This species contains 14 subspecies as defined by Hall and Kelton (1959):

- D. m. alfredi* Goldman 1937. Type from Gunnison Island, 4,300 ft., Great Salt Lake, Utah.
- D. m. aquilonius* Willet 1935. Type from 3 mi. E Eagleville, Modoc Co., California.
- D. m. bonnevillai* Goldman 1937. Type from Kelton, 4,300 ft., Boxelder Co., Utah.
- D. m. celsus* Goldman 1924. Type from 6 mi. N Wolf Hole, 3,500 ft., Arizona.
- D. m. centralis* Hall and Dale 1939. Type from 4 mi. SE Romano, Diamond Valley, Eureka Co., Nevada.
- D. m. idahoensis* Hall and Dale 1939. Type from 5 mi. SE Murphy, Owyhee Co., Idaho.
- D. m. leucotis* Goldman 1931. Type from 6 mi. W Colorado River Bridge, 3,700 ft., Houserock Valley, side Marble Canyon of Colorado River, Arizona.
- D. m. levipes* (Merriam 1904). Type from Perognathus Flat, 5,200 ft., Emigrant Gap, Panamint Mts., Inyo Co., California.
- D. m. microps* (Merriam 1904). See above.
- D. m. occidentalis* Hall and Dale 1939. Type from 3 mi. S Schurz, 4,100 ft., Mineral Co., Nevada.
- D. m. preblei* (Goldman 1921). Type from Narrows, Malheur Lake, Harney Co., Oregon.
- D. m. ruseoelus* Goldman 1939. Type from Dolphin Island, 4,250 ft., Great Salt Lake, Utah.
- D. m. subtenius* Goldman 1939. Type from Carrington Island, 4,250 ft., Great Salt Lake, Utah.
- D. m. woodburyi* Hardy 1942. Type from Beaverdam Slope, approximately 3,500 ft., W of Beaverdam Mts., Washington Co., Utah.

DIAGNOSIS

Skull usually less than 45 mm; lower incisors flat on anterior faces and chisel shaped, each tooth usually at least 1 mm wide; width of maxillary arch less than 3.9 mm, strongly angled; external fur-lined cheek pouches; hind foot more than 32 mm but less than 48 mm, with four functional toes and a small claw on toe about a third of the way from the tip of the inside toe (outside on skins) to ankle; tail ratio to head and body 130-150 percent;

DIAGNOSIS (Cont'd)

tip of tail with tuft of long hairs over 10 mm in length; dark ventral tail stripe wider than the white lateral stripe and extends to the tip of the caudal vertebrae (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 244-297 mm; tail 134-175 mm; hind foot 38-46.4 mm; ear (crown) 9-12 mm; weight 55-76.1 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 34.4-38.9 mm; basilar length 25.1-27.5 mm; length of nasal 11.7-13.5 mm; greatest breadth 21.7-24.6 mm; interorbital length 10.9-12.6 mm (Hall, 1946).

Pelage. Upper parts cinnamon-buff mixed with blackish; underparts, inside of hind legs and hind feet (soles excepted), forelegs and feet, upper legs, hip stripes, and lateral stripes of tail and its superior base white; supraorbital spots and postauricular patches white, with a few black hairs; vibrissae, arietiform facial markings, soles of hind feet, dorsal and ventral sides of tail, and sometimes inside of cheek pouches blackish (Hall, 1946). Probably two molts each year during May-June and August (Burt, 1934).

Baculum. Length 10.8 mm; width 1.52 mm; height 1.55 mm (Best and Schnell, 1974).

Locomotion. Gait is probably similar to other kangaroo rats, primarily bipedal with some low speed quadrupedal locomotion. Kangaroo rats are semi-saltatorial and utilize ricochetall locomotion when fleeing (Bartholomew and Carey, 1951). This species is also known to climb into shrubs while foraging (Kenagy, 1972).

Karyology. The diploid number for this species is 60 and the fundamental number is 100. There are six metacentric autosomes, 34 submetacentric, and 18 subtelocentric. The X chromosome is a large submetacentric; the Y chromosome is a small acrocentric (Stock, 1974). Csuti (1971b) reported a fundamental number of 116 with 58 metacentric autosomes and a metacentric X chromosome.

Dentition. The dental formula for this genus is 1-0-1-3/1-0-1-3 (Ingles, 1965). The lower incisors are chisel-like and relatively broad with flat anterior faces. This character is apparently a specialization for eating the leaves of saltbush (Kenagy, 1972, 1973b).

GEOGRAPHIC RANGE

Range of species. The range of this kangaroo rat extends northward to southeastern Oregon and extreme southwestern Idaho. Its easternmost extent is in central Utah, and it extends westward across Nevada to the Sierra Nevada and Tehachapi Mountains. Narrow corridors of suitable habitat extend southward into the Antelope Valley of California and eastward along the Utah-Arizona border to the Colorado River (Hall and Kelson, 1959).

This species is found only in the northern part of the California desert. It occurs in Mono, Inyo, Kern, and northern Los Angeles and San Bernardino counties (Hall and Kelson, 1959; Ingles, 1965; Csuti, 1971a).

DIAGNOSIS (Cont'd)

tip of tail with tuft of long hairs over 10 mm in length; dark ventral tail stripe wider than the white lateral stripe and extends to the tip of the caudal vertebrae (Hall and Kelson, 1959; Ingles, 1965).

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TROPHIC RELATIONS (Cont'd)

Foods eaten. Known food items include: *Plantago* and *Lepidium* (Burt, 1934; Hall, 1946); leaves of *Artemisia* (Burt, 1934), *Atriplex* spp. (Burt, 1934; Hall, 1946; Kenagy, 1972b, 1973b), *Grayia spinosa* (Hall, 1946), *Sarcobatus* (Hall, 1946; Kenagy, 1973b), *Trifolium variegatum* and "grass" (Hall, 1946); and the seeds or carpels of *Cryptantha* and a composite (Hall, 1946). They do not eat *Larrea* (Kenagy, 1973b). During the spring they consume the entire leaf of *Atriplex*, but during the rest of the year they eat only the inner, less saline, tissue. They shave the saltier outer layers off with their lower incisors (Kenagy, 1972, 1973b).

Foraging sites. Chisel-toothed kangaroo rats forage in the tops of shrubs where they snip off sprigs of leaves (Kenagy, 1972, 1973b, 1976a). They spend about 10 to 15 minutes per night climbing in shrubs (Kenagy, 1973b). Foraging on the ground probably takes place between shrubs (Brown and Lieberman, 1973).

Water. This species of kangaroo rat cannot survive on a diet of dry seeds, but must have some source of preformed water (Kenagy, 1972, 1973b).

LIMITING FACTORS

Environmental constraints. The distribution and abundance of this species is limited by the abundance of preferred shrubs with succulent and palatable leaves (Kenagy, 1973b).

SYMBIOSSES

Parasites and diseases. This species is known to host at least: 10 species of flea (Beck and Allred, 1966); 5 species of tick (Beck et al., 1963); and 14 species of mite (Goates, 1963).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Sensitivity to human activities. Vollmer et al., (1976) conducted a controlled test of the impact of off-road vehicles on desert ecosystems. Rodents, including this species, exhibited little response in population dynamics to the types of impact applied. It should be emphasized, however, that *D. microps* is dependent on the availability of certain specific types of shrubs and should these be removed or seriously depleted there would no doubt be a serious impact on population survival.

GENERAL LIFE HISTORY INFORMATION

This species has been used as a biomedical test model in some research laboratory colonies (Hatch et al., 1971), and it has also been used to assess the possible effects of plutonium on indigenous mammals (Paglia, 1968).

Johnson and Selander (1971) examined 11 enzymes and 6 non-enzymatic proteins in 11 species of kangaroo rat including *D. microps*. They reported that species of *Dipodomys* are less variable genetically than other organisms for which measures of polymorphism and heterozygosity are available. They concluded that *D. microps* is closely related to *D. agilis*, *D. panamintinus*, and *D. heermanni*, but is not closely related to *D. ordii* as previously thought by classical taxonomists.

GENERAL LIFE HISTORY INFORMATION (Cont'd)

D. microps has a thermoneutral zone between 27 and 32° C. It appears to be more cold-adapted than other species of kangaroo rat that have been tested, and it is also an obligate-hibernator under laboratory conditions (Breyer et al., 1973; Kenagy, 1973a).

LITERATURE CITED

Dipodomys microps - Chisel-toothed Kangaroo Rat

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LIFE HISTORY SUMMARY

Dipodomys merriami - Merriam's Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys merriami Mearns 1890. Type from New River, between Phoenix and Prescott, Maricopa Co., Arizona.

Synonyms:

Dipodomys merriami Mearns 1890

Dipodomys ambiguus Merriam 1890

Dipodomys mitchelli Mearns 1897

Dipodomys parvus Rhoads 1894

Dipodomys platycephalus Merriam 1907

Dipodomys simiolus Rhoads 1894

Dipodomys similis Rhoads 1894

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Dipodomysinae. This species contains 17 subspecies as defined by Hall and Kelson (1959).

D. m. annulus Huey 1951. Type from Barril, Gulf of California, Baja California.

D. m. arenivagus Elliot 1904. Type from San Felipe, Baja California.

D. m. atronasus Merriam 1894. Type from Hacienda La Parada, about 25 mi. NW San Luis Potosi, State of San Luis Potosi.

D. m. brunensis Huey 1951. Type from Llano de San Bruno, Baja California.

D. m. llanoensis Huey 1951. Type from Buena Vista, Magdalena Plain, Baja California.

D. m. mayensis Goldman 1928. Type from Alamos, Sonora.

D. m. melanurus Merriam 1893. Type from San Jose del Cabo, Baja California.

D. m. merriami Mearns 1890. See above.

D. m. mitchelli Mearns 1897. Type from Tiburon Island, Gulf of California, Sonora.

D. m. parvus Rhoads 1894. Type from Reche Canyon, 4 mi. SE of Colton, San Bernardino Co., California.

D. m. platycephalus Merriam 1907. Type from Calmalli, Baja California.

D. m. quintinensis Huey 1951. Type from 5 mi. E San Quintin, Baja California.

D. m. regillus Goldman 1937. Type from Tule Well, Tule Desert between Cabeza Prieta Mountains, Yuma Co., Arizona.

D. m. semipallidus Huey 1927. Type from 7 mi. N Santa Catarina, Baja California.

D. m. simiolus Rhoads 1894. Type from Agua Caliente, now Palm Springs, Riverside Co., California.

D. m. trinidadensis Huey 1951. Type from Aquajito Spring, El Valle de la Trinidad, Baja California.

D. m. vulcani Benson 1934. Type from lower end Toroweap Valley, about ½ mi. E. Vulcan's Throne, Mohave Co., Arizona.

DIAGNOSIS

The genus is characterized by having fur-lined external cheek pouches and expanded auditory bullae, and maintaining a bipedal stance. This kangaroo rat has only four toes upon its hind feet. The hind foot is less than 42 mm and the skull length is less than 38 mm. The auditory bullae are greatly expanded. The interorbital width is less than half the basal length of the skull. Tip of the tail is dusky or blackish brown, and the lateral tail lines are as wide or wider than the dorsal tail stripe (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERISTICS

Standard measurements. Total length is 220-260 mm; tail length is 123-161 mm; foot length is 36-41 mm; and ear length is 10-12 mm. Body weights for this species range from 30 to 45 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basal length ranges from 23.5-25.0 mm; nasal length 12.5-14.5 mm; greatest breadth 22.0-23.5 mm; maxillary breadth 19.0-20.0 mm; and interorbital breadth 12.0-13.5 mm (Hall, 1946).

Pelage: The upper parts are a light ochraceous buff, contrasting sharply with the white underparts. A white stripe extends across each flank to the tail base. There are white patches on the lips, and white spots above the eyes and behind the ears. The whisker patches are dark and unconnected (Hall, 1946; Miller and Stebbins, 1964; Ingles, 1965).

Baculum. The baculum in this species is approximately 11 mm long; 1.2 mm wide; and 1.3 mm high (Best and Schnell, 1974).

Locomotion. Merriam's kangaroo rat is strongly bipedal. When startled this species will escape with long bipedal hops and exhibit ricochetal behavior. The long tail is used to shift direction while in mid-air. While foraging and handling food, individuals maintain a bipedal stance. At slow speeds (5-25 m/min) the animals exhibit a quadrupedal mode of locomotion (Bartholomew and Caswell, 1951; Yousef et al., 1970).

Karyology. Stock (1974) reported that the diploid number for this species is 52, with a fundamental number of 100. The autosomal complement includes 6 metacentric chromosomes, 34 submetacentric, and 10 subtelocentric. The X chromosome is a large submetacentric and the Y chromosome is a small acrocentric.

Dentition. The dental formula for kangaroo rats is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. Sexual dimorphism is weak and within the range found within the sexes (Hall, 1946).

Other characteristics. Kangaroo rats are characterized by enlarged auditory bullae. The suspension of the ossicles and the enlarged tympanum lower the kangaroo rat's threshold of vibration and allowed a great degree of amplification from the tympanum to the fenestra ovale. These morphological characteristics make the kangaroo rat extremely sensitive to the sound frequencies which accompany the attack of a predator. When auditory bullae are experimentally reduced in volume, success in escaping predators is markedly reduced (Webster, 1961; 1962).

GEOGRAPHICAL RANGE

Range of species. The range of this species extends westward to western San Bernardino Co., California, and the Pacific coast of Baja California. Thence, the species reaches extreme northwestern Nevada, and extends south-eastward through Nevada, across southern Arizona and New Mexico. The easternmost extension is achieved in western Texas. The southernmost populations are found in San Luis Potosi (Hall and Kelson, 1959).

This species of kangaroo rat is ubiquitous throughout California below the pinon/juniper belt (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zone. Lower to Upper Sonoran.

Vegetation associations. Merriam's kangaroo rat has been found in creosote scrub, shadscale scrub, sagebrush scrub, Joshua tree woodland, and pinon/juniper woodland (Hall, 1946; Miller and Stebbins, 1964; Chew and Butterworth, 1964; Christopher, 1973; Kenagy, 1973; Beatley, 1976a).

Soil characteristics. These species avoids rocky areas where there are no loose, soft soils into which animals may burrow. It is found on a variety of soils ranging from loose, aeolian sands to coarse gravel and to hard-packed, gravelly slopes (Miller and Stebbins, 1974).

Elevation. Hall (1946) has captured individuals at elevations in Nevada up to 6,500 ft.

POPULATION CHARACTERISTICS

Survivorship. Mean life spans within experimental enclosures in south-central Nevada ranged from 3.8 to 4.7 mo (French et al., 1967). A number of individuals in this creosote scrub habitat survived for over 30 mo. French et al., (1974) found some surviving for more than 50 mo.

Mortality. French et al. (1974) estimated that *D. merriami* in an experimental enclosure in south-central Nevada, within creosote scrub vegetation, had an average instantaneous death rate of 0.21 to 0.22 deaths per individual per month.

Natality. French et al. (1974) estimated that these kangaroo rats had an instantaneous rate of birth of 0.38 to 0.40 births per individual per month.

Patterns of abundance. In a creosote scrub habitat of the Mojave desert of southern California, Merriam's kangaroo rats had densities ranging from 0.3 to 3.7 per ha, with peaks in two springs and one fall (Chew and Butterworth, 1964). Chew and Chew (1970) found densities of 8 to 15.5 per ha in a creosote scrub community in the Chihuahuan Desert of southeastern Arizona. In this study, the minima occurred in the winter and the maxima from May to July. Christopher (1973) found densities of 18.5 per ha in creosote scrub on the western edge of the Colorado Desert in California, and he found 2.6 individuals per ha in nearby pinon/juniper communities. In a study area near that of Chew and Butterworth (1964), Soholt (1973a) found densities ranging from 13 in early spring to 19 per ha in fall. In south-central Nevada creosote scrub, French et al. (1974) found densities that decreased from 40 to near 0 per ha-enclosure over a period of 6 years in the summer months. Kenagy (1973) noted population peaks in summer in a shadscale scrub community, whereas O'Farrell (1974) found no distinct peaks in abundance in a small population in a sagebrush scrub community.

POPULATION CHARACTERISTICS (Cont'd)

Age structure. Examination of the figures in French et al. (1974) suggests that the population is dominated by individuals less than 5 mo of age, although the older individuals become more important as the population declines.

Patterns of movement. French et al. (1968) found that this species, in a creosote scrub community in south-central Nevada, made long distance movements that ranged from 480 to 1,720 ft. Information suggests that a fairly large proportion of the trappable population consists of transients (Chew and Butterworth, 1964; Soholt, 1973a).

Predators. Miller and Stebbins (1964) recorded that kit foxes and badgers preyed upon this species of kangaroo rat. It is probable that coyotes, gray fox, snakes and owls also are important predators.

Nesting sites. As do many desert rodents, these kangaroo rats construct burrow systems in which they spend the day and raise their young. The burrow system of this species is simple, with rarely more than three or four entrances. Burrow systems are frequently located under shrubs. Runways average 4 to 6 cm in diameter, with some as narrow as 2.5 cm. Several widenings in runways may serve as resting areas. The nest is usually located at the deepest part of the system, consisting of grasses, stems, and foliage. The nest chamber is about 10 X 9 cm, and it may be located at depths ranging from 25 to 200 cm below the surface. The nature of the soil and climatic extremes seem to be the primary correlates with depth of the nest. Resting areas may be as shallow as 5 cm below the surface. These kangaroo rats may at times plug their burrows (Schmidt-Nielsen and Schmidt-Nielsen, 1950; Binek and Grundmann, 1971; Kenagy, 1973). Humidity within the burrow is generally higher than ambient air, sometimes exceeding 90% relative humidity (Schmidt-Nielsen and Schmidt-Nielsen, 1950). Concentrations of respiratory gases within the burrow system are generally within the levels that this species can tolerate (Soholt et al., 1973, 1974).

Home range. Maza et al. (1973) estimated that the area in which Merriam's kangaroo rats can be expected to spend 95% of their time ranged from 19 to 40 ha, with little difference between sexes. This study was carried out in the creosote scrub of south-central Nevada. In the same region, Allred and Beck (1963a) estimated that this species had average linear movements ranging from 40 to 60 m. Chew and Butterworth (1964) and Soholt (1973a) obtained similar estimates for linear movements in creosote scrub communities in the Mojave Desert of southern California. This species is at least weakly territorial (Fisler, 1969).

Patterns of activity. This kangaroo rat is active throughout the year (Chew and Butterworth, 1964; Chew and Chew, 1970; Soholt, 1973a; Kenagy, 1973; O'Farrell, 1974). Daily activity is initiated shortly after sunset, often in bright twilight (O'Farrell, 1974; Kenagy, 1976). Activity is terminated before sunrise, often in bright twilight (O'Farrell, 1974; Kenagy, 1976). Kenagy (1976) did note that some remained active after sunrise in winter months. In sagebrush scrub of northern Nevada, activity tended to peak in first quarter of the night in most seasons (O'Farrell, 1974); in shadscale scrub of eastern California, activity tended to decrease through the night (Kenagy, 1973, 1976). O'Farrell (1974) found that moonlight tended to inhibit activity while Kenagy (1976) found no such response. Rainfall did tend to inhibit activity in eastern California (Kenagy, 1973), but O'Farrell (1974)

POPULATION CHARACTERISTICS (Cont'd)

found no significant response in activity to weather conditions.

Kangaroo rats in eastern California spent 1-2 hours or less per night on the surface (Kenagy, 1976). Their surface activity was interrupted by frequent retreats to the burrow. Activity within the burrow increased in the night, but was still evident during the day. During summer, individuals rested in the burrow in sections where the temperatures ranged from 20 to 30° C. During cooler months, individuals rested in the warmer portions of the burrow, which during winter was usually the nest (Kenagy, 1973). Laboratory evidence suggests that kangaroo rats do not construct nests until temperatures reach 15 to 20°C (Soholt, 1973b).

Behavior. Kangaroo rats tend to be intolerant of members of their own species, and chase individuals that approach their burrow systems (Eisenberg, 1963; Kenagy, 1976). Dominance among heteromyids tends to be a function of body size and *D. merriami* is subordinate to the larger kangaroo rats (Eisenberg, 1963; Blaustein and Rissler, 1976). Kangaroo rats have fairly active sebaceous glands and oils accumulate on their pelage. Excess oils are removed through a combination of sandbathing and grooming (Borchelt et al., 1976). Nursing kangaroo rats vocalize in the frequencies to which the mother is most sensitive (Owings and Irvin, 1974).

REPRODUCTION AND GROWTH

Breeding season. Reproductive activity has been reported as early as December to January and as late as October to November. Males are reproductively active longer than females, and some reproductive males have been reported in all months of the year (Chew and Butterworth, 1964; Bradley and Mauer, 1971; Chew and Chew, 1970; Reichman and Van de Graaff, 1973, 1975). The onset of reproductive activity appears to be correlated with the germination of annual plants (Beatley, 1969; Chew and Butterworth, 1964; Bradley and Mauer, 1971; Reichman and Van de Graaff, 1975; Van de Graaf and Balda, 1973).

Length of gestation. The gestation period is 33 days (Eisenberg and Isaac, 1963).

Litter size. 1 to 5 per litter are born (Chew and Butterworth, 1959; Bradley and Mauer, 1971; Soholt, 1973a).

Frequency of litter. One litter per year is usual, but in exceptional years two litters may be born per female (Chew and Butterworth, 1964; Bradley and Mauer, 1971).

Weight at birth. Chew and Butterworth (1959) reported weights of neonates ranging from 2.2 to 4.6 g.

Age at weaning. Young are weaned at ages of 24 to 33 days old (Chew and Butterworth, 1959).

Age of maturity. Females have open vaginas by 24 to 33 days of age; males have scrotal testes as early as 85 days of age (Chew and Butterworth, 1959).

Growth and development. Neonatal kangaroo rats are naked, pigmentation appears by the third day and the first hair by days 5-6. Vibrissae are well developed at birth and are initially the important sense organ. Ears open on days 8-10; eyes open on days 11 to 15. The young can crawl feebly at birth, and quadrupedal locomotion is well developed by the 9th day, hopping

 

REPRODUCTION AND GROWTH (Cont'd)

by the 11th day. Sandbathing and caching of food is apparent by the 19th to 23rd days. Weight increase is accomplished in five phases, each of which has a relatively constant absolute growth rate, ranging from 13% per day in the first phase to 0.3% in the last phase. The young reach 50% of the adult weight in about 35 days after birth; they reach 90% of the adult weight in about 140 days after birth (Chew and Butterworth, 1959). The auditory bullae and the hind feet grow more rapidly than other regions (Van De Graaff, 1973).

TROPHIC RELATIONS

Food habits. These kangaroo rats are predominantly granivorous. In a creosote scrub community of southern California, Sohlt (1973a) found that the diet was dominated by seeds of the non-native *Erodium*, which formed over 75% of the annual diet. In the winter and spring when annual vegetation was present, herbage of *Erodium* and other annuals formed 20 to 35% of the diet. Arthropods formed from 0% in the spring to 4% in the summer. Bradley and Mauer (1971) found that seeds were dominant in the diets of kangaroo rats from southern Nevada. These individuals consumed mostly the seeds of perennial grasses *Oryzopsis* and *Hilaria* and of the forbs *Eriogonum* spp. During the spring, when the vegetation was leafing, the kangaroo rats consumed leaves of *Ambrosia* and other herbage. Arthropods formed only a small proportion of the diet. Chew and Chew (1970) found that in southeastern Arizona, this species consumed a predominance of the seeds of *Larrea*. In the creosote scrub of southern Arizona, 75 to 84% of the diet of kangaroo rats was seed, with *Plantago*, *Pectocarya*, *Erodium*, and *Euphorbia* forming about 52% of the diet (Reichman, 1975). This population consumed 15% insects in its diet. Green vegetation formed 1 to 9% of the diet during the year.

Food preferences. Kangaroo rats generally prefer seeds. In southern Arizona, *Euphorbia*, *Erodium*, and *Plantago* were the most preferred species (Reichman, 1975). In southern California *Erodium* was by far the preferred species (Sohlt, 1973a).

Foraging sites. Brown and Lieberman (1973) suggest that kangaroo rats forage more in open areas than under shrubs.

Energy budgets. Chew and Chew (1970) and Sohlt (1973a) have evaluated the energy budgets of Merriam's kangaroo rat in the creosote scrub communities of southeastern Arizona and southern California respectively. The Arizona population had an annual energy flow of 58 megacal/ha, while the California population's annual energy flow amounted to 86 megacal/ha. The difference was due to differences in population size and ambient temperatures. Less than 1% of the energy flow was diverted into the biomass of new individuals. Neither population consumed a large proportion of the annual net primary production: 1.2% in Arizona and 6.9% in California. Both populations consumed about 10% of that portion of the primary production that was considered available to them. The California population consumed more of the total production because more of the production was in the form of annual plants, readily available to kangaroo rats. The California population consumed over 90% of the production of its preferred food, *Erodium*.

LIMITING FACTORS

The kangaroo rat is highly adapted for xeric habitats and can survive on a diet of dry seed with little or no supplemental preformed water (Schmidt-Nielsen and Schmidt-Nielsen, 1951; Carpenter, 1966; Soholt, 1975). However, this species is poorly adapted to temperatures of 34°C or above and must be able to avoid such extremes in order to survive (Yousef and Dill, 1971). The inability of this species to successfully invade more mesic situations is probably due to its xeric specialization at the cost of reproductive capacity. This makes them poor competitors with the more reproductive mesic inhabitants. In addition, this species tends to be relatively non-aggressive, and it may be inhibited by more aggressive populations from invading new habitats (Eisenberg, 1963; Blaustein and Risser, 1976). Because kangaroo rats are burrowers, they cannot readily invade habitats that contain rocky soils in which burrowing is difficult.

SYMBIOSES

Populations of this species occur sympatrically with populations of several different species of rodents (Chew and Butterworth, 1964; Soholt, 1973a; Wood, 1969; Rosenzweig and Winakur, 1969; Bradley and Mauer, 1973; Chew and Chew, 1970; French et al., 1974; O'Farrell, 1974; Allred and Beck, 1963b; Brown, 1973).

Parasites and diseases. Fifteen species of mites (Paran, 1966; Goates, 1963) and six species of fleas (Beck and Allred, 1966) have been reported as ectoparasites of this kangaroo rat.

LITERATURE CITED

Dipodomys merriami - Merriam's Kangaroo Rat

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LIFE HISTORY SUMMARY

Dipodomys deserti - Desert Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys deserti Stephens 1887. Type from Mohave River (3 to 4 mi. from, and opposite, Hesperia), San Bernardino Co., California.

Synonyms: None.

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae, Subfamily Dipodomysinae. This species contains three subspecies as defined by Hall and Kelson (1959):

D. d. arizonae Huey 1955. Type from 3 mi. SE Picacho, Pinal Co., Arizona.

D. d. deserti Stephens 1887. See above.

D. d. sonoriensis Goldman 1923. Type from La Libertad Ranch, 30 mi. E. Sierra Seri, Sonora.

DIAGNOSIS

Four toes on hind feet; external, fur-lined cheek pouches; hind foot more than 42 mm; inflation of auditory bullae maximum for genus; enlargement of mastoidal bullae so restricting space for interparietal and supraoccipital that these bones are barely visible on dorsal surface of skull; skull without postorbital process on frontal bone; auditory bulla longer than crown surface of upper teeth and longer than incisive foramina; nasals projecting anteriorly of incisors; auditory bulla exposed on parietal face of skull; interparietal less than $\frac{1}{2}$ of greatest width of skull; dermal gland between shoulders; lacrimal throughout its entire length applied to maxillary root of zygomatic arch; crown surface of P4 elliptical (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 305-377 mm; tail 180-215 mm; hind foot 50-58 mm; ear (crown) 12-15 mm; weight 80-130 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Skull 42-47.7 mm; basal length 30-31 mm; breadth 29.5-30.5; maxillary breadth 23.2-23.8 mm; interorbital breadth 14.8-14.9 mm (Hall, 1946; Ingles, 1965).

Auditory bulla. Bone structure of the auditory bulla reveals: relatively free suspension of the bony labyrinth; inflated character of the mastoid and tympanic bones; enlarged tympanic membrane and elongated manubrium; and an intricate articulation of the malleus and incus. It is "likely" that auditory perception has been an adaptation of selective value in the evolution of *D. deserti* (Vial, 1962).

Pelage. Upper parts pale ochraceous buff and remainder of body white; ventral dark stripe on tail lacking; distal third of tail crested; long hair forming crest dusky except that distal 25 mm of tail is white (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. Length: 9.56 ± 0.7 (13) mm; width: 1.09 ± 0.1 (13) mm. Height: 1.28 ± 0.2 (13) mm. This species has the smallest baculum (actual and relative to body size) of *Dipodomys* (Best and Schnell, 1974).

Karyology. Diploid number is 64 and the fundamental number is 108. There are 3 pairs of metacentric, 16 pairs of submetacentric, 4 pairs of subtelocentric, and 8 pairs of acrocentric autosomes. The X chromosome is submetacentric and the Y is acrocentric to subtelocentric (Stock, 1974).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Locomotion. The mode of locomotion for the desert kangaroo rat is probably similar to related species studied in the laboratory. They are strongly bipedal, and when startled they will escape with long bipedal hops and exhibit ricochetal behavior. The long tail is used to assist in directional shifts while in mid-air. While foraging and handling food kangaroo rats maintain a bipedal stance. At slow speeds they use a quadrupedal mode of locomotion (Bartholomew and Caswell, 1951).

Sexual dimorphism. Males are 2.5 percent larger than females in linear measurements and about 7 percent heavier (Hall, 1946).

Glands. A dorsal holocrine skin gland, consisting of a modified and enlarged sebaceous gland, is found in the mid-dorsal skin over the arch of the back (Quay, 1954).

GEOGRAPHIC RANGE

The desert kangaroo rat has a long, narrow range from western Sonora along the Nevada/California border to the 41st parallel in west-central Nevada. Its range includes extreme southwestern Arizona, most of southeastern California and the southern and western portions of Nevada (Hall and Kelson, 1959).

In California it is distributed principally in the desert areas of Imperial, Riverside, San Bernardino and Inyo counties (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower and upper Sonoran (Hall, 1946; Ingles, 1965).

Vegetation associations. *Larrea/Ambrosia (Franseria)* (Jorgensen and Hayward, 1965; Beatley, 1976) and disturbed sites dominated by tumbleweeds, *Salsola* (Jorgensen and Hayward, 1965).

Soil characters. The most consistently mentioned habitat requirement is loose, wind-blown sands that have accumulated to a degree that permits extensive burrowing (Beatley, 1976; Bradley and Deacon, 1971; Brown, 1973; Brown and Lieberman, 1973; Burt, 1934; Congdon, 1974; Grinnell, 1922; Hall, 1946; Jorgensen and Hayward, 1965; Miller and Stebbins, 1964).

Elevation. Sea level to 5,700 ft (Hall, 1946; Hall and Kelson, 1959).

POPULATION CHARACTERISTICS

Home range. Thought to have a large home range compared with other species of kangaroo rats (Brown and Lieberman, 1973).

Longevity. The maximum recorded longevity in captivity is 5 years and 5 months (Brattstrom, 1960).

POPULATION CHARACTERISTICS (Cont'd)

Sociability. As with other members of the genus, this species is thought to be highly asocial, living in solitary burrows with minimal contact during the breeding season. Field and laboratory studies have shown it to have dominance over *D. merriami* and *Perognathus longimembris*, and it appears to be the most aggressive of the three species (Congdon, 1974).

Activity patterns. Desert kangaroo rats are probably nocturnal and crepuscular in their activity patterns.

Nesting sites. Desert kangaroo rats have large burrows that frequently run into banks, dunes or mounds that are held by clumps of vegetation. There may be 6 to 12 entrances, about 10 cm in diameter, clustered around a mound, but only 1 or 2 are usually in use. The burrows are seldom deeper than 60 cm. Trails 125 mm wide and up to 75 m long extend out from the active burrows (Hall, 1946; Miller and Stebbins, 1964).

Behavior. Desert kangaroo rats have been observed using their hind legs to kick sand onto suspicious objects. It is thought that they attempt to detect movement of concealed predators this way (Benson, 1935).

REPRODUCTION AND GROWTH

Age at reproductive maturity. Under laboratory conditions the vagina opens between 24 and 33 days after birth, and scrotal testes are observed 85 days after birth (Haley, 1964).

Litter size. Embryo counts in the field indicate a mean litter size of 4 with a range of 3 to 5 (Hall, 1946). Litter sizes in the laboratory range between 2 and 5 (Haley, 1964).

Litter frequency. Under colony conditions an average of 3.29 litters per female were observed (Butterworth, 1961).

Weight at birth. Average birth weights observed in the laboratory were 3.04 g with a range of 2.2 to 4.6 g (Haley, 1964).

Age at weaning. Weaned in the laboratory between days 15 and 25 (Haley, 1964).

Mating season. In Nevada pregnant desert kangaroo rats have been trapped in January, March and June (Hall, 1946). At Saratoga Springs, California, there was limited evidence that reproduction may have taken place in "early fall" (Bradley and Deacon, 1971).

Onset of reproductive activity. Under laboratory conditions no definitive courtship period was observed. The sexes were compatible for a short precopulatory period only. The female resists advances of the male until she is in the proper stage of estrus. At that time she presents herself to the male, he sniffs her and then mounts. After separation both kick sand and drum and thump the ground. A vaginal plug develops within a few hours (Butterworth, 1961).

Length of gestation. Gestation periods observed in the laboratory ranged between 29-32 days (Butterworth, 1961).

Growth and development. At birth the young are naked with a thin, transparent skin. Black pigmentation appears after 5 days. Ears open 9 to 15 days after birth, and the eyes open between days 11 to 17. Incisors erupt at days 7 to 10 and solid food is eaten shortly after. They are fully furred by days 11

REPRODUCTION AND GROWTH (Cont'd)

to 15 and weaned at days 15 to 25. They are fully mature at 90 days after birth and reach adult body weight between days 150 and 180 (Haley, 1964).

TROPHIC RELATIONS

Food Habits. *D. deserti* is primarily a granivorous rodent. Cheek pouch contents have included: the seeds and heads of *Glyptopleura marginata*; seeds of *Lupinus concinnus*, *Gilia leptomeria*; leaves of *Atriplex*; seeds of *Larrea* and *Artemisia*; and fragments of *Penstemon* (Burt, 1934; Hall, 1946). This species uses a range of seed sizes for food but selects few smaller than 2 mm in diameter. The mean size of selected seeds is 4.5 mm in diameter (Brown and Lieberman, 1973).

Foraging sites. Desert kangaroo rats concentrate their foraging activities away from shrubs, and have not been observed to climb into the shrub canopy (Brown and Lieberman, 1973).

Foraging techniques. Olfaction and surface cues appear to be important to kangaroo rats searching for subsurface seed caches. With seeds on the surface 50% of caches at depths of 10 cm or less are retrieved. Without surface seeds 50% of caches at depths of 6-7 cm or less are recovered. There appears to be a preference for seeds high in carbohydrates (Lockard and Lockard, 1971).

LIMITING FACTORS

Environmental constraints. This species appears to be restricted primarily by the availability of deep, wind-blown soils with associated seed supplies.

SYMBIOSES

Ectoparasites. At least three species of flea are known to occur on this species in Nevada (Beck and Allred, 1966).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Nuisance. Because of their preference for dunes this species has never been regarded as a nuisance.

Sensitivity to human activity. The use of ORV's on sand dunes poses a potential threat to this species as it has no known alternative habitat other than dunes. The destruction of burrow systems and food supplies, in addition to disruptions of behavioral and reproductive activities could prove to be detrimental to the continued existence of healthy populations of *D. deserti* throughout its former range. There are no known publications dealing with the impact of human activities on this species, however.

Endangered and threatened status. Because its narrow habitat requirements include dunes, which are becoming a highly desirable location for ORV use, *D. deserti* might be considered in a sensitive position. Some consideration should be given to its nomination as a threatened species if recreational activities expand farther into its habitats.

GENERAL INFORMATION

The desert kangaroo rat has been used as a biomedical test model in several types of laboratory research (Haley, 1964; Hatch et al., 1971).

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LIFE HISTORY SUMMARY

Peromyscus crinitus - Canyon Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus crinitus (Merriam 1891). Type from Shoshone Falls, N side Snake River, Jerome Co., Idaho.

Synonyms:

Hesperomys crinitus Merriam 1891

Peromyscus crinitus Bangs 1899

Sitomys auripectus J. A. Allen 1893

Peromyscus stephensi Mearns 1897

Peromyscus petraeus Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains eight subspecies as defined by Hall and Kelson (1959):

P. c. auripectus J. A. Allen 1893. Type from Bluff City, San Juan Co., Utah.

P. c. crinitus (Merriam 1891). See above.

P. c. delgadilli Benson 1940. Type from 2 mi. S Crater Elegante, 34 mi. W Sonoita, Sierra del Pinacate, Sonora.

P. c. disparilis Goldman 1932. Type from Tinajas Altas, 2,000 ft., Gila Mts., Yuma Co., Arizona.

P. c. doubtii Goin 1944. Type from Antelope Canyon, 7,200 ft., 20 mi. SE Duchesne, Duchesne Co., Utah.

P. c. pallidissimus Huey 1931. Type from small island in Gonzaga Bay, Baja California.

P. c. pergracilis Goldman 1939. Type from S end Stansbury Island, 4,250 ft., Great Salt Lake, Tooele Co., Utah.

P. c. stephensi Mearns 1897. Type from 3 mi. E Mountain Spring, Imperial Co., California.

DIAGNOSIS

Coronoid process of the jaw lower than the condyloid process; premaxillary bones not noticeably extending posterior to nasals; zygomatic arches compressed anteriorly; nasals attenuate; posterior tips of nasals and premaxillae subequal; without longitudinal grooves on upper incisors; M1 has both anterior and posterior ends indented, minor fold narrow and deep; ear 21 mm or less; tail usually more than 90% of head and body length, bicolored, terminated with hairs 4-10 mm long; hind foot 24 mm or less, sole naked to heel; usually less than 260 mm total length; more grayish, yellowish, or buffy than brownish dorsally; no external cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 162-192 mm; tail 80-118 mm; hind foot 17-23 mm; ear 15.3-21.6 mm; weight (males) 16.6 g, females 19.5 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Greatest length of skull 23.0-26.8 mm; basilar length 16.9-19.1 mm; greatest breadth of braincase 11.3-12.3 mm; inter-orbital constriction 4.0-4.9 mm (Hall and Hoffmeister, 1942; Hall, 1946; Ingles, 1965). The molars are smaller relative to cranial size than in *P. maniculatus* and *P. leucopus*. They have simple patterns and no accessory lophs. The lower teeth are simpler than the upper teeth. Although placed in the subgenus *Haplomylomys*, teeth of this species have styles: a characteristic of the subgenus *Peromyscus* (Hooper, 1957).

Pelage. Fur long and soft, pale yellowish buff with many dusky tipped hairs above; side more brightly colored than the back; whitish below, (except *P. c. delgadilli* which is unicolored); hairs on tip of tail 5-10 mm; ears without white edge (Ingles, 1965). This species has been cited in many classic references to selection of pelage color effected by color of soils in the environment. Lawlor (1976) reexamined the relationship in Pisgah lava flow and Lava Beds National Monument. Canyon mice from the former location were not darker on the lava flows than nearby populations on lighter soils, but specimens from Lava Beds N. M. were significantly darker.

Baculum. Length approximately 8.5 mm (Ingles, 1965).

Locomotion. The species is quadrupedal and displays excellent climbing ability (Egoscue, 1964).

Karyology. The diploid chromosome number is 48. There are 4 pair of biarmed and 20 pair of acrocentrics (Lawlor, 1971).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Females are larger than males: 3.5% in total length; 17.5% in weight; 2.1% in greatest skull length (Hall, 1946; Egoscue, 1964).

Mammae. This species has four close-set inguinal mammae (Egoscue, 1964).

GEOGRAPHIC RANGE

The range of the canyon mouse extends from southeastern Oregon and southwestern Idaho south to northwestern Mexico and northeastern Baja California (Hall and Kelson, 1959).

In California it is restricted to arid habitats in the extreme northeastern and southeastern counties (Ingles, 1965).

HABITAT

Life zones. Lower Sonoran into Transition life zones (Hall and Hoffmeister, 1942; Hall, 1946).

Vegetation associations. The canyon mouse has been taken in the following vegetation associations: *Larrea/Ambrosia*; *Grayia/Lycium*; *Coleogyne*; *Atriplex/Kochia*; pinon/juniper; *Phragmites/Distichlis*; *Juncus/Nitrophila*; *Scirpus*; *Atriplex hymenolytra*; *Allenrolfea* borax flats; yellow pine/fir (Allred and Beck, 1963; Allred et al., 1963; Bradley and Deacon, 1971; Bradley and Mauer, 1973; Burt, 1934; Deacon et al., 1964; Grinnell, 1937; Hardy, 1945; Jorgensen and Hayward, 1965). Egoscue (1964) reported that plants had little influence on the distribution and abundance of this

HABITAT (Cont'd)

species in Utah. On the Nevada Test Site this species and related cricetid rodents are identified with vegetation associations having higher shrub cover (Beatley, 1976).

Soil characters. This species is always associated with rocky or stony edaphic conditions (Bradley and Deacon, 1971; Burt, 1934; Egoscue, 1964; Hall, 1946; Hall and Hoffmeister, 1942; Hall and Kelson, 1959; Hardy, 1945; Jorgensen and Hayward, 1965).

Elevation. Canyon mice have been trapped at elevations from 180 ft below sea level (Grinnell, 1937) to 10,600 ft (Hall and Hoffmeister, 1942).

Topographical characters. This species is often associated with rocky canyons, cliffs, and rocky or stony washes (Burt, 1934; Egoscue, 1964).

POPULATION CHARACTERISTICS

Longevity. The maximum longevity for this species under laboratory colony conditions was 7 years 8 months (Egoscue et al., 1970).

Patterns of abundance. In Nevada it was most abundant in the *Coleogyne* vegetation (Allred and Beck, 1963), and it was the most common mammal in the marsh surrounding Saratoga Springs, California (Bradley and Deacon, 1971).

Activity patterns. This species is active aboveground throughout the year (Bradley and Deacon, 1971; Bradley and Mauer, 1973).

Behavior. In the laboratory this is a quarrelsome, nervous mouse. It is a poor nest builder. Teat-holding is strongly developed in neonates (Egoscue, 1964).

REPRODUCTION AND GROWTH

Breeding season. Free-ranging canyon mice are seasonally polyestrous (Egoscue, 1964). Pregnant females have been found in April and May in Utah (Egoscue, 1964), and in May through July in Nevada (Hall, 1946). Others report that they are reproductively active throughout the year in California and Nevada, although there is a marked reduction in breeding during fall and winter (Bradley and Deacon, 1971; Bradley and Mauer, 1973). Under laboratory colony conditions they breed every month (Egoscue, 1964; Rood, 1966), although most litters are born between January and August (Egoscue, 1964).

Estrous cycle. The mean duration of estrous in the laboratory is 6.1 days (Dewsbury et al., 1977).

Litter size. In the field embryo counts averaged 3.6 (range 3-5) in Utah (Egoscue, 1964), and 4.0 (range 3-5) in Nevada (Hall, 1946). In the laboratory average litter sizes are 2.96-3.1 with a range of 1-6 (Egoscue, 1964; Rood, 1966; Egoscue et al., 1970).

Gestation length. The gestation period requires at least 24-25 days and most litters were born 29-31 days after conception (Egoscue, 1964; Rood, 1966). Lactation delays gestation by 3 to 5 days (Egoscue, 1964).

REPRODUCTION AND GROWTH (Cont'd)

Frequency of litters. This species will breed at parturition. The maximum number of litters in a year is 10-13 (Rood, 1966; Egoscue et al., 1970). The maximum reproductive longevity was 46 months (Egoscue, 1964) with a maximum of 33 litters containing 94 young born to a female (Egoscue et al., 1970).

Onset of reproductive activity. Some canyon mice breed as early as 70 days after birth, but most were 4 to 6 months old before breeding (Egoscue, 1964).

Growth and development. Newborn canyon mice had an average weight of 2.2 g (1.8-2.6 g) in a laboratory colony (Egoscue, 1964). They are lightly pigmented at birth, vibrissae are present, the ears are folded, the eyes are closed and most squeak faintly when handled. At 7 days they weigh 5.0-6.0 g, and have short, black fur with scattered, longer guard-type hairs on the dorsum. Eyes open at days 15-17. Young are weaned at about 4 weeks when their weight is between 13.2 and 15.0 g. Upper parts of juvenile canyon mice are a uniform pale gray with no brown undertones (Egoscue, 1964).

TROPHIC RELATIONS

Foods eaten. Canyon mice are omnivorous, eating green vegetation, seeds, and some insects (Bradley and Deacon, 1971).

Food preferences. Canyon mice prefer green vegetation and consume it throughout the year. Seeds are the second most common item in their diet, and they are eaten throughout the year. Insects are eaten when available, and they are an important food item in spring and summer (Bradley and Deacon, 1971; Bradley and Mauer, 1973).

LIMITING FACTORS

Environmental constraints. This species is restricted to habitats with rocky or stony edaphic conditions (Burt, 1934; Egoscue, 1964; Hall, 1946).

SYMBIOSES

Interactions with other populations. The canyon mouse is closely associated with the long-tailed pocket mouse and desert wood rat since they share many of the same habitat requirements.

Parasites and diseases. The canyon mouse is host to at least 22 species of flea (Beck and Allred, 1966; Egoscue, 1964; Parker and Howell, 1959), 4 species of tick (Egoscue, 1964), 8 species of mite (Allred and Goates, 1964), 1 species of louse (Ignoffo, 1956), and 1 species of nematode (Grundmann, 1957).

GENERAL LIFE HISTORY INFORMATION

Physiological adaptations. The canyon mouse has evolved several physiological adaptations to cope with its xeric, climatically extreme environment. Unlike other deer mice, the canyon mouse can live without exogenous water under laboratory conditions. Water independence is accompanied by the capacity to concentrate urine with little change in blood concentrations (Abbott, 1971). MacMillen (1972) suggested that the canyon mouse may well owe its water independence to its ability to tolerate moderate renal

GENERAL LIFE HISTORY INFORMATION (Cont'd)

concentrations, and also to its ability to periodically reduce its respiratory water loss through circadian torpor. This species can enter periods of daily torpor under food stress at temperatures between 12.2 and 26.5° C. Their body temperature drops to 17.0° C and they remain in torpor for a maximum duration of 9.5 hours (Morhardt and Hudson, 1966). Measurements of energy metabolism under field conditions between fall and early spring also suggest that canyon mice undergo some periods of torpor or hypothermia in their native environment (Mullen, 1971). Canyon mice have a relatively low basal metabolic rate in the laboratory, 1.48 to 1.58 ccO₂/g/hr, and their body temperature is 0.9° C lower than related species. It has been suggested that low conductance, low BMR, and low body temperature have evolved as adaptations in this species to prevent overheating (McNab and Morrison, 1963).

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LIFE HISTORY SUMMARY

Peromyscus eremicus - Cactus Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus eremicus (Baird 1858). Type from Old Fort Yuma, Imperial Co., California, on Colorado River, opposite Yuma, Arizona.

Synonyms:

Hesperomys eremicus Baird 1858
Peromyscus eremicus J. A. Allen 1895
Hesperomys anthonyi Merriam 1887
Peromyscus cedrosensis J. A. Allen 1898
Peromyscus eva Thomas 1898
Vesperimus fraterculus Miller 1892
Sitomys herronii Rhoads 1893
Peromyscus homochroia Elliot 1903
Peromyscus tiburonensis Mearns 1897

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae.
This species contains 14 subspecies as defined by Hall and Kelson (1959):

- P. e. anthonyi* (Merriam 1887). Type from Camp Apache, Big Hachita Mts., Hidalgo Co., New Mexico.
- P. e. avius* Osgood 1909. Type from Cerralbo Island, Gulf of California, Baja California.
- P. e. carmeni* Townsend 1912. Type from Carmen Island, Gulf of California, Baja California.
- P. e. cedrosensis* J. A. Allen 1898. Type from Cerros (= Cedros) Island, Baja California.
- P. e. eremicus* (Baird 1858). See above.
- P. e. eva* Thomas 1898. Type from San Jose del Cabo, Baja California.
- P. e. fraterculus* (Miller 1892). Cotypes from Dulzura, San Diego Co., California.
- P. e. insulicola* Osgood 1909. Type from Espiritu Santo Island, Gulf of California, Baja California.
- P. e. papagensis* Goldman 1917. Type from Sierra Pinacate, Sonora.
- P. e. phaeurus* Osgood 1904. Type from Hacienda la Parada, San Luis Potosi.
- P. e. polypotius* Osgood 1909. Type from Margarita Island, off west coast of southern Baja California.
- P. e. pullus* Blossom 1933. Type from Black Mtn., 10 mi. S Tucson, Pima Co., Arizona.
- P. e. tiburonensis* Mearns 1897. Type from Tiburon Island, Gulf of California, Sonora.
- P. e. cinereus* Hall 1931. Type from SW end of San Jose Island, Baja California.

DIAGNOSIS

Braincase high and somewhat inflated; infraorbital region robust; coronoid process of the jaw lower than the condyloid process; premaxillary bones extending posterior to the nasals (1 mm or more); without longitudinal grooves on upper incisors; M1 has rounded anterior and posterior ends,

DIAGNOSIS (Cont'd)

minor fold about as wide as deep, both conules on the anterocone indistinguishably fused into one; ears relatively large and thin, almost naked, or clothed with fine hairs; ear usually 21 mm or less (from notch), less than hind foot length; tail bicolored or not, but usually more than 90% of head and body length; tail terminated with hairs 2-4 mm long at tip; hind foot 24 mm or less; sole of hind foot naked to heel; total length usually less than 260 mm; more grayish, yellowish, or buffy than brownish dorsally (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 169-218 mm; tail 89-128 mm; hind foot 18-22 mm; ear 18-20 mm; weight 20.0-28.5 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length of skull 24.4-26.5 mm; basilar length 18.2-20.3 mm; breadth of braincase 11.2-12.0 mm; interorbital constriction 3.7-4.1 mm (Hall, 1946; Ingles, 1965). The teeth are simple in pattern; typically uncomplicated by secondary folds; rarely is there a mesoloph. Secondary styles may be present. Second tooth in each row tends to be simpler than the first. This species lies at the "simple" end of a spectrum of tooth complexity developed for the genus (Hooper, 1957).

Axial skeleton. Early in ontogeny of the cactus mouse the relations of limb elements are similar to adults and there is no allometric growth (Van de Graaff, 1973).

Pelage. Soft and silky; buffy gray above; underparts white or whitish with buff or tawny; feet white and sole naked to heel; tail faintly bicolored, has a broad, dorsal dusky stripe, whitish below, sparsely covered with hairs about 2-4 mm long at its tip; ear without white edge (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Baculum. The average length is approximately 7.61 mm and the width at the base is 1.76 mm (Ingles, 1965; Lawlor, 1971.)

Locomotion. The cactus mouse is strictly quadrupedal, and is an excellent climber (Grinnell, 1937).

Karyology. The diploid chromosome number is 48. There are 24 pair of biamed chromosomes (Lawlor, 1971).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. None apparent.

GEOGRAPHIC RANGE

The range of the cactus mouse extends northwesterly from central Mexico and Baja California to include southern New Mexico, California, and Nevada. Southern and northwestern Arizona and the extreme southwest corner of Utah are also included in the range (Hall and Kelson, 1959).

In California it is found only in the five most southern counties (Ingles, 1965).

 

HABITAT

Life zone. Lower Sonoran (Hall, 1946; Ingles, 1965).

Vegetation associations. The cactus mouse has been trapped in areas dominated by the following vegetation associations: *Larrea*; *Larrea/Ambrosia*; pinon/juniper; *Coleogyne*; *Tamarix*; *Chrysothamnus*; riparian vegetation around springs; *Carnegiea/Cercidium*; *Encelia*; *Tamarix/Prosopis/Populus*; *Artemisia/Eriodictylon/Eriogonum/Salvia*; *Yucca/Opuntia* (Bradley and Mauer, 1973; Burt, 1934; Chew and Chew, 1970; Deacon et al., 1964; Grinnell, 1937; Hardy, 1945; Jorgensen and Hayward, 1965; Lewis, 1972; MacMillen, 1964; Meserve, 1976a; Miller and Stebbins, 1964; Reichman and Van de Graaff, 1973; Whitford, 1976). This species has often been identified with vegetation associations having dense shrub cover (Beatley, 1976; Bradley and Mauer, 1973; Hardy, 1945; Jorgensen and Hayward, 1965; MacMillen, 1964; Meserve, 1976a, b).

Soil characters. The cactus mouse is primarily an inhabitant of sandy soils, although it will tolerate some rocky or stony ground (Grinnell, 1937; Hardy, 1945; Lewis, 1972; MacMillen, 1964; Miller and Stebbins, 1964).

Elevation. *P. eremicus* has been trapped at elevations between 180 ft below sea level (Grinnell, 1937) to at least 6,600 ft (Deacon et al., 1964).

POPULATION CHARACTERISTICS

Survivorship. In a *Larrea* habitat in Arizona the cactus mice had a half-time in the trappable population of 60 days, although some females were trapped for 5-8 months or more (Chew and Chew, 1970). In a coastal sage scrub habitat in California resident mice were trappable for an average of 5.5 months (M'Closkey, 1962).

Density. In an Arizona *Larrea* habitat the average density of cactus mice was 1.09/ha with a range of 0.21-3.3/ha (Chew and Chew, 1970). In coastal sage scrub densities were between 0.2 and 1.6/ha (MacMillen, 1964). Biomass estimates for these two habitats were: 4 to 67 g/ha for the former area; and 3.4 to 30.6 g/ha for the latter habitat (Chew and Chew, 1970; MacMillen, 1964). Population densities in several habitats showed a depression in the trappable population during the warmer months of spring and summer when it has been speculated that this species estivates (Bradley and Mauer, 1973; Lewis, 1972; MacMillen, 1964).

Home range. In Arizona the calculated range of movements was 87.1 ± 7.0 m (Chew and Chew, 1970). The estimated home range size in California sage scrub was 0.3 ha with a range between 0.12 and 0.45 ha (MacMillen, 1964).

Activity patterns. The cactus mouse is trappable on the surface throughout the year, although there may be some depression in numbers during the spring and summer (Bradley and Mauer, 1973; Chew and Chew, 1970; Hall and Kelson, 1959; Lewis, 1972; MacMillen, 1964; Miller and Stebbins, 1964; Reichman and Van de Graaff, 1973). Laboratory studies indicate that this species may be most active on moonlit nights (Owings and Lockard, 1971).

Behavior. The cactus mouse maintains a high level of hoarding behavior, but there is no evidence from laboratory studies to link hoarding with nutritional needs or deficits (Barry, 1976). In the field this species is

POPULATION CHARACTERISTICS (Cont'd)

thought to be placid, avoiding activity that takes energy and elevates the body temperature (Murie, 1961). Under laboratory colony conditions they are shy and excitable (Brand and Ryckman, 1968). They are mutually incompatible with other members of their species (MacMillen, 1964). They are dominant socially over *Perognathus*, but are subordinate to most other species tested except for other species of *Peromyscus* (MacMillen, 1964).

REPRODUCTION AND GROWTH

Breeding season. Field and laboratory data indicate that this species breeds throughout the year (Hall and Kelson, 1959; MacMillen, 1964; Brand and Ryckman, 1968; Rood, 1966). Field data from different areas show some seasonal changes in the breeding season as follows: California, April to October (Grinnell, 1937; Miller and Stebbins, 1964); Nevada, January to June (Burt, 1934; Hall, 1946); Arizona, January to September (Lewis, 1972), or males all year, females June to November with a peak in summer (Reichman and Van de Graaff, 1973). In California coastal sage scrub MacMillen (1964) found the peculiar situation in which females were reproductively active throughout the year, but males had fully scrotal testes from March to September, flaccid testes from October to November, and a variety of reproductive conditions in December through February.

Litter size. In the field average litter sizes vary between 2.53 and 3.7 with a range of 1-6 (Burt, 1934; Grinnell, 1937; Hall and Kelson, 1959; Lewis, 1972; MacMillen, 1964; Miller and Stebbins, 1964). Laboratory colony litter sizes average between 2.2 and 2.5 with a range of 1-5 (Brand and Ryckman, 1968; Davis and Davis, 1947; Rood, 1966).

Length of gestation. Gestation requires 21-27 days (Svihla, 1932; Rood, 1966).

Frequency of litters. The mean duration of estrous is 5.3 days (Dewsbury et al., 1977). There is a postpartum estrous (Rood, 1966). In the field adult females had up to three litters per year (MacMillen, 1964). The maximum number of litters per year in a laboratory colony was 12, and the maximum number of litters during a reproductive lifetime was 16 (Rood, 1966). Prolonged copulation in the cactus mouse is critical to the initiation of neuroendocrine responses that halt the estrous cycles and trigger a functional luteal phase (Dewsbury and Estep, 1975).

Onset of reproductive activity. The cactus mouse can breed during its first year (MacMillen, 1964).

Growth. Average birth weight in a laboratory colony was 2.2 g, range 1.9-2.6 g (Rood, 1966). They appear to be more advanced than neonates of *Peromyscus maniculatus* at birth (Svihla, 1932). Their incisors erupt 2-3 days after birth; ears open on days 9-11, and their eyes open on days 11-15. They attain 68% of their adult weight within 60 days. Weaning begins between 20-22 days after birth and is completed by day 25. Adult pelage begins to appear within 34-37 days (Brand and Ryckman, 1968).

TROPHIC RELATIONS

Food preferences. The cactus mouse is omnivorous, eating green vegetation, seeds, and insects (Bradley and Mauer, 1973; Chew and Chew, 1970; Meserve, 1976a, b; Miller and Stebbins, 1964).

TROPHIC RELATIONS (Cont'd)

Foods eaten. In California coastal sage scrub the cactus mouse diet consisted primarily of the fruits, seeds, flowers, and foliage of shrubs. In the fall and winter *Rhus* was eaten. In spring *Lotus* was a major food item, and in summer the diet shifted to *Salvia*. They also ate grass and grass seeds during late-spring and summer. Arthropods were moderately important in their diet (Meserve, 1976a, b). In Arizona arthropods were a major part of the diet of *P. eremicus* (Reichman and Van de Graaff, 1973).

Water consumption. This species requires exogenous sources of water for survival (Miller and Stebbins, 1964). They drink about 1.8 cc/day of water in the laboratory, which is about 11% of their body weight (Lindeborg, 1952; MacMillen, 1964).

Energy requirements. In an Arizona *Larrea* habitat the cactus mouse population required an average annual energy flow of 4,680 kcal/ha or 11.8 kcal/animal/day (Chew and Chew, 1970).

SYMBIOSES

Parasites and diseases. The cactus mouse is host to at least 1 species of flea (Beck and Allred, 1966).

GENERAL LIFE HISTORY INFORMATION

Physiological adaptations. The cactus mouse has evolved physiological mechanisms for survival in its xeric environment. It has a basal metabolic rate of 1.48-1.6 ccO₂/g/hr (McNab and Morrison, 1963) that is lower than the rate for comparable species such as *P. maniculatus* (Murie, 1961). Although they must have exogenous water, cactus mice can survive on a regimen of only 0.2 cc water per day (Lindeborg, 1952). They can tolerate high ambient temperatures before losing water through salivation (Murie, 1961). Cactus mice can also enter periods of torpor under stress. They will enter daily torpor if food is absent at temperatures between 9.5 and 22.1° C. The lowest body temperature they can survive is 19° C, and they can maintain torpor for up to 11.2 hours (Morhardt and Hudson, 1966). If they are well fed and watered they will remain active at temperatures between 5-38° C. In winter torpor is induced only by food deprivation. In summer it is a response to restricted food or a negative water balance at any temperature below 30° C (MacMillen, 1965, 1966). Cactus mice have difficulty maintaining their body temperature at ambient temperatures less than 1-2° C (McNab and Morrison, 1963), and will die if their body temperature gets below 16° C (MacMillen, 1965). Since their burrow temperatures can reach 16° C or less in the winter, torpor is thought to be a summer phenomenon only (MacMillen, 1965, 1966). Torpor offers an advantage since the mice can avoid pulmocutaneous water loss, and conserve both energy and water while inactive (MacMillen, 1965, 1966).

Systematics. Electrophoresis of serum proteins indicated that *P. eremicus* resembles *P. interparietalis* but not *P. guardia*. Protein banding patterns of *P. crinitus* and *P. boylii* were similar to each other but distinct from the three species mentioned above (Brand and Ryckman, 1969).

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LIFE HISTORY SUMMARY

Onychomys torridus - Southern Grasshopper Mouse

NOMENCLATURE AND SYNONYMY

Onychomys torridus (Coues 1874). Type from Camp Grant, Graham Co., Arizona.

Synonyms:

Hesperomys torridus Coues 1874

Onychomys torridus Merriam 1889

Onychomys longicaudus Merriam 1889

Onychomys macrotis Elliot 1903

Onychomys pulcher Elliot 1904

Onychomys ramona Rhoads 1893

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains 11 subspecies as defined by Hall and Kelson (1959):

O. t. oaxus Merriam 1904. Type from San Juan Capistrano, Zacatecas.

O. t. alarus Hollister 1913. Type from Keeler, east shore Owens Lake, Inyo Co., California.

O. t. longicaudus Merriam 1889. Type from St. George, Washington Co., Utah.

O. t. macrotis Elliot 1903. Type from head San Antonio River, W slope Sierra San Pedro Martir, Baja, California.

O. t. perpallidus Mearns 1896. Type from left bank Colorado River at Monument No. 204, Mexican boundary line, Yuma Co., Arizona.

O. t. pulcher Elliot 1904. Type from Morongo Pass, San Bernardino Mts., California.

O. t. ramona Rhoads 1893. Type from Reche Canyon, 1,250 ft., 4 mi. SE Colton, San Bernardino Valley, California.

O. t. surrufus Hollister 1914. Type from Miquihuana, Tamaulipas.

O. t. torridus (Coues 1874). See above.

O. t. tularensis Merriam 1904. Type from Bakersfield, Kern Co., California.

O. t. yakiensis Merriam 1904. Type from Camoa, Rio Mayo, Sonora.

DIAGNOSIS

Without longitudinal grooves on upper incisors; mouselike; usually less than 260 mm total length; hind foot usually less than 30 mm; tail between 50 and 60 percent of head and body length; coronoid process of the jaw as high as or higher than the condyloid process; M1 is equal to or more than half of the length of the molar tooth row; M3 transversely ovoid in cross section (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length, 119-163 mm; tail, 39-52 mm; hind foot, 18-23 mm; ear (crown), 11-18 mm; weight, 20.2-25.5 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Skull characteristics. Greatest length of skull 24.1-25.8 mm; basilar length 18.3-19.9 mm; breadth of braincase 11.1-11.7 mm; interorbital constriction 4.6-5.2 mm (Hall, 1946).

Pelage. Light pinkish cinnamon marked with blackish on back and top of tail, but less marked with black on side; cheeks, underparts, legs, feet, underside of tail and its tip white; tail basal two-thirds like upper parts dorsally; hairs of underparts basally plumbeous, but faintly so; young, bluish above (Hall, 1946; Ingles, 1965). The post-juvenile molt occurs 55 to 95 days after birth. Adults molt once each year, usually in summer or autumn. Intraspecific variations in pelage coloration are complex and related to age and local environmental conditions (Hollister, 1914; Van Cura and Hoffmeister, 1966).

Baculum. The baculum has a shaft length of 3.9 to 6.5 mm, and a width of 0.51 to 1.02 mm at the base (Van Cura and Hoffmeister, 1966).

Karyology. The diploid chromosome number is 48. The 46 autosomes include 26 metacentric and submetacentrics, and 18 acrocentric or telocentric. The X chromosome is a large submetacentric, and the Y chromosome is acrocentric and indistinguishable from several pairs of acrocentric autosomes. There is considerable subspecific variation in chromosomal morphology (Hsu and Benirschke, 1968). Hybridization between *Onychomys torridus* and *O. leucogaster* has been reported for laboratory-reared and bred animals, but there is no evidence that this is a common occurrence in free-ranging populations (Pinter, 1971).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual Dimorphism. Females average a fraction of 1 percent longer in external measurements and 9 percent heavier than males (Hall, 1946).

Gastric morphology. The cardiac and pyloric regions of the stomach are thin-walled and lined with cornified stratified squamous epithelium. The fundic area is more vascular with a variety of cell types. Gastric glands are restricted to a fundic pouch which may protect them from the abrasive action of chitin fragments (Horner et al., 1964).

GEOGRAPHIC RANGE

The range of the southern grasshopper mouse extends northwestwardly from central Mexico and northern Baja California across southwestern Texas, southern New Mexico, Arizona, and California to central Nevada (Hall and Kelson, 1959).

This species is found in arid and semi-arid habitats over most of the southern half of California (Ingles, 1965).

HABITAT

Life zones. Lower Sonoran (Hall and Kelson, 1959).

Vegetation associations. Southern grasshopper mice have been trapped in habitats dominated by: *Larrea*, Arizona (Chew and Chew, 1970); *Larrea/Yucca schottigera/Hilaria rigida*, California (Chew and Butterworth, 1964); *Larrea/Ambrosia*, Nevada (Bradley and Mauer, 1973); *Larrea/Ambrosia, Atriplex/Kochia, Grayia/Lycium, Coleogyne*, pinon/juniper, Nevada (Jorgensen and Hayward, 1965; Beatley, 1976; *Artemisia/Grayia/Atriplex*, Nevada (O'Farrell, 1974); *Larrea* or mesquite, New Mexico (Whitford, 1976).

HABITAT (Cont'd)

Elevation. This species has been trapped at elevations between 500 and 7,200 feet in Nevada (Hall, 1946).

POPULATION CHARACTERISTICS

Patterns of abundance. Southern grasshopper mice are usually found in low densities (Bailey and Sperry, 1929; Bradley and Mauer, 1973; Chew and Chew, 1970; Jorgensen and Hayward, 1965; Beatley, 1976). In a *Larrea* community in Arizona Chew and Chew (1970) estimated a density of 1.8 per hectare. Jorgensen and Hayward (1965) estimated densities of 0.02 to 0.25 per hectare in a variety of vegetation types of the Nevada Test Site.

Nesting sites. The nest of the grasshopper mouse is located in a burrow that may have been abandoned by another small mammal (Bailey and Sperry, 1929).

Home range. The estimated home range size for southern grasshopper mice in New Mexico was 3.2 hectares for males and 2.4 hectares for females (Blair, 1943). In Arizona the mean trapping area for adults was 11.45 ha (Chew and Chew, 1970).

Sociability. Limited field information suggests that grasshopper mice occur in male-female pairs, widely separated from their neighbors, owing to a strongly territorial disposition (Horner and Taylor, 1968).

Activity patterns. The species is primarily nocturnal in its native habitats. They can be trapped throughout the year and do not appear to enter torpor (Bailey and Sperry, 1929).

Behavior. In the laboratory, adults engage in vigorous boxing when they first encounter a stranger. Mortality may occur if more than a male-female pair is housed together. The grasshopper mouse has evolved several effective strategies for attacking and killing prey several times its weight (Bailey and Sperry, 1929; Horner et al., 1964). When hunting darkling beetles that can secrete quinones to ward off predators, grasshopper mice grasp the beetle in their forepaws and press the abdomen in the earth to avoid the stinging liquid (Eisner and Meinwald, 1966). Scorpions are rendered harmless by repeated bitings of the terminal region of the tail (Horner et al., 1964). *Onychomys* are dominant over *Mus*, *Peromyscus*, and *Reithrodontomys* under laboratory conditions (Horner et al., 1964). Both male and females care for the neonates. After a short period of exclusion during parturition, the male often grooms and huddles with the young (Horner, 1961). Grasshopper mice have a variety of vocalizations including a high-pitched call lasting several seconds that is thought to serve in nature as a territorial advertisement and spacing mechanism. They also produce a series of chirps during grooming, threats, and fighting (Bailey and Sperry, 1929; Horner and Taylor, 1968).

REPRODUCTION AND GROWTH

Age at reproductive maturity. In the laboratory a male *Onychomys* had sperm in the caudal epididymides at 40 days after birth. In the field males bred at about 5½ months of age (Taylor, 1963). A female experienced introitus at 44 days old, but this was more commonly observed in the laboratory six weeks after birth (Taylor, 1968). Field caught females can breed as early

REPRODUCTION AND GROWTH (Cont'd)

as 7 weeks (Horner and Taylor, 1968), but in the laboratory females rarely bred before 4 months of age (Taylor, 1968; Pinter, 1970).

Litter size. Estimated litter sizes using both laboratory and field data are 2.6 with a range of 1 to 5. Embryo counts up to 7 have been noted (Bailey and Sperry, 1929; Taylor, 1968).

Length of gestation. The gestation period for non-lactating and lactating females in the laboratory colony was 27-30 days (Taylor, 1968; Pinter, 1970).

Litter frequency. In the field grasshopper mice breed between April and December (Bailey and Sperry, 1929). However, most litters are conceived before July, after which there is a sharp drop in breeding activity until the next spring (Taylor, 1968). This breeding lull appears to be genetically linked since it is apparent in laboratory colonies as well (Taylor, 1963; Horner and Taylor, 1968). In captivity grasshopper mice seldom remain reproductively active past the age of two years (Pinter, 1970) and most are reproductively senescent past 1 year (Taylor, 1968).

Growth and development. The average weight of southern grasshopper mice at birth in a laboratory colony was 2.34 g. The neonates are devoid of hair and covered with pink skin. Ears unfold within 2-3 days, upper and lower incisors erupt by day 11, the ears open by day 11, and the eyes open 15-17 days after birth. They reach 90% of their adult weight 7 weeks after birth (Horner and Taylor, 1968).

Age at weaning. Southern grasshopper mice in the laboratory could be weaned at 20 days after birth at an average weight of 9.2 g (Horner and Taylor, 1968).

TROPHIC RELATIONS

Food preference. The southern grasshopper mouse is almost exclusively insectivorous although it will eat other animals, seeds, and some green vegetation (Sperry, 1929; Horner et al., 1964).

Foods eaten. Animal matter accounts for about 89% of the foods eaten by southern grasshopper mice, of which 56% is composed of grasshoppers, crickets, caterpillars and moths, and 21% is ground and darkling beetles. Less than 5% of the diet consists of seeds. They have been known to eat salamanders, lizards, and small mammals. Vegetable matter in stomachs has included apples, cactus, lettuce, spinach, celery, grass and carrots (Sperry, 1929).

Energy budget. The mean basal metabolic rate at 30°C is $1,550 \text{ mm}^3 \text{O}_2/\text{g}$ body weight/hour (Whitford and Conley, 1971).

LIMITING FACTORS

Physiological constraints. Studies of food and water requirements of southern grasshopper mice (Schmidt-Nielsen and Haines, 1964; Chew, 1965; Whitford and Conley, 1971) have shown that this species does not possess any specialized adaptations for coping with arid environments. They are able to survive under xeric conditions only because of the availability of insects and other animals as a source of food and water.

LIMITING FACTORS (Cont'd)

Behavioral constraints. Because of their asocial and highly aggressive nature, southern grasshopper mice are limited by territorial behavior that tends to effect low densities in most habitats.

SYMBIOSES

Parasites, pathogens, and diseases. This species acts as a host to at least 2 species of tick (Beck et al., 1963), 12 species of mite (Allred, 1962), and 10 species of flea (Beck and Allred, 1966). They are subject to clonic-tonic seizures in laboratory colonies (Horner, 1961).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Nuisance animals. Because of the high proportion of insects in their diet southern grasshopper mice are considered to be a useful indigenous species (Bailey and Sperry, 1929).

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LIFE HISTORY SUMMARY

Neotoma albigula - White-throated Wood Rat

NOMENCLATURE AND SYNONYMY

Neotoma albigula Hartley 1894. Type from vicinity of Fort Lowell near Tucson, Pima Co., Arizona.

Synonyms:

Neotoma albigula Hartley 1894
Neotoma intermedia Merriam 1894
Neotoma leucodon Merriam 1894
Neotoma venusta True 1894
Neotoma cumulator Mearns 1897
Neotoma desertorum Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains 14 subspecies as defined by Hall and Kelson (1959):

- N. a. albigula* Hartley 1894. See above.
N. a. brevicauda Durrant 1934. Type from Castle Valley, about 25 mi. NE Moab, Grand Co., Utah.
N. a. durangae J. A. Allen 1903. Type from San Gabriel, Durango.
N. a. laplataensis Miller 1933. Type from near Bondad, La Plata Co., Colorado.
N. a. leucodon Merriam 1894. Type from San Luis Potosi, San Luis Potosi.
N. a. mearnsi Goldman 1915. Type from Tinajas Altas, Gila Mts., Yuma Co., Arizona.
N. a. melanura Merriam 1894. Type from Ortiz, Sonora.
N. a. melas Dice 1929. Type from Malpais Spring, Malpais lava beds near Carrizozo, Lincoln Co., New Mexico.
N. a. robusta Blair 1929. Type from Limpia Canyon, 4,300 ft., 16 m. N Fort Davis, Jeff Davis Co., Texas.
N. a. seri Townsend 1912. Type from Tiburon Island, Gulf of California, Sonora.
N. a. sheldoni Goldman 1915. Type from Papago Tanks, Sierra Pinacate, Sonora.
N. a. venusta True 1894. Type from Carrizo Creek, Imperial Co., California.
N. a. warreni Merriam 1903. Type from Gaume Ranch, 4,600 ft., northwest corner Baca Co., Colorado.
N. a. zacatecae Goldman 1905. Type from Plateado, 7,600 ft., Zacatecas.

DIAGNOSIS

The genus is ratlike in appearance, usually exceeding 260 mm total body length. The palate extends posteriorly not further than the anterior of the last molar. The tail of this species is markedly bicolored. The hairs of the throat are white to the base (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total body length ranges from 218 to 400 mm; tail length 75 to 185 mm; hind foot length 30 to 38 mm; ear length from notch 26 to 30 mm. Body weights range from 136 to 294 g (Vorhies and Taylor, 1940; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Skull basal length ranges from 36.3 to 40.5 mm. The skull has a relatively broad rostrum, and the audital bullae are of moderate size. Sphenopalatine vacuities are large (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts are grayish washed with fulvous to ochraceous mixed with dusky. Underparts are white or grayish, with individual hairs plumbous basally except on the throat. The tail is brown or dusky above and whitish below. Juvenile pelage is grayer, less buffy than adult pelage (Vorhies and Taylor, 1940; Hall and Kelson, 1959).

Locomotion. Gait in this family is predominantly quadrupedal with some scansorial behavior.

Dentition. The dental formula for this family is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Males have a larger body weight on the average than do females (Vorhies and Taylor, 1959).

GEOGRAPHIC RANGE

Range of species. The range of this species extends north into southeastern Utah, northern New Mexico, and southwestern and southeastern Colorado. Thence, the range reaches southeastward into central Texas and southward into the state of Mexico. This species extends northwestward to the coast of Sonora and reaches its westernmost extent in the southern Colorado desert of California (Hall and Kelson, 1959).

This species is found in the southern Colorado desert from the Colorado River through Imperial County and the southern edge of Riverside County above the Salton Sea. This species has been captured at Borrego Springs in eastern San Diego County (Hall and Kelson, 1959).

HABITAT

Life zone. This species is found predominantly in the Lower Sonoran Life Zone. However it does extend into portions of the Upper Sonoran and Transition life zones (Vorhies and Taylor, 1940).

Vegetation association. Vorhies and Taylor (1940) indicate that this species can be found in most desert scrub communities within its range, in pinon/juniper woodland, in scrub oak woodland, and in pine/oak forest. Dens tended to be associated with such plants as: hackberry, yucca, prickly pear, paloverde, cholla, catclaw, agave, and mesquite.

Soil characters. Soil does not appear to influence the distribution of this species (Vorhies and Taylor, 1940; Olsen, 1973).

Elevation. This species has been captured at elevations up to 8,200 ft (Vorhies and Taylor, 1940).

Topographical characters. Olsen's (1973) data suggest that these woodrats may prefer areas with rock outcroppings for nest sites, but they are abundant in other situations.

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POPULATION CHARACTERISTICS

Survivorship. Landstrom (1971) reported that a single woodrat captured in southern Arizona lived for 41 mo in captivity before being killed. He estimated that the animal was about 60 mo old when it died.

Patterns of abundance. Vorhies and Taylor (1940) found a maximum abundance of 20.7 woodrat dens per acre and frequently found about 10 per acre. In one transect, they found 0.2 dens per acre in a foothill habitat in Arizona and 7.5 per acre in semidesert and mesquite communities in southern New Mexico, densities ranged from an average of 0 to 1 per acre (Wood, 1969). Densities of dens in pinon/juniper ranged from 0.2 to 2.5 per ha in New Mexico (Turkowski and Watkins, 1976). In southeastern Arizona, densities ranged from 0 to 0.4 per ha (Chew and Chew, 1970). In this population, peak densities occurred in the summer.

Patterns of movement. Woodrats often have well defined trails leading from their dens. They do exhibit homing behavior when removed 200 ft from their nest (Vorhies and Taylor, 1940).

Home range. In a northern California riparian woodland male home ranges (0.23 ha) were significantly larger than those of adult females (0.19 ha), or juveniles (0.17 ha) and overlap was lower than 28% (Cranford, 1977).

Nesting sites. These woodrats build two types of nests: one in rock crevices and one beneath shrubs. Dens in crevices consist mostly of litter piled before the main opening of the crevice and a nesting area in the rear of the crevice. Dens associated with shrubs consist of a pile of litter that can reach 3 ft high and 10 ft in diameter. The nature of the litter depends upon its availability in the habitat and the species of plant serving as support for the den. Cholla joints, prickly pear pads, sticks of mesquite and catclaw are favored items of litter because the spines provide protection from predators. Woodrats prefer as support plants shrubs and cacti that have much cover near the ground. Several entrances lead into the interior of the den and runways intertwine within the interior. Several chambers may exist within the den which are used for feeding and other activities. Runways lead to a simple system of burrows below the pile of litter that are frequently at the surface of the ground but may go as deep as 30 cm or more. Nests are located below the ground surface in these dens. Woodrats construct a flattened sphere of soft material such as grass stems which is about 8 in in diameter. The interior of the nest is hollowed out for occupancy (Vorhies and Taylor, 1940; Brown, 1968; Olsen, 1973; Turkowski and Watkins, 1976). Olsen (1973) suggested that rock crevices are the preferred site and that shrubs are used only when rocks are unavailable. Vorhies and Taylor (1940) noted no such preference.

Patterns of activity. This species is active all year round. It is primarily nocturnal but may venture from the den during the day (Vorhies and Taylor, 1940).

Behavior. Individuals tend to be solitary and asocial. When moving small cactus joints, they grab a spine in their incisors and lift the joint holding it away from their chest. Larger joints are grabbed by a spine and dragged along the ground. Woodrats are not immune to cactus spines, and

POPULATION CHARACTERISTICS (Cont'd)

are in serious pain when they are punctured. They work carefully around cacti and cactus joints in order to avoid being punctured (Vorhies and Taylor, 1940).

Predators. Among the predators known to feed upon this species are coyotes, ringtails, bobcats, gray fox, several owls, some hawks, bull snakes, and rattlesnakes (Vorhies and Taylor, 1940).

REPRODUCTION AND GROWTH

Breeding season. The breeding has been reported to extend from November to August, peaking in spring, in southern Arizona (Vorhies and Taylor, 1940) and from January to July in the creosote scrub and mesquite of southern California (Schwartz and Bleich, 1975).

Litter size. Embryo counts of animals from southern Arizona revealed a range of 1 to 3 per female, with maximum litter sizes in spring (Vorhies and Taylor, 1940). Schwartz and Bleich (1975) found a range of 2 to 3 neonates per litter in laboratory births.

Frequency of litter. The length of the breeding season suggests that more than one litter may be borne by a single female in one breeding season.

Weight at birth. Vorhies and Taylor (1940) reported that the average weight of neonates was around 8.5 g; from a larger sample size, Schwartz and Bleich (1975) found average weights at birth to be around 12 g.

Age of weaning. Schwartz and Bleich (1975) found individuals weaned at ages of 27 to 40 days.

Age of maturity. Females are reproductively active by ages of 80 to 87 days; males are reproductively active by about 100 days of age (Schwartz and Bleich, 1975).

Growth and development. Neonates are naked, blind, and helpless. By 8 days of age they are crawling and are covered by silky hair. By 13 to 17 days of age, the ears open; by 11 to 14 days of age the eyes open. By 100 days of age, the young have achieved about 85% of their adult body weight (Vorhies and Taylor, 1940; Schwartz and Bleich, 1975).

TROPHIC RELATIONS

Food habits. Stomach analyses by Vorhies and Taylor (1940) revealed that the principal foods of woodrats are succulent. Diet contained 43% by volume of cacti, 30% mesquite, some yucca, and very little grasses or animal matter. Foods are stored in the dens and some of the den's construction materials may also serve as food. Wood (1969) found that the diet in a population, which was from creosote/mesquite communities of New Mexico consisted of 33% yucca leaves, 38% other greens, 18% composite heads, and less than 10% flowers and arthropods.

Energy budgets. Chew and Chew (1970) found that a population of *N. albigula* in southeastern Arizona had an annual energy assimilation rate of 1.2 megacal/ha / yr. This population consumed less than 0.5% of the production available to it. About 1.2% of the total energy flow in the population was diverted into secondary production.

LIMITING FACTORS

The primary factor limiting the distribution of this species is the availability of suitable nesting sites. The density of woodrats is directly correlated with the abundance of suitable shrubs for supporting nests (Vorhies and Taylor, 1940; Turkowski and Watkins, 1976). These woodrats are tolerant of high ambient temperatures but are less tolerant of cold temperatures than woodrats from more mesic habitats (Brown, 1968). This may limit their northward distribution and their elevational distribution.

SYMBIOSES

Interactions with other populations. The dens of the woodrat provide shelter for a number of other animals; among the most abundant of these cohabitants are daddy long-legs, microlepidopterans, assassin bugs, crickets, and assorted spiders. Lizards and snakes are infrequent occupants of the dens (Vorhies and Taylor, 1940).

Vorhies and Taylor (1940) observed that the woodrats usually killed the shrub which they used for supporting their den. Greene and Reynard (1932) and Greene and Murphy (1932) suggest that the woodrats' activities may enhance the fertility of the soil for shrub growth.

Parasites. Vorhies and Taylor (1940) found that 8% of their population of *N. albigula* was infected with larvae of the bot-fly, *Cuterebra* spp. Individuals carry 1 to 5 larvae. In another area in southern Arizona, 62% of the sample was infected. Four species of fleas and two species of assassin bugs were isolated from this species. No pathogens were isolated (Vorhies and Taylor, 1940).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Vorhies and Taylor (1940) concluded that these woodrats were not major competitors for cattle forage. They did have minor nuisance value for human habitations and were a major harbinger of the blood-sucking assassin bug. They probably have only a minor role in the spread of cacti through grazing land. On the positive side, they did note that this species may have some positive effects upon soil fertility and the dispersal of browse species.

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LIFE HISTORY SUMMARY

Neotoma lepida Desert Wood Rat

NOMENCLATURE AND SYNONYMY

Neotoma lepida Thomas 1893. Type from somewhere on "Simpson's route" between Camp Floyd, Utah, and Carson City, Nevada.

Synonyms:

- Neotoma lepida* Thomas 1893
- Neotoma desertorum* Merriam 1894
- Neotoma bella* Bangs 1899
- Neotoma abbreviata* Goldman 1909
- Neotoma arenacea* J. A. Allen 1898
- Neotoma auripila* Blossom 1933
- Neotoma californica* Price 1894
- Neotoma intermedia* Rhoads 1894
- Neotoma insularis* Townsend 1912
- Neotoma nevadensis* Taylor 1910
- Neotoma nudicauda* Goldman 1905

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae.
This species contains 30 subspecies as defined by Hall and Kelson (1959):

- N. l. abbreviata* Goldman 1909. Type from San Francisco Island (near southern end of San Jose Island), Gulf of California, Baja California.
- N. l. arenacea* J. A. Allen 1898. Type from San Jose del Cabo, Baja California.
- N. l. aureotunicata* Huey 1937. Type from Punta Penascosa, Sonora.
- N. l. auripila* Blossom 1933. Type from Agua Dulce Mts. 9 mi. E Papago Well, Pima Co., Arizona.
- N. l. bensoni* Blossom 1935. Type from Papago Tanks, Sierra Pinacate, Sonora.
- N. l. californica* Price 1894. Type from Bear Valley, San Benito Co., California.
- N. l. devia* Goldman 1927. Type from Tanner Tank, 5,200 ft., Painted Desert, Arizona.
- N. l. egressa* Orr 1934. Type from 1 mi. E El Rosario, 200 ft., Baja California.
- N. l. felipensis* Elliot 1903. Type from San Felipe, Baja California.
- N. l. flava* Benson 1935. Type from Tinajas Altas, 1,150 ft., Yuma Co., Arizona.
- N. l. gilva* Rhoads 1894. Type from Banning, Riverside Co., California.
- N. l. grinnelli* Hall 1942. Type from Colorado River 20 mi. above Picacho, Imperial Co., California.
- N. l. harteri* Huey 1937. Type from 10 mi. S Gila Bend (2 mi. N Black Gap) Maricopa Co., Arizona.
- N. l. insularis* Townsend 1912. Type from Angel de la Guarda Island, Gulf of California, Baja California.
- N. l. intermedia* Rhoads 1894. Type from Dulzura, San Diego Co., California.
- N. l. latirostris* Burt 1932. Type from Danzante Island, Gulf of California, Baja California.
- N. l. lepida* Thomas 1893. See above.
- N. l. macrosensis* Burt 1932. Type from San Marcos Island, Gulf of California, Baja California.

CONTEXT AND CONTENT (Cont'd)

- N. l. marshalli* Goldman 1939. Type from Carrington Island, about 4,250 ft., Great Salt Lake, Tooele Co., Utah.
- N. l. molagrandis* Huey. 1945. Type from site of old well near mesalike shelf, some 3 mi. inland from landing beach, Santo Domingo Landing, about 50 ft., Baja California.
- N. l. monstrabilis* Goldman 1932. Type from Ryan, 6,000 ft., Kaibab National Forest, Coconino Co., Arizona.
- N. l. nevadensis* Taylor 1910. Type from Virgin Valley, 4,800 ft., Humboldt Co., Nevada.
- N. l. notia* Nelson and Goldman 1931. Type from La Laguna, 5,500 ft., Sierra de la Victoria, Baja California.
- N. l. nudicauda* Goldman 1905. Type from Carmen Island, Gulf of California, Baja California.
- N. l. perpallida* Goldman 1909. Type from San Jose Island, Gulf of California, Baja California.
- N. l. petricola* von Bloeker 1938. Type from Abbotts Ranch, Arroyo Seco, 670 ft., Monterey Co., California.
- N. l. pretiosa* Goldman 1909. Type from Matancita, 100 ft., 50 mi. N. Magdalena Bay, Baja California.
- N. l. ravida* Nelson and Goldman 1931. Type from Comondu, 700 ft., Baja California.
- N. l. sanrafaeli* Kelson 1950. Type from Rock Canyon Corral, 5 mi. SE Valley City, 4,500 ft., Grand Co., Utah.
- N. l. vicina* Goldman 1909. Type from Espiritu Santo Island, Gulf of California, Baja California.

DIAGNOSIS

This species is ratlike in appearance and usually exceeds 260 mm in total length. The hairs on the throat are lead colored to the roots. Upper pelage is grayish mixed with black, and the underparts are white to buffy. The tail is markedly bicolored and is about three quarters of the head and body length. Short hairs cover the scales of the tail.

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length ranges from 225 to 380 mm; tail length 95-185 mm; hind foot 28 to 41 mm. Body weight ranges from 96 to 158 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basal length of the skull ranges from 30 to 36 mm. Zygomatic breadth ranges from 18 to 22 mm; interorbital breadth 4.6 to 5.3 mm; length of nasals 13.4 to 17.4 mm; length of incisive foramina 7.3 to 9.5; length of palatal bridge 6.4 to 7.6 mm; alveolar length of upper tooth row 7.6 to 8.8 mm (Hall, 1946; Ingles, 1965).

Pelage. See above.

Locomotion. Movement in this family is predominantly quadrupedal with some scansorial habits.

Dentition. The dental formula for this family is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Sexual dimorphism is marked with males being about 10% heavier than females (Hall, 1946).

GEOGRAPHIC RANGE

Range of species. This species ranges northward into southeastern Oregon and southwestern Idaho. Thence, it extends southeastward through western Utah with an easternmost extension into far western Colorado. The range reaches southward through western Arizona into Baja California. On the west, this species is found to the coast of California almost to the San Francisco Bay area (Hall and Kelson, 1959).

The desert woodrat is found throughout the Mojave and Colorado deserts of California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zone. The species is found primarily in the Lower Sonoran Life Zone, but it does extend through the Upper Sonoran to the Transition (Hall, 1946; Ingles, 1965; Miller and Stebbins, 1964).

Vegetation association. This species of woodrat is found in a variety of vegetation associations: creosote scrub, Joshua tree woodland, pinon/juniper woodland, coastal sage scrub, sagebrush scrub, fir/pine forest (rare), salt grass marsh or subalpine (Hall, 1946; Deacon et al, 1964; MacMillen, 1964; Miller and Stebbins, 1964; Stones and Hayward, 1968; Turkowski and Reynolds, 1970; Bradley and Deacon, 1971; Bradley and Mauer, 1973). In southern Idaho, this species was found in small numbers in habitats dominated by greasewood, shadscale, hopsage, sagebrush/cheatgrass, black sage, or juniper/big sage (Larrison and Johnson, 1973). In south-central Nevada, Jorgensen and Hayward (1965) found this species most abundant in rocky areas and areas with *Yucca*. They also collected this species in *Larrea/Ambrosia*, *Grayia/Lycium*, *Coleogone*, *Atriplex/Koeberia*, *Salsola*, and pinon/juniper associations.

Soil characters. This species is found on a variety of soil types. They are abundant upon rocky soils, large rock outcroppings, and rocky slopes (Hall, 1946; Miller and Stebbins, 1964; Deacon et al., 1964; Jorgensen and Hayward, 1965; Bradley and Deacon, 1971).

Elevation. This species ranges up to 8,700 ft (Hall, 1946).

Topographic characters. They are particularly abundant in areas with rock outcroppings and rocky cliffs and slopes (Hall, 1946; Miller and Stebbins, 1964; Deacon et al., 1964; Jorgensen and Hayward, 1965; Bradley and Deacon, 1971).

POPULATION CHARACTERISTICS

Patterns of abundance. In a coastal sage scrub community in southern California, MacMillen (1964) found densities of this species that ranged from 1.4 to 4.9 individuals per acre. Peak densities were in the summer. Bleich and Schwartz (1975) estimated that woodrat densities approached 30 per ha in a coastal sage scrub community in California. Brown et al. (1972) found an estimated 38 per ha in a stand of jumping cholla cactus in southern California. Stones and Hayward (1968) found densities that averaged 1.1 individuals per acre during the spring and summer in a juniper/sagebrush habitat in Utah.

Predators. Potential predators upon this species include coyote, bobcat, skunks, long-tailed weasels, badgers, hawks, owls, snakes, and foxes.

POPULATION CHARACTERISTICS (Cont'd)

Survivorship. Egoscue et al. (1970) reported that this species lived for over 5 years in the laboratory.

Home range. MacMillen (1964) reported home ranges of about 0.5 acre for woodrats in a coastal sage scrub community. In a similar habitat, Bleich and Schwartz (1975) estimated that a population of woodrats had home ranges of about 400 m². Average linear distances moved were about 13-14 m. In a juniper/sagebrush community, Stones and Hayward (1968) found that males moved distances of about 80 m per night and females moved only about 45 m.

Patterns of activity. This species is active all year round and is primarily nocturnal. Some diurnal activity is likely (MacMillen, 1964; Stones and Hayward, 1968; Miller and Stebbins, 1964).

Nesting sites. Woodrats of this species usually construct houses of litter or utilize the crevices of rock outcroppings for their nesting sites. Woodrats appear to show a preference for rock crevices if they are available. The front of the crevice is generally blocked with a pile of twigs, sticks, rocks, cactus joints, and a variety of other litter. The crevices can be almost a meter deep, providing shelter from the extremes of the macro-environment. Several entrances to the crevice are usual. Nests and food caches are located within the crevice. Where rock outcroppings are not available, houses are constructed by piling litter to form a conical to hemispherical structure which is usually supported by a tree or shrub. The litter used is again twigs, sticks, cactus joints, rocks, feces, and other materials. The specific nature of the building materials varies with the availability of material in the habitat. Where cacti are abundant, cactus joints are a favored building material. In some areas, the houses may be built several feet off the ground in trees. Several to many entrances lead to the interior of the house and passageways intertwine through the medium composing the interior. In some habitats the interiors are formed from smaller materials than the exterior and urine and pitch may be used to cement materials into a solid mass. The newer houses are generally smaller and have a less complicated system of passageways than the older houses. One to several chambers within the house serve as nesting chambers, food caches, and eating areas. Nests were usually constructed from fine, fibrous materials such as grass or shredded stem. Size of the houses is variable, with maximum dimensions exceeding 1 m high and 1.5 m in diameter (Stones and Hayward, 1968; Cameron, 1971; Cameron and Rainey, 1972; Bonaccorso and Brown, 1972; Egoscue, 1957; Brown et al., 1972).

Behavior. Adult woodrats tend to be solitary (Stones and Hayward, 1968).

REPRODUCTION AND GROWTH

Breeding season. Schwartz and Bleich (1975) found this species breeding from October through April in a coastal sage scrub community in southern California. MacMillan (1964) found a similar breeding season in a similar habitat. In creosote scrub desert of Nevada, breeding is more common in the spring and early summer (Bradley and Deacon, 1971; Bradley and Mauer, 1973). In a juniper/sagebrush habitat in Utah, Stones and Hayward (1968) found breeding activity restricted to the period from March to May.

REPRODUCTION AND GROWTH (Cont'd)

Litter size. Litter size ranges from 1 to 5 neonates per female (Egoscue, 1957; Cameron, 1973; Schwartz and Bleich, 1975).

Frequency of litters. Females in the laboratory are polyestrus, but they infrequently enter estrus immediately after parturition. It is likely that females in the wild do bear more than one litter in some seasons (Egoscue, 1957).

Weight at birth. Neonates weigh about 10 g (Egoscue, 1957; Schwartz and Bleich, 1975). Weight decreases as litter size increases (Cameron, 1973).

Length of gestation. Gestation in the laboratory lasts 30 to 36 days (Egoscue, 1968).

Age of weaning. Nurslings are weaned from 27 to 40 days of age (Egoscue, 1957; Cameron, 1973; Schwartz and Bleich, 1975).

Maturity. Females are capable of entering estrus by 2 to 3 months of age (Egoscue, 1957).

Growth and development. Neonates have a pigmented dorsum and the tips of hair are visible. The ears open in 14 to 20 days after birth and the eyes open 11 to 17 days after birth. In 100 days the young reach 67% of the adult weight (Schwartz and Bleich, 1975). Cameron (1973) found that development was more rapid and survival better as litter size decreased.

TROPHIC RELATIONS

Food habits. In coastal sage scrub communities in southern California, this species' diet was dominated by *Salvia apiana*, white sage (Meserve, 1974). They also consumed prickly pear. MacMillen (1964) also noted that this species consumed prickly pear readily. In an area with Joshua trees and pinon/juniper associations, this species consumed the leaves of an evergreen oak, juniper berries, and yucca shoots (Cameron and Rainey, 1972). In a creosote scrub wash area, food caches contained the seeds and leaves of *Acacia*, catclaw, and some *Cucurbita* and *Isomeris*; while, in a creosote scrub habitat dominated by jumping cholla, the woodrats ate creosote, cholla and desert ground berry (Cameron and Rainey, 1972). Stones and Hayward (1968) found that the diet of desert woodrats in a juniper/sagebrush community consisted of: *Ephedra* stems; seeds of *Astragalus*; leaves of mustard, sagebrush, and buckwheat; flowers of mallow, and juniper foliage (in descending order of abundance in the diet). Chew and Chew (1971) found that this species could maintain its body weight upon a diet of *Larrea*, *Mirabilis*, *Coreopsis*, or *Machaenthera*, but they were unable to maintain weight when fed *Aplopappus*, *Gutierrezia*, or *Yucca brevifolia*. These woodrats were unable to survive on diets of the chaparral species of evergreen oak, chemise, or black sage (Chew and Woodman, 1974).

Food preferences. Meserve (1974) lists the following species from coastal sage scrub communities in descending order of preference by the desert woodrat: coast live oak > *Artemisia* > *Eriogonum* = *Salvia* = scrub oak = *Lotus* > *Rhus*.

LIMITING FACTORS

Populations of this species are well adapted for life in arid and semi-arid habitats. The major factor that would limit their distribution is the availability of suitable nesting sites. Northern and elevational distribution may be limited by temperature (Lee, 1963; MacMillen, 1964; Stones and Hayward, 1968; Cameron and Rainey, 1972; Brown et al., 1972).

SYMBIOSES

Interactions with other populations. The houses of this species do provide shelter for several other vertebrates and probably a number of arthropods (Stones and Hayward, 1968). MacMillen (1964) suggested that this species may behaviorally prevent other species from obtaining water from succulents during drought conditions.

Parasites. This species is commonly infected with the larvae of *Cuterebra*. Twenty-seven species of mites have been described from this woodrat, three species of chiggers, ten species of fleas, and two species of ticks (Stones and Hayward, 1968; MacMillen, 1964; Beck et al., 1963; Allred and Goates, 1964; Brennan, 1965; Beck and Allred, 1966).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

These woodrats are probably minor nuisances in areas of human habitation. They may also serve as reservoirs for pathogens.

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Neotoma lepida - Desert Wood Rat

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LIFE HISTORY SUMMARY

Lagurus curtatus - Sagebrush Vole

NOMENCLATURE AND SYNONYMY

Lagurus curtatus (Cope 1868). Type from Pigeon Spring, Mt. Magruder, Nevada, near boundary between Inyo Co., California, and Esmeralda Co., Nevada.

Synonyms:

Arvicola curtata Cope 1868
Lagurus curtatus Thomas 1912
Arvicola decurtata Coues 1877
Microtus intermedius Taylor 1911
Lemmyscus curtatus Goldman 1941
Arvicola pallidus Merriam 1888
Arvicola pauperrima Cooper 1868
Microtus curtatus Anthony 1913

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Microtinae. This species contains six subspecies as defined by Hall and Kelson (1959):

- L. c. curtatus* (Cope 1868). See above.
- L. c. intermedius* (Taylor 1911). Type from head of Big Creek, 8,000 ft., Pine Forest Mts., Humboldt Co., Nevada.
- L. c. levidensis* (Goldman 1941). Type from 5 mi. E Canadian River, west base Medicine Bow Range, 8,000 ft., east of Walden, North Park, Jackson Co., Colorado.
- L. c. orbitus* Dearden and Lee 1955. Type from Steep Creek, 15 mi. N of Boulder, 8,500 ft., Garfield Co., Utah.
- L. c. pallidus* (Merriam 1888). Type from Fort Buford, Williams Co., North Dakota.
- L. c. pauperrimus* (Cooper 1868). Type from plains of the Columbia, near the Snake River, southeastern Washington.

DIAGNOSIS

External form lemming-like in that ears are short and concealed in fur and tail is short. Tail is not compressed laterally and is longer than 5 mm but usually less than 10 mm beyond the extended hind legs. Hind foot less than 50 mm. Color is light gray. No cheek pouches. Tympanic bullae and mastoid bullae much enlarged. Auditory bullae shorter than crown surface of upper cheek teeth or shorter than incisive foramina and usually shorter than each. Cheek teeth not rooted, without cusps, having a length of 10 mm or less. Lower incisors passing from lingual to labial side of molars between bases of roots of M2 and M3 and ascending behind molars to termination within or near condylar process. M1 and M2 with traces of extra complexities between inner folds (M1 with 5 closed triangles). Upper incisors not grooved or equally bicolored longitudinally, M3 with 4 prisms (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 108-142 mm; tail 16-28 mm; hind foot 14-18 mm; ear (notch) 9-13 mm. Weight 17.5-24.8 g (Hall, 1946; James and Booth, 1954; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Length 21.0-24.6 mm; zygomatic breadth 13.4-14.1; occipitonasal length 22.7-23.6; interorbital breadth 3.2-3.4; mastoidal breadth 11.7-12.1 (Hall, 1946; Ingles, 1965).

Pelage. Long and lax; upper parts pale buffy gray to ashy gray; ears and nose tinged with buff; sides paler; venter silvery or soiled whitish to buffy; tail indistinctly bicolor, with dusky line above but silvery white to buffy below (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Dentition. Dental formula is 1-0-0-3/1-0-0-3 (Hall, 1946).

Locomotion. Sagebrush voles are strictly quadrupedal. Although they have been observed in shrub habitats there are no records of their climbing into the vegetation.

Sexual dimorphism. Males average 1 to 3 percent larger than females in most linear measurements, and are 20 percent heavier (Hall, 1946).

GEOGRAPHICAL RANGE

The range of the sagebrush vole coincides with the distribution of arid and semiarid steppe and grassland types in North America. It is found as far east as western North Dakota and eastern Colorado, and its range abuts the eastern slopes of the Cascades on the west. The southern limit of its distribution is north of Death Valley and its range then extends as far north as central Alberta.

In California it has been taken in eastern Lassen County and in arid habitats in eastern Mono and Inyo counties (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper Sonoran and Transitional, possibly in Canadian Life Zone (Hall, 1928).

Vegetation associations. Sagebrush voles have been trapped in habitats dominated by: *Artemisia tridentata* or *A. nova* (Hall, 1928; Moore, 1943); *Artemisia rigida*/*Poa sandbergii* (Rickard, 1960); *A. tridentata*/*Agropyron spicatum* (Johnson et al., 1948; Rickard, 1960; O'Farrell, 1972, 1975ab); *Agropyron spicatum*/*Poa sandbergii* (O'Farrell, 1975ab); *A. tridentata*/*Bromus tectorum* (Larrison and Johnson, 1973; O'Farrell, 1975b); planted fields of crested wheatgrass (Larrison and Johnson, 1973).

Soil characters. Light, loose soils with good drainage seem to be a requisite for sagebrush voles (Johnson et al., 1948; James and Booth, 1954).

Elevation. *Lagurus* has been trapped at the following elevations: Washington, 550 to 3,500 ft (Johnson et al., 1948; O'Farrell, 1972, 1975ab); Oregon, 5,000 ft (Moore, 1943); Nevada and California, 8,000 to 10,500 ft (Hall, 1928).

POPULATION CHARACTERISTICS

Survivorship. In laboratory colonies sagebrush voles have lived as long as 23 months (Egoscue et al., 1970).

POPULATION CHARACTERISTICS (Cont'd)

Nesting sites. Burrows have 20 to 30 entrances (James and Booth, 1954) and are located beneath sagebrush and other shrubs (Hall, 1928; Moore, 1943; Johnson et al., 1948) James and Booth, 1954). Tunnels are just below the surface to a depth of up to 46 cm (Hall, 1928; Moore, 1943; Johnson et al., 1948; James and Booth, 1954), and usually attain a length of less than 60 cm (Hall, 1928). Nest chambers are from 9 to 25 cm in diameter (Hall, 1928; Moore, 1943; James and Booth, 1954) and the nest itself consists of shredded sagebrush bark and grass stems (Moore, 1943; James and Booth, 1954).

Predators. The species is probably preyed on by many classes of predators although the short-eared owl (Moore, 1943) and rattlesnakes, *Crotalus* sp., (Bailey, 1936), are species of record.

Activity patterns. Sagebrush voles are not strictly nocturnal, and are often seen active on the surface during the day (Cooper, 1868; Bailey, 1900; Hall, 1928; Johnson et al., 1948, James and Booth, 1954). Normally activity is greater in early morning and late afternoon than during mid-day. They are active throughout the year (James and Booth, 1954).

Behavior. Sagebrush voles are social and often live in large colonies (Hall, 1928; James and Booth, 1954). They establish runway systems although they may be more indistinct than those used by other microtines (Hall, 1928; Johnson et al., 1948; James and Booth, 1954). Colony sanitation is maintained owing to the behavior of depositing feces on established sites outside the burrow entrance (James and Booth, 1954). Agonistic behavior in laboratory colonies is shown most often between males and nonreceptive females. Groups of females seldom fight, and young animals have never been known to fight (James and Booth, 1954). The largest males appear to dominate the colony which has a well developed peck order (James and Booth, 1954).

REPRODUCTION AND GROWTH

Breeding season. Moore (1943) speculated that sagebrush voles in Oregon bred throughout the year, but James and Booth (1954) noted a marked lull in breeding during the summer in Washington.

Litter size. Moore (1943) tabulated embryos and uterine scars in Oregon sagebrush voles and published an average litter size of 6 with a range of between 4 and 10. In Washington, similar tabulations yielded a mean of 5.3 and a range of 1 to 11 (James and Booth, 1954).

Frequency of litters. Sagebrush voles can breed at parturition, and in the laboratory a female has had up to 14 litters per year (Egoscue et al., 1970).

Length of gestation. The gestation period is 25 days and does not appear to be altered by the size of the litter or whether the female is lactating (James and Booth, 1954).

Age at weaning. Young are usually weaned 21 days after birth (James and Booth, 1954).

Age at reproductive maturity. Males reach sexual maturity 60 days after birth. Females breed as early as 47 days of age, but the majority breed no earlier than 60 days after birth (James and Booth, 1954).

REPRODUCTION AND GROWTH (Cont'd)

Growth. Average weight at birth is 1.5 g. At birth the neonates are naked, blind and helpless with bright pink, wrinkled skin. On day 3 their ears unfold, and by day 4 dark hair appears on their back and sides. They are covered with hair by day 5, and their eyes open on about day 11. On day 15 they are stable on their legs but seldom leave their dam's side. They are weaned on day 21, but continue to grow until day 60 when they have attained most of their adult size and weight (James and Booth, 1954).

TROPHIC RELATIONS

Food habits. Sagebrush voles are primarily herbivorous. Bailey (1900) noted the flowers of *Artemisia frigida* and *Liatris graminifolia*, and the seeds and heads of *Eurotia lanata* and "many grasses" as foods consumed by *Lagurus*. Hall (1928) mentioned only the leaves and cambium of *Artemisia* as food, but Moore (1943) found no evidence that sagebrush was eaten in Oregon. He found a varied diet consisting of items such as *Collinsia parviflora* and grasses including *Poa sandbergii* and *Sitanion hystrix*. James and Booth (1954) reported that the most common plants eaten by *Lagurus* in Washington included *Artemisia tridentata*, *Allium* sp., *Bromus tectorum*, *Agropyron spicatum* and *Sisymbrium longipedicellatum*.

Foraging sites. Most foraging is done under protection of the shrubs and grass crowns (James and Booth, 1954).

Foraging techniques. Under cover of the crown, voles eat into the succulent crown and "mow off" culms and leaves. Seed tops and stem nodes are preferred. Little edible material is taken back into burrows (James and Booth, 1954).

LIMITING FACTORS

Sagebrush voles may be considered an indicator species because of their strong affinity for the sagebrush/bunchgrass zones of western North America. In fact, their original distribution neatly coincides to that of *Artemisia* (Rickard, 1960). Since they are successful in areas where sagebrush, but not native bunchgrasses, have been eliminated by fire, it appears that they are restricted by the microclimatological conditions associated with this habitat, as well as to the presence of perennial native grasses (O'Farrell, 1972). They are found in the most xeric habitats occupied by members of the subfamily Microtinae.

SYMPTOMSES

Sagebrush voles are host to at least 6 species of fleas including *Megabothris elantoni* and *Thrassia bacchi johnsoni* which are two known plague vectors (Egoscue, 1966; O'Farrell, 1975a).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Sagebrush voles are one of the most important reservoirs of sylvatic plague in northwestern North America (Johnson et al., 1948; James and Booth, 1954). *Lagurus* has been infected in at least 20 of 21 outbreaks of plague in Washington. However, there is no evidence that it has been responsible for transmission to man or his livestock.

There is no evidence to indicate that sagebrush voles cause any damage to agricultural crops even in years of population irruptions.

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES (Cont'd)

Man and his activities, however, have had an almost devastating impact on the sagebrush vole. Its habitat is one of the most productive in the west and overgrazing and agriculture, especially wheat farming, have eliminated most of the original range of this species (O'Farrell, 1972, 1975a).

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Lagurus curtatus - Sagebrush Vole

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3

LIFE HISTORY SUMMARY
Vulpes macrotis - Kit Fox

NOMENCLATURE AND SYNONYMY

Vulpes macrotis Merriam 1888. Type from Riverside, Riverside Co., California.

Synonyms:

Vulpes macrotis Merriam 1888

Vulpes arctipus Elliot 1904

Vulpes muticus Merriam 1902

CONTEXT AND CONTENT

Order Carnivora; Family Canidae. This species contains eight subspecies as defined by Hall and Kelson (1959):

V. m. arctipus Elliot 1904. Type from Daggett, San Bernardino Co., California.

V. m. devia Nelson and Goldman 1909. Type from Llano de Yrais, opposite Madgalena Island, Baja California.

V. m. macrotis Merriam 1888. See above.

V. m. mutica Merriam 1902. Type from Tracy, San Joaquin Co., California.

V. m. neomexicana Merriam 1902. Type from Daird's Ranch, eastern side San Andres Mts., Dona Ana Co., New Mexico.

V. m. nevadensis Goldman 1931. Type from near Willow Creek Ranch, near Jungo, Humboldt Co., Nevada.

V. m. tenuirostris Nelson and Goldman 1931. Type from Trinidad Valley, northwest base of Sierra San Pedro Martir, Baja California.

V. m. zinseri Benson 1938. Type from San Antonio de Jaral, Coahuila.

DIAGNOSIS

Skull length less than 130 mm; postorbital process thin and concave dorsally; basilar length usually less than 147 mm; 42 teeth; upper incisors usually not prominently lobed; teeth of rami relatively widely spaced, anteroposterior diameter of I1 at base usually less than distance between alveoli of I1 and C; rostrum relatively narrow, its width measured at a point opposite the cone of P2 less than 18% of condylobasal length; ears long and pointed; tail comprises about 40% of total length; without a black band running dorsally on the tail; tail round in cross section, gray dorsally and black-tipped; hind foot less than 150 mm (Hall and Kelson, 1959; Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 600-840 mm; tail 225-323 mm; hind foot 108-137 mm; ear from crown 78-94 mm; 1.4-2.3 kg (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 105-122 mm; least interorbital breadth 20.6-23.0 mm; mastoidal breadth 36.3-38.4 mm; zygomatic breadth 56.3-60.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Grayish above; longest hairs are tipped with black or with brown; the shorter overhairs are tipped with white or broadly banded near the tip with white; the underfur is tipped with brownish, then broadly banded with buffy, and the basal half is plumbeous; buffy color predominates on the

MORPHOLOGICAL CHARACTERS (Cont'd)

sides and buff is present across the chest, on the backs of the ears, on the legs, and on all but the distal 1 cm of the underside of the tail; underparts of the body are white; sides of the muzzle, all vibrissae on the head, lower lip, and posterior third of the upper lip are blackish or brownish (Hall, 1946). There are two molts each year. The vernal molt begins in about April and is completed by July. The autumnal molt begins in late-summer and is completed by October (Egoscue, 1962). Distinct color phases as occur in the red fox are unknown, but at least 3 distinct color groups can be recognized in the field: pale; dark; and intermediate (Egoscue, 1962).

Locomotion. Cursorial; digitigrade (Ingles, 1965).

Dentition. The dental formula is 3-1-4-2/3-1-4-3 (Ingles, 1965).

Sexual dimorphism. Males average up to 8% heavier than non-pregnant females (Egoscue, 1962).

GEOGRAPHIC RANGE

The range of the kit fox extends from northern Mexico northwesterly across southwestern Texas, to southeastern Oregon and southwestern Idaho. All of Baja California is included in the range that extends through southern California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran and lower parts of the Upper Sonoran (Hall; 1946; Ingles, 1965).

Vegetation associations. Kit fox have been studied in areas where the dominant vegetation includes: dunes vegetated with *Atriplex*; *Sarcobatus*; shadscale flats dominated by *Atriplex confertifolia*; *Larrea/Ambrosia*; and annual grasslands (Burt, 1934; Allred et al., 1963; Egoscue, 1962; Jorgensen and Hayward, 1965; Laughrin, 1970; Morrell, 1971, 1972).

Soil characters. Most authors associate kit fox primarily with loose textured soils (Burt, 1934; Hall, 1946; Egoscue, 1962; Laughrin, 1970; Morrell, 1971, 1972).

Elevation. The kit fox has been observed or trapped at elevations from 282 feet below sea level to at least 5,300 feet in Nevada (Hall, 1946).

POPULATION CHARACTERISTICS

Longevity. In Utah the oldest known-age animal was at least seven years old at its last capture (Egoscue, 1975).

Mortality. Approximately 40-50% of the residents were lost to either mortality or emigration each year in Utah (Egoscue, 1962).

Abundance. In California densities of kit fox have been estimated to be between 1/43 ha and 1/260 ha (Laughrin, 1970; Morrell, 1972). In Utah densities of adults varied between 1/471 ha and 1/1,036 ha (Egoscue, 1975).

Age structure. The average age of populations in Utah varied between 1.8 and 2.2 years (Egoscue, 1975). There were usually at least four annual age classes represented in the population (Egoscue, 1975).

POPULATION CHARACTERISTICS (Cont'd)

Dispersion. No pups born on the large study area in Utah took up residence there and were all thought to have made dispersal movement out of the area (Egoscue, 1975).

Predators. Egoscue (1962) had evidence that a Golden Eagle had taken a Kit fox. Although several authors have suggested that coyotes may prey on kit fox, no evidence to support this speculation was gathered during an intensive investigation (Egoscue, 1962).

Den sites. Kit fox dens are found in a number of vegetation associations, soils, and topographic situations. Dens are not randomly scattered but are located in groups. In Utah as many as 8 to 10 dens were located in 1-2 hectares (Egoscue, 1962). Most burrows have multiple entrances ranging between 2-7, although one den was found to have 24 entrances (Egoscue, 1962). Entrances are 20-25 cm in diameter, although they tend to be higher than wide and too narrow to permit passage of badgers or coyotes (Egoscue, 1962). Ramp-shaped mounds of dirt are deposited at the burrow entrances, and most of these dirt mounds are 1-2 m long. The average length of burrows is 2-5 m and the maternity chamber may be 3-6 dm wide and 3 dm high. There are numerous tunnels, chambers, and entrances (Egoscue, 1956; Morrell, 1971, 1972).

Home range. The kit fox is thought to have a home range of 260-520 ha with considerable overlap between individual ranges (Morrell, 1972).

Activity. The kit fox is nocturnal although some diurnal activity around the den takes place (Egoscue, 1962; Morrell, 1971, 1972). Activity commences near sunset and continues sporadically throughout the night (Egoscue, 1956; Morrell, 1971, 1972). Kit fox are active throughout the year.

Behavior. Kit fox are a relatively unwary animal (Hall, 1946; Egoscue, 1956, 1962; Laughrin, 1970). They are one of the only carnivores known to use a den throughout the year. They will use dens dug by other animals but are capable of digging their own, especially in light-textured soils (Lechleitner, 1969; Egoscue, 1962; Morrell, 1972). They are capable of swimming water barriers (Reeder, 1949). Kit fox have at least 4 types of vocalizations: bark; growl; purr; croak; and snarl (Egoscue, 1962). They do not appear to use scent posts, and scats are found along trails, at dens and near novel items in their habitat (Egoscue, 1962). Both monogamous and polygamous breeding have been observed (Egoscue, 1962; Morrell, 1971, 1972). Some breeding pairs remain together for more than one year (Egoscue, 1962), while others have more than one mate within a year (Morrell, 1971, 1972).

REPRODUCTION AND GROWTH

Breeding season. Kit fox breed between December and either January or February, and the young are born in February or March. Most juveniles are weaned between May and August (Egoscue, 1962; Morrell, 1971, 1972).

Gestation. The length of gestation is thought to be 49-55 days (Egoscue, 1962).

Litter size. Average litter sizes observed in California and Utah were 4.0 and 4.5 respectively, with a range of 3 to 5 (Egoscue, 1962; Morrell, 1972).

REPRODUCTION AND GROWTH (Cont'd)

Frequency of litters. Only one litter is born each year.

Age at reproductive maturity. Kit fox do not successfully breed during their first year (Morrell, 1971, 1972).

Growth and development. At birth a kit fox weighed 39.9 g. Most of the body was covered with short, buffy red hairs. The eyes and ears were closed and only one ear had completely unfolded. Claws were well formed. The teeth had not erupted (Egoscue, 1966). By one month the young fox are covered with short, wooly puppy fur with longer black guard hairs showing through brown fur on the back and hips. The fur is very reddish on the shoulders and front legs. The dark area on the muzzle is pronounced and the tail is grayish-black with brown undertones. The underparts are white and the eyes are still gray-blue. Average weight is 575 g (Egoscue, 1956). Pups achieved most of their adult weight within 4-5 months after birth (Egoscue, 1962).

TROPHIC RELATIONS

Food preferences. The kit fox is primarily carnivorous. They eat some insects, but little vegetation (Laughlin, 1970; Egoscue, 1962, 1975; Morrell, 1971, 1972).

Foods eaten. In Utah the principal food items were black-tailed jack-rabbits, desert cottontails, and some kangaroo rats (Egoscue, 1962, 1975). In the San Joaquin 80-90% of the material observed in 600 kit fox scats were kangaroo rats (Laughlin, 1970; Morrell, 1971, 1972). They also eat other small rodents, ground-dwelling birds, a few reptiles, insects, and some vegetable material (Egoscue, 1956, 1962, 1975; Laughlin, 1970; Morrell, 1971, 1972).

Foraging techniques. Tracks indicate that, when hunting, kit fox systematically meander, circling clumps of brush and wandering back and forth where cover is scarce. When prey are found, the fox makes a stealthy approach, and then a swift rush to capture its prey (Egoscue, 1962).

Energy requirements. In captivity adults consume about 175 g of fresh meat per day, and subadults require about 85 g of meat. A den with 2 adults and 5 pups had food remains from an estimated 38,100 g of animals. This is about 85% of the estimated food requirements for the 7 animals over 64 days: 44,605 g (Egoscue, 1962). Kit fox would be at an obvious advantage where they could depend on capturing 22 rabbits over that period of time rather than 900 kangaroo rats (Egoscue, 1975).

LIMITING FACTORS

Environmental constraints. Egoscue (1975) concluded that kit fox carrying capacity is primarily related to their territorial requirements. Continued increases in the number of rabbits, their major food item, beyond what was needed to support a maximum fox population did not result in further increases in foxes. In the San Joaquin Valley of California, kit fox populations appear to be constrained by significant losses of suitable habitat through increased agricultural development (Laughlin, 1970; Morrell, 1971, 1972, 1975).

SYMBIOSES

Diseases and parasites. The kit fox is known to host: 7 species of flea (Egoscue, 1962; Beck and Allred, 1966); and three species of tick (Egoscue, 1962). Only 3 of 71 living foxes showed evidence of injury or illness; an emaciated pup was captured after it wandered into a building; a female was blinded in her right eye; and a male had lost his right front paw (Egoscue, 1962).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Sensitivity to human activities. Highway fatalities are one of the most significant sources of mortality (Egoscue, 1962; Morrell, 1971, 1972, 1975). Kit fox are also vulnerable to hunting, especially night-hunting for predators (Laughrin, 1970; Morrell, 1971, 1972). There is some evidence to indicate that indiscriminate killing and habitat disturbance by off-road vehicle enthusiasts has a negative impact on kit fox populations (Laughrin, 1970). Some studies have been performed to determine whether rodent control practices may threaten kit fox through secondary poisoning (Schitoskey, 1975; Morrell, 1975).

Endangered and threatened status. The San Joaquin kit fox, *V. m. muticus*, is on the Secretary of the Interior's list of endangered wildlife. It is considered to be rare by the California Department of Fish and Game, and it is listed in the IUCN Red Book (1968).

PENDING TAXONOMIC REVISION

A taxonomic review of the five subspecies in the western part of the range of the kit fox was published recently (Waithman and Roest, 1977). Analysis of 9 cranial measurements provided data to support the subspecific status of *V. m. mutica*. Three other subspecies, *V. m. arsipus*, *V. m. devia*, and *V. m. tenuirostris* were synonymized with *V. m. macrotis*. The authors suggested that further studies should be made of the remaining 3 subspecies to clarify their relationships since it has already been suggested that *V. m. nevadensis* should be included with *V. m. macrotis*.

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LIFE HISTORY SUMMARY
Taxidea taxus - Badger

NOMENCLATURE AND SYNONYMY

Taxidea taxus (Schreber 1778). Type locality, Labrador and Hudson Bay.

Synonyms:

Ursus taxus Schreber 1778
Taxidea taxus Rhoads 1894
Meles taxus Boddaert 1784
Ursus labradorius Gmelin 1788
Meles jeffersonii Harlan 1825
Taxidea sulcata Cope 1878
Taxidea marylandica Gidley 1933
Taxidea berlandieri Baird 1858
Taxidea americana Gray 1865

CONTENT AND CONTENT

Order Carnivora; Family Mustelidae. This species contains 15 subspecies as defined by Hall and Kelson (1959):

- T. t. apache* Schantz 1948. Type from San Pedro River, Arizona and Sonora, Mexico-United States boundary.
T. t. berlandieri Baird 1858. Type from Llano Estacado, Texas, near boundary of New Mexico.
T. t. dacotensis Schantz 1946. Type from Folsom, Custer Co., South Dakota.
T. t. halli Schantz 1949. Type from White Sage Flat, between Desert Range and Sheep Range, Desert Game Range, Clark Co., Nevada.
T. t. hallorani Schantz 1949. Type from Castle Dome Mts., Kofa Game Refuge, Yuma Co., Arizona.
T. t. infusca Thomas 1898. Type from Santa Anita, Baja California.
T. t. iowae Schantz 1947. Type from near Clarion, Wright Co., Iowa.
T. t. jacksoni Schantz 1946. Type from 4 mi. E. Milton, Rock Co., Wisconsin.
T. t. kansensis Schantz 1950. Type from 4 mi. SE McLouth, Leavenworth Co., Kansas.
T. t. littoralis Schantz 1949. Type from Corpus Christi, Nueces Co., Texas.
T. t. merriami Schantz 1950. Type from Banner, Trego Co., Kansas.
T. t. montana Schantz 1950. Type from 35 mi. S Dillon, Beaverhead Co., Montana.
T. t. neglecta Mearns 1891. Type from Fort Crook, Shasta Co., California.
T. t. sonoriensis Goldman 1939. Type from Camoa, Rio Mayo, about 15 mi. above Navojoa, Sonora.
T. t. taxus (Schreber 1778). See above.

A recent revision (Long, 1972) recognized four subspecies as follows:

- T. t. berlandieri* Baird 1858. Type, see above.
T. t. jacksoni Schantz 1946. Type, see above.
T. t. jeffersonii (Harlan, 1825), see above (*sulcata*, Cope, 1878, *neglecta* Mearns, 1891, and *montana* Schantz, 1950, are synonyms). Type locality "open plains of Columbia River Valley, sometimes those of Missouri Valley."

CONTEXT AND CONTENT (Cont'd)

T. t. taxus (Schreber, 1778), see above (*americanus* Boddaert, 1784, *labradorius* Gmelin, 1788, *dacotensis* Schantz, 1946, *lowae* Schantz, 1947, *merriami* Schantz, 1950, and *kansensis* Schantz, 1950, are synonyms).

DIAGNOSIS

Tail as long as or longer than hind foot; less than 100 pounds; not dog-, fox-, or cat-like; 34 teeth; tail without alternating light and dark bands; plantigrade or without fully retractile claws; without webs between all toes; grizzly gray or yellowish brown dorsally with a median longitudinal white stripe on head; short, stout legs; tail about a fourth the length of the head and body; long foreclaws; last upper molar triangular and slightly longer than wide; skull large, rugose; occiput depressed, facial angle steep; tympanic bullae highly inflated, not in contact with paroccipital processes; palate extending posteriorly beyond plane of upper molars (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 521-871 mm; tail 90-157 mm; hind foot 89-136 mm; ear 42-55 mm; weight 3.6-10.0 kg (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 108.0-138.2 mm; zygomatic breadth 64.6-92.0 mm; least interorbital breadth 25.3-30.0 mm; mastoidal breadth 65.4-81.1 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts grayish to reddish, guard hairs long, white-tipped with subterminal black band, longest on sides; white stripe extending from nose at least to shoulders; nose, top of head, preauricular and postauricular spots brownish to black; chin, throat and midventral region whitish, underparts buffy; feet dark brown to black (Hall and Kelson, 1959).

Locomotion. Plantigrade (Ingles, 1965).

Dentition. The dental formula is 3-1-3-1/3-1-3-2 (Ingles, 1965).

Sexual Dimorphism. Females average smaller than males (Hall, 1946).

GEOGRAPHIC RANGE

The range of the badger extends from northern Alberta to central Mexico, and from southern Ontario to the Pacific coast of California and Baja California (Hall and Kelson, 1959).

The badger is found throughout California (Ingles, 1965).

HABITAT

Life zones. Usually found in the treeless habitats of Transition and Upper Sonoran life zones, but it has been found from Arctic-alpine to the lower Austral Life Zone (Hall, 1946; Long, 1973).

Soil characters. Badgers occupy many kinds of soil in Nevada. Their burrows are numerous in sandy valleys, but are present also in gravelly or even stony areas. They appear to avoid only the clay and adobe soils, especially those adjacent to playas (Hall, 1946).

Taxidea taxus - Badger

HABITAT (Cont'd)

Elevation. Badgers have been observed from below sea level in Death Valley to at least 12,000 ft (Hall, 1946; Long, 1973).

POPULATION CHARACTERISTICS

Longevity. In captivity badgers live from 11 to 15 years (Flower, 1931; Jackson, 1961).

Mortality. Although some predation does occur, most badgers are killed by automobiles, guns, poisons, and traps (Long, 1973).

Patterns of abundance. Seton (1929) estimated badger densities at one animal per 2.6 square kilometers.

Predators. Badgers occasionally fall prey to coyotes (Seton, 1929), and golden eagles (Grinnell, 1929).

Denning sites. Limited data suggest that badgers dig a new burrow each night in summer, but reuse dens often in the autumn before occupying a single den for the winter (Sargeant and Warner, 1972). When pressed the badger can dig rapidly to depths of 4 to 6 ft and up to 30 ft laterally (Hall, 1946). Burrows are used for dens, escape, and predation, and vary in size and structure depending upon several factors (Snead and Hendrickson, 1942).

Home range. Information gathered on one animal in Minnesota suggested an overall home range of 850 hectares which varied from 725 hectares in summer, to 53 hectares in autumn, to 2 hectares in winter (Sargeant and Warner, 1972).

Activity patterns. Badgers are active both day and night (Seton, 1929; Perry, 1939; Hall, 1946). They are active on the surface throughout most of the year, but may remain underground for extended periods of time during the winter (Hall, 1946).

Behavior. Badgers are primarily a fossorial mammal (Seton, 1929; Hall, 1946). It is ferocious when cornered emitting aggressive sounds (Seton, 1929) and may use its anal glands for defense (Grinnell et al., 1937). Males are solitary except during the mating season, and females are usually so except when mating or raising a litter (Hall, 1946), and are not considered to be monogamous (Davis, 1946). Badgers may cooperate with coyotes to catch prey (Seton, 1929; Cahalane, 1950). They are good swimmers (Seton, 1929; Hall, 1946). They reportedly bury their scats (Hall, 1946; Walker et al., 1964). Predation may be accomplished by lurking within a burrow (Balph, 1961) or by plugging the burrows of the prey to prevent their escape (Knopf and Balph, 1969).

REPRODUCTION AND GROWTH

Age at reproductive maturity. Females may breed at 4 to 5 months of age but this is rare; impregnation usually takes place in animals older than one year. Yearling males do not breed (Wright, 1966; Hall, 1946).

Reproductive season. Spermatogenesis occurs between May and August. Mating occurs in summer and early autumn (Davis and Robertson, 1944; Wright, 1966, 1969). Three follicles usually ovulate (Wright, 1966). Implantation is

REPRODUCTION AND GROWTH (Cont'd)

delayed with development arrested in the blastula stage until December to February (Hamlett, 1932). Young are born in March to April. They are furred but blind. Lactation occurs through June and there is no breeding at parturition.

Litter size. A maximum of seven embryos has been reported (Schwartz and Schwartz, 1959) but the mean number reported by Hall (1946) was 3.

TROPHIC RELATIONS

Foods eaten. Badgers are carnivorous and eat a variety of small vertebrates including: rodents, fish, snakes, and birds. They also consume some insects, and have been known to consume honey combs (Errington, 1937; Sneed and Hendrickson, 1942; Hall, 1946; Hamilton, 1939; Drake and Presnall, 1950; Jackson, 1961; Grinnell et al., 1937; Potter, 1924).

LIMITING FACTORS

Environmental constraints. Badgers appear to be limited to habitats having suitable deep soils for burrowing, an abundance of small vertebrates as a food base, and freedom from harassment by humans.

SYMBIOSES

Parasites and diseases. Badgers are hosts for a variety of parasites including: nematodes (Ortleit, 1929; Herman and Goss, 1940; Kalkan and Hansen, 1966; Keppner, 1969a; Tiner, 1953; Leiby et al., 1971; Worley, 1961); tapeworms (Rausch, 1947; Keppner, 1967, 1969b; Leiby et al., 1971); flukes (Swanson and Erickson, 1946; Leiby et al., 1971); mallophaga (Emerson, 1964); fleas (Fox, 1940; Ellis, 1955; Hubbard, 1947); and ticks (Hubbard, 1947; Ellis, 1955; Gregson, 1956). They are susceptible to rabies and tularemia (Jackson, 1961).

INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES

Game animals. The badger has a vascillating position in the game regulations of the states it inhabits. It is concurrently listed as a predator and nuisance species by some, or as a fur-bearer by others.

Nuisance animals. The major objection to badgers comes from ranchers and farmers who object to their digging activities: the former are concerned that badger diggings pose a threat to running livestock; and the latter do not want badgers digging up their fields (Hall, 1946). It has also been noted that badgers are very important in the natural control of rodent populations, especially of ground squirrel populations. Ranchers and farmers chronically request governmental assistance to control squirrel populations, especially in areas where predatory control continued for many years (Hall, 1946).

Sensitivity to human activities. When predator control activities were more common over most of western North America, the badger suffered severe mortality since it was a non-target carnivore that was killed in the quest to control coyotes. In Nevada it was estimated that 16-20 badgers were killed for every 100 coyotes taken (Hall, 1946). Badgers are still indiscriminately shot, poisoned, and killed by automobiles.

Taxidea taxus - Badger

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INTERACTIONS WITH HUMANS AND THEIR ACTIVITIES (Cont'd)

Disease vectors. As mentioned above, the badger is susceptible to rabies and tularemia; therefore, it could serve as a vector or reservoir for these pathogenic organisms.

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Taxidea taxus - Badger

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LIFE HISTORY SUMMARY

Didelphis marsupialis - Opposum

NOMENCLATURE AND SYNONYMY

Didelphis marsupialis Kerr 1972. Type locality, Virginia.

Synonyms:

- Didelphis virginiana* Kerr 1792
- Didelphis marsupialis* J. A. Allen 1902
- Didelphis pilosissima* Link 1795
- Didelphis illinensium* Link 1795
- Didelphis wacpink* Barton 1806
- Didelphys mes-americana* Oken 1816
- Didelphis californica* Bennett 1833
- Didelphis breviceps* Bennett 1833
- Didelphis yucatanensis* J. A. Allen 1901
- Didelphis richmondi* J. A. Allen 1901

CONTEXT AND CONTENT

Order Marsupialia; Suborder Polyprotodontia; Superfamily Didelphoidea; Family Didelphidae. This species contains 12 subspecies as defined by Hall and Kelson (1959):

- D. m. battyi* Thomas 1902. Type from Coiba Island, Panama.
- D. m. californica* Bennett 1816. Type probably from northern, or north-western, part of Republic of Mexico.
- D. m. cozumelae* Merriam 1901. Type from Cozumel Island, Yucatan.
- D. m. etensis* J. A. Allen 1902. Type from Eten, Piura, Peru.
- D. m. insularis* J. A. Allen 1902. Type from Caparo, Trinidad.
- D. m. pigra* Bangs 1893. Type from Oak Lodge, opposite Micco, Brevard Co., Florida.
- D. m. particeps* Goldman 1917. Type from San Miguel Island, Golfo de Panama, Panama.
- D. m. richmondi* J. A. Allen 1901. Type from Greytown, Nicaragua.
- D. m. tabascensis* J. A. Allen 1901. Type from Teapa, Tabasco.
- D. m. texensis* J. A. Allen 1901. Type from Brownsville, Cameron Co., Texas.
- D. m. virginiana* Kerr 1792. See above.
- D. m. yucatanensis* J. A. Allen 1901. Type from Chichen-Itza, Yucatan.

DIAGNOSIS

Precranial part of skull long and pointed; braincase small; high sagittal and occipital crests; zygomatic arches large; zygomatic breadth less than three-fifths of basal length; tympanic bulla poorly developed, the middle ear being protected by a downward projecting process of the alisphenoid bone; postorbital processes present; hard palate with fenestral opposite molars; upper molars tritubercular; lower molars tritubercular with well developed trigonids; upper tooth-rows not prominently bowed outward (relatively straight and convergent anteriorly); five subequal incisors above and four below; 50 teeth; tail more or less prehensile, less than

DIAGNOSIS (Cont'd)

proximal half of tail furred, remainder naked; tail more than three-fourths as long as head and body; fewer than 33 caudal vertebrae; eight separate bones in sternum; five toes on each foot; hind feet with toes not webbed; clawless hallux of hind foot opposable to other digits; marsupial pouch on lower abdomen; stomach simple; pelage of two distinct types of hair: underfur and coarse, long, white-tipped guard hair; ears naked (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 645-1,017 mm; tail 240-535 mm; hind foot 48-80 mm; ear (crown) about 40 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 80-139 mm (Hall and Kelson, 1959).

Pelage. Pelage consisting of underfur and white-tipped over-hairs; color gray, black, reddish, or rarely white; basal tenth or so of tail furred, remainder naked (Hall and Kelson, 1959).

Dentition. The dental formula is 5-1-3-4/4-1-3-4 (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The range of the opossum extends along the coast of the Pacific states and it interrupted by the Great Plains of southern Canada and the United States together with the more southern desertlike country of southern New Mexico and northwestern Mexico. The range is continued southward in Mexico to South America and eastward in the United States from eastern Colorado to the Atlantic coast between Massachusetts and Florida. Southern Quebec is included in the range (Hall and Kelson, 1959).

HABITAT

Life zones. Tropical through Transition Life Zone (Hall and Kelson, 1959).

LIFE HISTORY SUMMARY

Sorex vagrans - Vagrant Shrew

NOMENCLATURE AND SYNONYMY

Sorex vagrans Baird 1858. Type from Shoalwater Bay (known also as Willapa Bay), Pacific Co., Washington.

Synonyms:

Sorex vagrans Baird 1858
Sorex suckleyi Baird 1858
Sorex dobsoni Merriam 1891
Sorex amoenus Merriam 1895
Sorex nevadensis Merriam 1895
Sorex shastensis Merriam 1899
Sorex obscurus Merriam 1895
Sorex glacialis Merriam 1900
Sorex bairdi Merriam 1895
Sorex longicauda Osgood 1901
Sorex halicoetes Grinnell 1913
Sorex monticolus Merriam 1890
Sorex melanogenys Hall 1932
Sorex orizabae Merriam 1895
Sorex pacificus Coues 1877
Sorex setosus Elliot 1899
Sorex alascensis Merriam 1900
Sorex vancouverensis Merriam 1895
Sorex yaquinae Jackson 1918

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains 27 subspecies as defined by Hall and Kelson (1959):

- S. v. alascensis* Merriam 1895. Type from Yakutat, Alaska.
- S. v. bairdi* Merriam 1895. Type from Astoria, Oregon.
- S. v. calvertensis* Cowan 1941. Type from Safety Cove, Calvert Island, British Columbia.
- S. v. elassodon* Osgood 1901. Type from Cumshewa Inlet near old Indian Village of Clew, Moresby Island, Queen Charlotte Islands, British Columbia.
- S. v. halicoetes* Grinnell 1913. Type from salt marsh near Palo Alto, Santa Clara Co., California.
- S. v. insularis* Cowan 1941. Type from Smythe Island, Bardswell Group, British Columbia.
- S. v. isolatus* Jackson 1922. Type from mouth Millstone Creek, Nanaimo, Vancouver Island, British Columbia.
- S. v. longicauda* Merriam 1895. Type from Wrangell, Alaska.
- S. v. longiquus* Findley 1955. Type from 25 mi. ESE Big Sandy, Eagle Creek, Chouteau Co., Montana.
- S. v. malitiosus* Jackson 1919. Type from E side Warren Island, Alaska.
- S. v. mixtus* Hall 1938. Type from Vanada, Texada Island, Georgia Strait, British Columbia.

CONTEXT AND CONTENT (Cont'd)

- S. v. monticola* 1890. Type from San Francisco Mtn., 11,500 ft., Coconino Co., Arizona.
- S. v. neomexicanus* V. Bailey 1913. Type from Cloudcroft, 9,000 ft., Sacramento Mts., Otero Co., New Mexico.
- S. v. obscuroides* Findley 1955. Type from Bishop Creek, 6,600 ft., Inyo Co., California
- S. v. obscurus* Merriam 1891. Type from near Timber Creek, 8,200 ft., Salmon River Mts. (now Lemhi Mts.), 10 mi. W Junction (near present town of Leadore), Lemhi Co., Idaho.
- S. v. orizabae* Merriam 1895. Type from W slope Mt. Orizaba, 9,500 ft., Puebla.
- S. v. pacificus* Coues 1877. Type from Fort Umpqua, mouth Umpqua River, Douglas Co., Oregon.
- S. v. paludivagus* von Bloeker 1939. Type from salt marsh at mouth Elkhorn Slough, Moss Landing, Monterey Co., California.
- S. v. parvidens* Jackson 1921. Type from spring known as Thurman's Camp, Bluff Lake, about 7,500 ft., San Bernardino Mts., California.
- S. v. permiliensis* Jackson 1918. Type from Permia Lake, W base Mt. Jefferson, Cascade Range, Marion Co., Oregon.
- S. v. prevostensis* Osgood 1901. Type from N end Prevost Island (Kunghit Island on some maps), off coast of Houston Stewart Channel, Queen Charlotte Islands, British Columbia.
- S. v. setosus* Elliot 1899. Type from Happy Lake, Olympic Mts., Clallam Co., Washington.
- S. v. shumaginensis* Merriam 1900. Type from Popof Island, Shumagin Islands, Alaska.
- S. v. sonomae* Jackson 1921. Type from Sonoma Co. side of Gualala River, Gualala, California.
- S. v. soperi* Anderson and Rand 1945. Type from 2½ mi. NW Lake Audy, Riding Mtn. National Park, Manitoba.
- S. v. vagrans* Baird 1858. See above.
- S. v. vancouverensis* Merriam 1895. Type from Goldstream, Vancouver Island, British Columbia.
- S. v. yaquinae* Jackson 1918. Type from Yaquina Bay, Lincoln Co., Oregon.

DIAGNOSIS

Skull about 16-18 mm long; foramen magnum not extending halfway to the top of the skull; interorbital width usually less than 3.3 mm; braincase flat; five unicuspid teeth between the front bicuspid incisors and the large premolars on each side of the upper jaw; one lower incisor on each side; at least four of the unicuspid teeth (upper jaw) clearly visible in lateral view; third unicuspid (unworn) smaller than the fourth; unicuspid, except 5th, with a pigmented ridge extending from near apex of each tooth medially to cinulum and sometimes ending as internal cusplet; tail more than a third to almost half of the total length; tail usually more than 60 but less than 80 percent of head and body length; tail unicolored or weakly bicolored; tail usually less than 46 mm; total length usually less than 110 mm; hind foot less than 16 mm; toes and sides of feet without a comblike fringe of stiff hairs; cinnamon, gray, or brown, dorsally; never black (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 90-153 mm; tail 31-67 mm; hind foot 11-17.5 mm; weight 6.7 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Condylobasal length 16.0-23.0 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts in summer, reddish to grayish, and in winter, black to pale gray; underparts gray, tinged with brownish; tail unicolored, or indistinctly bicolored (i.e., gradually grading from the dark dorsal side to the lighter ventral side) (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is $3-1-3-3/1-1-1-3$ (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the vagrant shrew extends from Alaska to central Mexico and from the Rocky Mountains to the Pacific coast in Alaska south to central California (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through the Hudsonian life zones (Hall, 1946).

LIFE HISTORY SUMMARY

Sorex ornatus - Ornate Shrew

NOMENCLATURE AND SYNONYMY

Sorex ornatus Merriam 1895. Type from head San Emigdio Canyon, Mt. Pinos, Kern Co., California.

Synonyms:

Sorex ornatus Merriam 1895

Sorex oreinus Elliot 1903

Sorex californicus Merriam 1903

Sorex lagunae Nelson and Goldman 1909

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains six subspecies as defined by Hall and Kelson (1959):

S. o. californicus Merriam 1895. Type from Walnut Creek, Contra Costa Co., California.

S. o. lagunae Nelson and Goldman 1909. Type from La Laguna, 5,500 ft., Sierra Laguna, Baja California.

S. o. ornatus Merriam 1895. See above.

S. o. relictus Grinnell 1932. Type from Buena Vista Lake, 290 ft., Kern Co., California.

S. o. salarius von Bloeker 1939. Type from salt marsh at mouth Salinas River, Monterey Co., California.

S. o. salicornicus von Bloeker 1932. Type from Playa del Rey, Los Angeles Co., California.

DIAGNOSIS

Foramen magnum extending about halfway to the top of skull; palate more than 6.7 mm; braincase flattened on top; cranium relatively narrow; five unicuspid teeth between the front bicuspid incisors and the large premolars on each side of the upper jaw; one lower incisor on each side; at least four of the unicuspid teeth (upper jaw) clearly visible in lateral view; third unicuspid (unworn) smaller than the fourth; first and second unicuspid teeth noticeably larger than third and fourth; metacone of M1 relatively high; eyes minute but visible; pinnae of ear usually projecting slightly above pelage; three pairs of inguinal mammae; hind foot usually less than 18 mm; toes and sides of feet without a comblike fringe of stiff hairs; tail unicolored or weakly bicolored, usually less than 80 percent but more than 55 percent of head and body length; never blackish (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 86-110 mm; tail 30-44 mm; hind foot 10-14 mm (Ingles, 1965).

Skull characteristics. Condylbasal length 15.9-17.1 mm (Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Sooty brown or grayish brown dorsally; smoky gray on underparts; tail indistinctly bicolored (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 3-1-3-3/1-1-1-3 (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The ornate shrew is found in northern Baja California and in California west of the crest of Sierra Nevada south from Napa County, California. A subspecies, *S. o. lagunae*, is found in southernmost Baja California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Sonoran and Transition life zones (Ingles, 1965).

LIFE HISTORY SUMMARY
Sorex palustris - Water Shrew

NOMENCLATURE AND SYNONYMY

Sorex palustris Richardson 1828. Type from "marshy places, from Hudson's Bay to the Rocky Mountains."

Synonyms:

Sorex palustris Richardson 1828
Neosorex albibarbis Cope 1862
Neosorex palustris G. M. Allen 1915
Neosorex navigator Baird 1858

CONTEXT AND CONTENT

Order Insectivora; Family Soricidae. This species contains nine subspecies as defined by Hall and Kelson (1959):

- S. p. albibarbis* (Cope 1862). Type from Profile Lake, Franconia Mts., Grafton Co., New Hampshire.
- S. p. brooksi* Anderson 1934. Type from Black Creek, 150 ft., Comox District, E coast Vancouver Island, British Columbia.
- S. p. gloveralleni* Jackson 1926. Type from Digby, Digby Co., Nova Scotia.
- S. p. hydrobadistes* Jackson 1926. Type from Withee, Clark Co., Wisconsin.
- S. p. labradorensis* Burt 1938. Type from Red Bay, Strait of Belle Isle, Labrador.
- S. p. navigator* (Baird 1858). Type from near head Yakima River, Cascade Mts., Washington.
- S. p. palustris* Hooper 1942. Type from 6 mi. NW Durbin, Shavers Fork of Cheat River, 3,600 ft., Randolph Co., West Virginia.
- S. p. turneri* Johnson 1951. Type from Fort Chimo (on eastern bank Koksoak River), Ungava District, Quebec.

DIAGNOSIS

Anterior part of rostrum comparatively short, little decurved; anterior part of premaxillae approximately as deep as middle part; depth of rostrum measured at third unicuspid equal to approximately half the distance between anterior border of infraorbital foramen and posterior border of I1; condylobasal length 18-21 mm; five unicuspid teeth between the front bicuspid incisors and the large premolars on each side of the upper jaw; at least four of the unicuspid teeth (upper jaw) clearly visible in lateral view; fourth unicuspid larger than the third; protocone of M1 and M2 usually without posterior cusplike lobe; upper parts blackish or brownish, with gray to brownish underparts; tail sharply bicolored; tail more than a third of the total length; tail usually 70-105 percent of head and body length; toes and sides of hind foot edged with a comblike fringe of stiff hairs directed downward (sometimes inconspicuous); hind foot usually more than 18 mm; living near water (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 139-163 mm; tail 57-83 mm; hind foot 18-22 mm; weight 10.8-17.6 g (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Condylobasal length 18.8-21.5 mm (Ingles, 1965).

Pelage. Black dorsally with some gray-tipped hairs; white, gray or brownish ventrally; tail markedly bicolored (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 3-1-3-3/1-1-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the water shrew extends from southeastern Alaska and most of British Columbia across Canada to Labrador. This species is found in appropriate habitats in the northeastern, the north central and the western United States. One subspecies has a range extending from West Virginia to eastern Tennessee. In California the range includes the northeastern portion of the state (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through the Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Scapanus latimanus - Broad-footed Mole

NOMENCLATURE AND SYNONYMY

Scapanus latimanus (Bachman 1842). Type probably from Santa Clara, Santa Clara Co., California.

Synonyms:

- Scalops latimanus* Bachman 1842
- Scalops californicus* Ayres 1856
- Scapanus latimanus* Grinnell and Swarth 1912
- Scapanus anthonyi* J. A. Allen 1893
- Scapanus dilatus* True 1894
- Scapanus truei* Merriam 1897
- Scapanus alpinus* Merriam 1897

CONTEXT AND CONTENT

Order Insectivora; Family Talpidae; Subfamily Scalopiniae. This species contains 12 subspecies as defined by Hall and Keelson (1959):

- S. l. anthonyi* J. A. Allen 1893. Type from Sierra San Pedro Martir, 7,000 ft., Baja California.
- S. l. campi* Grinnell and Storer 1916. Type from Snelling, 250 ft., Merced Co., California.
- S. l. caurinus* F. G. Palmer 1937. Type from Laytonville, Mendocino Co., California.
- S. l. dilatus* True 1894. Type from Fort Klamath, 4,200 ft., Klamath Co., Oregon.
- S. l. grinnelli* Jackson 1914. Type from site of old Fort Independence (on ranch of Carl Walters), 2 mi. N Independence, 3,900 ft., Inyo Co., California.
- S. l. insularis* F. G. Palmer 1937. Type from Angel Island, San Francisco Bay, Marin Co., California.
- S. l. latimanus* (Bachman 1842). See above.
- S. l. minusculus* Bangs 1899. Type from Fyffe, 3,500 ft., Eldorado Co., California.
- S. l. monoensis* Grinnell 1918. Type from Taylor Ranch, 5,300 ft., 2 mi. S Benton Station, Mono Co., California.
- S. l. occultus* Grinnell and Swarth 1912. Type from Santa Ana Canyon, 400 ft., 12 mi. NE Santa Ana, Orange Co., California.
- S. l. parvus* F. G. Palmer 1937. Type from Alameda, Alameda Co., California.
- S. l. sericatus* Jackson 1914. Type from Yosemite, Yosemite Valley, Mariposa Co., California.

DIAGNOSIS

Skull conoidal, flattened; braincase relatively broad; interparietal large, somewhat rectangular; audital bulla complete, depressed; infraorbital foramen relatively small; I1 long and broad; C simple and conical, approximately two-thirds as long as I1; M1 and M2 subequal, M3 much smaller

DIAGNOSIS (Cont'd)

than either of those teeth; cuspid teeth not evenly spaced and usually somewhat crowded; body robust; tail short and thick, tapered toward tip, slightly constricted proximally, indistinctly annulated, not flesh-colored, nearly covered with silver coarse hairs; snout long, pointed; naked anterior to nostrils; palms of forefeet as broad as long; soles of hind feet bearing 1-3 (usually 2) distinct tubercles; neither forefeet nor hind feet webbed; no external ear conchs; eyes minute; 4 pairs of mammae, 2 pectoral, 1 abdominal, 1 inguinal; total length more than 130 mm but less than 195 mm; hind foot more than 18 mm but less than 24 mm; 44 teeth; drab gray or coppery brown fur (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 132-192 mm; tail 21-45 mm; hind foot 18-25 mm; weight 52.2-85.0 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 29.0-37.5 mm; mastoidal breadth - 16.0-17.2 mm; interorbital breadth 7.2-8.0 mm (Hall, 1946; Ingles, 1965).

Pelage. Fur dark gray to coppery brown, appears silvery when smoothed; short hairs extend almost to snout; tail nearly covered with silver coarse hairs (Ingles, 1965).

Dentition. The dental formula is 3-1-4-3/3-1-4-3 (Ingles, 1965).

Sexual Dimorphism. In some subspecies the females are generally of smaller size (Hall, 1946).

GEOGRAPHIC RANGE

The range of the broad-footed mole extends from south-central Oregon through northeastern Nevada, most of California except desert regions, and northern Baja California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran to Hudsonian life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Macrotus californicus - California Leaf-nosed Bat

NOMENCLATURE AND SYNONYMY

Macrotus californicus Baird 1858. Type from Old Fort Yuma, Imperial Co., California, on right bank of Colorado River, opposite present town of Yuma, Arizona.

Synonyms: None.

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Phyllostomidae; Subfamily Phyllostominae. This species contains no subspecies.

DIAGNOSIS

Slender skull, especially in the interorbital and rostral regions; teeth weak; extension of the tail for about 7 mm behind interfemoral membrane; ears large, averaging more than 30 mm, and subovate; ears when laid forward reaching far beyond nostrils; tragus, smooth and acute, and about one-half the ear length; with fleshy nose-leaf projecting from the dorsal surface of the nose; length usually more than 90 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 84-103 mm; tail 33-38 mm; hind foot 13-15 mm; ear 33-36 mm; forearm 49-57 mm; weight 11.0-15.9 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length of skull, 22.0-24.1 mm; interorbital breadth 3.4-4.0 mm; zygomatic breadth 11.0-12.0 mm; breadth of braincase 9.0-9.2 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts, sooty brown tips on hair with basal two-thirds white; underparts pale drab to buffy brown, usually with silvery wash (Hall, 1946; Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-2-3/2-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the California leaf-nosed bat includes all of Baja California, northwest Mexico, southern California, southern Nevada, and southern and western Arizona (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran (Hall, 1946).

LIFE HISTORY SUMMARY

Choeronycteris mexicana - Mexican Long-tongued Bat

NOMENCLATURE AND SYNONYMY

Choeronycteris mexicana Tschudi 1844. Type from Mexico.

Synonyms: None

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Phyllostomidae;
Subfamily Glossophaginae. This species contains no subspecies.

DIAGNOSIS

Rostrum elongated comprising more than half of skull; zygomata incomplete; pterygoid processes strongly concave on inner sides; hamulae in contact with auditory bullae; tail approximately half the length of femur and not extending to midpoint of interfemoral membrane; calcar weakly developed; lower incisors absent in adults; W-shaped pattern of upper molars nearly obliterated; with a fleshy nose-leaf projecting from the dorsal surface of the nose; ears when laid forward never reaching to nostrils; length usually less than 90 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 76-86 mm; forearm 43-45 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 30-30.5 mm; zygomatic breadth 10.3-10.6 mm; length of upper tooth row 11.3-11.6 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Dark brown (Ingles, 1965).

Dentition. The dental formula is 2-1-2-3/0-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the Mexican long-tongued bat extends from Guatemala north to southern New Mexico, Arizona, and California. All of Baja California is included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. Upper and Lower Sonoran life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Myotis lucifugus - Little Brown Myotis

NOMENCLATURE AND SYNONYMY

Myotis lucifugus (Le Conte 1831). Type from Georgia; probably the Le Conte Plantation, near Riceboro, Liberty Co.

Synonyms:

Vespertilio lucifugus Le Conte 1831
Myotis lucifugus Miller 1897
Vespertilio gryphus F. Cuvier 1832
Vespertilio salarii F. Cuvier 1832
Vespertilio crassus F. Cuvier 1832
Vespertilio domesticus Green 1832
Vespertilio lanceolatus Wied-Neuwied 1839
Vespertilio carolii Temminck 1840
Vespertilio virginianus Audubon and Bachman 1841
Vespertilio brevirostris Wied-Neuwied 1860
Vespertilio affinis H. Allen 1864
Myotis carissima Thomas 1904
Myotis yumanensis H. W. Grinnell 1916
Myotis albicinctus G. M. Allen 1919
Myotis permex Hollister 1911

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains five subspecies as defined by Hall and Kelson (1959):

- M. l. alacensis* Miller 1897. Type from Sitka, Alaska.
- M. l. carissima* Thomas 1904. Type from Lake Hotel, Yellowstone National Park, Wyoming.
- M. l. lucifugus* (Le Conte 1831). See above.
- M. l. permex* Hollister 1911. Type from Henry House, Alberta.
- M. l. phasma* Miller and G. M. Allen 1928. Type from Snake River, south of Sunny Peak, Routt Co., Colorado.

DIAGNOSIS

Skull more than 14 mm in length; skull with broad rostrum and flattened braincase, the area of which exceeds the rostrum; without sagittal crest; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward, not extending beyond the muzzle; tragus slender, pointed; tragus approximately half as high as ear; tail nearly all enclosed within the interfemoral membrane; posterior edge of the interfemoral membrane naked, or with scattered single hairs, or with only a few scattered bunches of hairs; fur with glossy sheen; fur (except scattered hairs) not extending to elbow or knee on underside of wing; without a nose leaf; dark brown, yellowish or buffy; foot, not including calcar, 7-12 mm and more than half the tibia length (usually 48-60 percent of its length); calcar not keeled; third finger longer than the fourth (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 79-93 mm; tail 30-40 mm; hind foot 9.0-15.5 mm; ear (notch) 14-15 mm; tragus 7-8 mm; forearm 34.5-41.0 mm; weight 5.2-5.7 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 14.0-15.8 mm; zygomatic breadth 8.1-9.8 mm; breadth of braincase 7.0-7.8 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts cinnamon buff to dark brown; underparts buffy to pale gray, often with lighter wash; buffy shoulder spot sometimes present; pelage long and silky, individual hairs being shiny (almost having metallic sheen) at tip (Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the little brown bat extends from most of Alaska and northern Canada to just below the northern half of the United States and from the Atlantic coast between Newfoundland and Georgia to the Pacific coast between southern Alaska and central California (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Myotis yumanensis - Yuma Myotis

NOMENCLATURE AND SYNONYMY

Myotis yumanensis (H. Allen 1864). Type from Old Fort Yuma, Imperial Co., California, on right bank of Colorado River, opposite present town of Yuma, Arizona.

Synonyms:

Vespertilio yumanensis H. Allen 1864

Myotis yumanensis Miller 1897

Vespertilio obscurus H. Allen 1866

Vespertilio macropus H. Allen 1866

Myotis californicus J. A. Allen 1903

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains six subspecies as defined by Hall and Kelson (1959):

M. y. lambi Benson 1947. Type from San Ignacio, Baja California.

M. y. lutosus Miller and G. M. Allen 1928. Type from Patzcuaro, Michoacan.

M. y. oaxalis Dalquest 1947. Type from Oaxalis, San Joaquin Valley, Fresno Co., California.

M. y. saturatus Miller 1897. Type from Hamilton, Skagit Co., Washington.

M. y. sociabilis H. W. Grinnell 1914. Type from Old Fort Tejon, Tehachapi Mts., Kern Co., California.

M. y. yumanensis (H. Allen 1864). See above.

DIAGNOSIS

Forehead steep, high without sagittal crest; short rostrum; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward reach nostril; tragus slender, pointed; dark brown, yellowish or buffy; tail nearly all enclosed within the interfemoral membrane; posterior edge of the interfemoral membrane naked or with scattered single hairs, or with only a few scattered bunches of hairs; foot, not including calcar, 7-12 mm and more than half the tibia length (usually 48-60 percent of its length); calcar not keeled; a lobe at end of unkeeled calcar; tibia 13.5-16.0 mm; without a nose-leaf; fur (except scattered hairs) not extending to elbow or knee on underside of wing, or, if thus covered with fur, with forearm less than 36 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 73-91 mm; tail 31-38 mm; hind foot 9-11 mm; ear (notch) 13-15 mm; tragus 7.2-7.8 mm; forearm 32-38 mm; weight 4.2-7.5 mm (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 13-14.2 mm; breadth of braincase 6.6-7.5 mm; zygomatic breadth 7.8-8.8 mm; interorbital constriction 3.8 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Fur on back is tawny, buffy, or brown, dark subspecies often with buffy wash; underparts paler, buffy to yellowish white; membranes and ears pale brownish (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the Yuma Myotis extends from central Mexico north to central British Columbia, and from east of the Rockies to the Pacific coast. All of California is included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran to lower part of Canadian life zones (Hall, 1946).

LIFE HISTORY SUMMARY
Myotis velifer - Cave Myotis

NOMENCLATURE AND SYNONYMY

Myotis velifer (J. A. Allen 1890). Type from Santa Cruz del Valle, Guadalajara, Jalisco.

Synonyms:

Vespertilio velifer J. A. Allen 1890

Myotis velifer Miller 1897

Myotis californicus Menegaux 1901

Vespertilio incautus J. A. Allen 1896

Myotis peninsularis Miller 1898

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains five subspecies as defined by Hall and Kelson (1959):

M. v. brevis Vaughan 1954. Type from Madera Canyon, 5,000 ft., Santa Rita Mts., Pima Co., Arizona.

M. v. cobanensis Goodwin 1955. Type from Coban, 1,305 m, Alta Verapaz, Guatemala.

M. v. incautus (J. A. Allen 1896). Type from San Antonio, Bexar Co., Texas.

M. v. peninsularis Miller 1898. Type from San Jose del Cabo, Baja California.

M. v. velifer (J. A. Allen 1890). See above.

DIAGNOSIS

Skull more than 14 mm in length; forehead moderate; rostrum short; sagittal crest present; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward reach only to tip of the nose; tragus slender, pointed; tail nearly all enclosed within the interfemoral membrane; foot not including calcar, 7-12 mm and more than half the tibia length (usually 48-60 percent of its length); calcar not keeled; calcar terminating in a minute lobule; without a nose-leaf; posterior edge of the interfemoral membrane naked; pelage dull sepia (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 90-105 mm; ear 13.0-16.6 mm; forearm 36.5-47.0 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 14.0-17.6 mm; zygomatic breadth 9.0-11.6 mm; breadth of braincase 7.0-8.2 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Pelage of back dull, of moderate length; upper parts dull sepia to drab; underparts paler (Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the cave myotis extends from Guatemala to northern Utah and from central Texas to southeastern California. The southern tip of Baja California is included in its range (Hall and Kelson, 1959).

Habitat

Life zones. Tropical through Upper Sonoran Life Zone (Hall and Kelson, 1959).

LIFE HISTORY SUMMARY

Myotis evotis - Long-eared Myotis

NOMENCLATURE AND SYNONYMY

Myotis evotis (H. Allen 1864). Type locality, by subsequent restriction, Monterey, California.

Synonyms

Vespertilio evotis H. Allen 1864

Myotis evotis Miller 1897

Vespertilio chrysonotus J. A. Allen 1896

Myotis micronyx Nelson and Goldman 1909

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains three subspecies as defined by Hall and Kelson (1959).

M. e. auriculus Baker and Stains 1955. Type from 10 mi. W and 2 mi. S Piedra, 1,200 ft., Sierra de Tamaulipas, Tamaulipas.

M. e. evotis (H. Allen 1864). See above.

M. e. pacificus Dalquest 1943. Type from 3½ mi. E and 5 mi. N Yacolt, 500 ft., Clark Co., Washington.

DIAGNOSIS

Low forehead, long rostrum; sagittal crest often present but never large; braincase not flattened; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears, when laid forward, extending 5-10 mm beyond the muzzle; tragus slender, pointed; tragus nearly half as long as the ear; tail nearly all enclosed within the interfemoral membrane; the third metacarpal is the longest, reaching to within 2 mm of the elbow; the fourth and fifth fingers are of nearly equal length; a few (easily overlooked) stiff hairs along free border of the interfemoral membrane; without a nose-leaf; light to dark brown dorsally (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 75-97 mm; tail 35-49 mm; hind foot 7-10 mm; ear (notch) 19-25 mm; tragus 9-13 mm; forearm 35.5-41.0 mm; weight 4.1-7.5 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 15.0-16.4 mm; zygomatic breadth 8.6-10.1 mm; breadth of braincase 7.0-8.2 mm (Hall and Kelson, 1959).

Pelage. Dark to light golden brown fur; membranes and ears black (Ingles, 1965).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the long-eared myotis extends from Baja California and central

Myotis evotis - Long-eared Myotis

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GEOGRAPHIC RANGE (Cont'd)

Mexico north to central British Columbia and from central New Mexico and western North Dakota to the Pacific coast. All of California is included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. The Upper Sonoran through the Canadian Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Myotis thysanodes - Fringed Myotis

NOMENCLATURE AND SYNONYMY

Myotis thysanodes Miller 1897. Type from Old Fort Tejon, Tehachapi Mts., Kern Co., California.

Synonyms: None.

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains two subspecies as defined by Hall and Kelson (1959):

M. t. aztecus Miller and G. M. Allen 1928. Type from San Antonio, Oaxaca.

M. t. thysanodes Miller 1897. See above.

DIAGNOSIS

Sagittal crest well developed; length of upper tooth-row exceeded by greatest breadth of palate including molars; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward extend 3-5 mm beyond the muzzle; ear less than 19 mm (from notch posterior to tragus); tragus slender, pointed and a little more than half the length of the ear; tail nearly all enclosed within the interfemoral membrane; conspicuous clusters of short stiff hairs along the border of the interfemoral membrane; without a nose-leaf (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 80.0-88.4 mm; tail 34-42 mm; hind foot 7.6-11.0 mm; ear (notch) 16-19 mm; forearm 39.8-46.0 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 16.1-17.2 mm; breadth of braincase 7.2-8.2 mm; zygomatic breadth 9.2-10.8 mm; interorbital constriction 3.8-4.1 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Upper parts yellowish brown to darker olivaceous tones; underparts barely, if any, lighter (Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the fringed myotis extends from northern Baja California and central Mexico to south-central British Columbia and from southwestern South Dakota to the Pacific coast between central California and Oregon (Hall and Kelson, 1959).

HABITAT

Life zones. Lower to Upper Sonoran life zones (Hall, 1946).

1967-1968

1968-1969

1969-1970

1970-1971

1971-1972

1972-1973

1973-1974

1974-1975

1975-1976

1976-1977

1977-1978

1978-1979

1979-1980

1980-1981

1981-1982

1982-1983

1983-1984

1984-1985

1985-1986

1986-1987

1987-1988

1988-1989

1989-1990

1990-1991

1991-1992

1992-1993

1993-1994

1994-1995

1995-1996

1996-1997

1997-1998

1998-1999

1999-2000

2000-2001

2001-2002

2002-2003

2003-2004

LIFE HISTORY SUMMARY

Myotis volans - Long-legged Myotis

NOMENCLATURE AND SYNONYMY

Myotis volans (H. Allen 1866). Type from Cabo San Lucas, Baja California.

Synonyms:

Vespertilio volans H. Allen 1866

Myotis volans Goldman 1914

Myotis capitaneus Nelson and Goldman 1909

Myotis longicrus Miller 1914

Vespertilio longicrus True 1886

Myotis altifrons Hollister 1911

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains four subspecies as defined by Hall and Kelson (1959):

M. v. amotus Miller 1914. Type from Cofre de Perote, 12,500 ft., Veracruz.

M. v. interior Miller 1914. Type from 5 mi. S Twining, 11,300 ft., Taos Co., New Mexico.

M. v. longicrus (True 1886). Type from vicinity of Puget Sound, Washington.

M. v. volans (H. Allen 1866). See above.

DIAGNOSIS

Skull small, delicate; rostrum short; braincase abruptly elevated from rostral level; occipital region somewhat inflated; sagittal crest low, poorly defined; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward, not extending more than 4 mm beyond the muzzle; tragus slender, pointed; tail nearly all enclosed within the interfemoral membrane; without a nose-leaf; fur extending to knee and elbow on underside of wing, calcar distinctly keeled; posterior edge of the interfemoral membrane naked or with scattered single hairs or with only a few scattered bunches of hairs; dark brown, yellowish or buffy (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 80-105 mm; tail 34-49 mm; hind foot 6.5-10.0 mm; ear 10.0-14.0 mm; tragus, 4.5-9.0 mm; forearm 35.2-42.0 mm; weight 5.3-9.0 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 12.1-15.0 mm; zygomatic breadth 8.0-9.0 mm; breadth of braincase 6.7-7.6 mm; length of upper tooth row 4.6-6.5 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Upper parts brown to distinctly yellow; underparts usually paler; hairs extending sparingly onto upper side of uropatagium to a line connecting knees, extending half as far on ventral side of membrane (Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

Myotis volans - Long-legged Myotis

- 2 -

GEOGRAPHIC RANGE

The range of the long-legged myotis includes all of Baja California and extends from northern Mexico to southeastern Alaska, and from the Rocky Mountains to the Pacific coast (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through Hudsonian (Hall, 1946).

LIFE HISTORY SUMMARY

Myotis subulatus - Small-footed Myotis

NOMENCLATURE AND SYNONYMY

Myotis subulatus (Say 1823). Type from the Arkansas River near present town of La Junta, Otero Co., Colorado.

Synonyms:

Vespertilio subulatus Say 1823

Myotis subulatus Miller 1897

Vespertilio ciliolabrum Merriam 1886

Vespertilio leibii Audubon and Bachman 1842

Vespertilio melanorhinus Merriam 1890

Vespertilio nitidus H. Allen 1894

Myotis orinomus Elliot 1903

Myotis winnemana Nelson 1913

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains three subspecies as defined by Hall and Kelson (1959):

M. s. leibii (Audubon and Bachman 1842). Type from Erie County, Ohio

M. s. melanorhinus (Merriam 1890). Type from Little Spring, 8,250 ft.,

N base San Francisco Mtn., Coconino Co., Arizona.

M. s. subulatus (Say 1823). See above.

DIAGNOSIS

Forehead gradually rising from the rostrum; low sagittal crest sometimes present; braincase conspicuously flattened; with six cheek teeth behind the canine on each side of the upper and lower jaws; ears when laid forward barely exceeding muzzle; tragus slender, pointed; tail nearly all enclosed within the interfemoral membrane; foot small, delicate; calcar keeled; calcar long slender terminating in a minute lobule; third metacarpal usually shorter than the forearm; third and fourth finger about equal in length; without a nose-leaf; upper parts yellowish to golden brown; ears and face black (darkest fur is on face); posterior edge of the interfemoral membrane naked, or with scattered single hairs, or with only a few scattered bunches of hairs; fur extending slightly onto membranes below (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 60-90 mm; tail 32-45 mm; hind foot 7-9 mm; ear 12-16 mm; tragus 6-10 mm; forearm 30.8-36.0 mm; weight 3.3-5.9 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 13.2-14.7 mm; zygomatic breadth 8-9 mm; breadth of braincase 6.2-7.1 mm (Hall and Kelson, 1959).

Pelage. Pelage long, silky; the tips frequently glossy; ear and face black; upper parts light buff to golden brown; underparts buffy to almost white; fur dark at base, palest on the tips (Hall and Kelson, 1959; Ingles, 1965).

Myotis subulatus - Small-footed Myotis

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MORPHOLOGICAL CHARACTERS (Cont'd)

Dentition. The dental formula is 2-1-3-3/3-1-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the small-footed myotis extends from southwestern Texas to central Alberta covering most of the western states. The range also includes a band reaching from southwestern South Dakota and northern Oklahoma to the Atlantic coast of southern Maine and Maryland (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through Transition life zones (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Lasionycteris noctivagans - Silver-haired Bat

NOMENCLATURE AND SYNONYMY

Lasionycteris noctivagans (Le Conte 1831). Type from eastern United States.

Synonyms:

Vespertilio noctivagans Le Conte 1831

Lasionycteris noctivagans H. Allen 1894

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains no subspecies.

DIAGNOSIS

Skull flattened; rostrum broad; depth of braincase including auditory bullae approximately three-fourths of mastoid breadth; sagittal crest obsolete; interorbital region wide, flattish; upper edge of orbit with low "bead"; central part of bead forming angle suggesting incipient post-orbital process; upper surface of rostrum distinctly concave on each side between lacrimal region and nares; with fewer than six cheek teeth on each side of the upper jaw; without a combination of four upper cheek teeth and two upper incisors at each side; inner upper incisor bicuspid and outer one simple; P3 absent; hypocone distinctly indicated in M1 and M2; M3 with more than half the crown area of M1; in M3 metacone nearly as large as paracone, and its three commissures well developed; ears when laid forward scarcely reaching to the end of the nose; ears short, nearly as broad as long; tail nearly all enclosed within the interfemoral membrane; interfemoral membrane furred on basal half above; light brown or silver-tipped chocolate or blackish brown ventrally; without three white spots dorsally; without a nose-leaf; forearm usually less than 47 mm but more than 35 mm; length usually less than 110 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 91-108 mm; tail 31-46 mm; hind foot 8-10 mm; ear 11-14 mm; tragus 6.3-7.0 mm; forearm 39-43 mm; weight 5.8-11.4 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 15.5-16.5 mm; zygomatic breadth (2) 9.5-9.8 mm; braincase breadth (2) 8.1-8.2 mm; interorbital constriction (2) 4.2-4.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Blackish or chocolate brownish dorsally and ventrally, with some hairs tipped with white or silver; ears and membranes black and naked except for the basal half of the interfemoral membrane on dorsal side which is furred ((Hall, 1946; Ingles, 1965).

Dentition. The dental formula is 2-1-2-3/3-2-3-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the silver-haired bat extends from southern Canada to southern Texas and from the Atlantic coast between Nova Scotia and South Carolina to the Pacific coast between central British Columbia and central California (Hall and Kelson, 1959).

Lasiorycteris noctivagans - Silver-haired Bat

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HABITAT

Life zones. In the winter, the silver haired bat is found in the Lower Sonoran Life Zone; in the summer, the bat is found from the Upper Sonoran through the Canadian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Eptesicus fuscus - Big Brown Bat

NOMENCLATURE AND SYNONYMY

Eptesicus fuscus (Palisot de Beauvois 1796). Type from Philadelphia, Pennsylvania.

Synonyms:

- Vespertilio fuscus* Palisot de Beauvois 1796
- Eptesicus fuscus* Mehely 1900
- Vespertilio carolinensis* E. Geoffroy St.-Hilaire 1806
- Vespertilio phaiops* Rafinesque 1818
- Vespertilio melanops* Rafinesque 1820
- Vespertilio arquatus* Say 1823
- Vespertilio ursinus* Temminck 1835-1841
- Scotophilus greenii* Gray 1843
- Vespertilio duteurtrei* P. Gervais 1837
- Scotophilus cubensis* Gray 1839
- Eptesicus hispaniolae* Miller 1918
- Scotophilus miradorensis* H. Allen 1866
- Eptesicus pallidus* Young 1908
- Eptesicus wetmorei* Jackson 1916

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains 10 subspecies as defined by Hall and Kelson (1959):

- E. f. bahamensis* (Miller 1897). Type from Nassau, New Providence, Bahamas.
- E. f. bernardinus* Rhoads 1902. Type from near San Bernardino, San Bernardino Co., California.
- E. f. duteurtrei* (P. Gervais 1837). Type from Cuba.
- E. f. fuscus* (Palisot de Beauvois 1796). See above.
- E. f. hispaniolae* Miller 1918. Type from Constanza, Dominican Republic.
- E. f. miradorensis* (H. Allen 1866). Type from Mirador, Veracruz.
- E. f. osceola* Rhoads 1902. Type from Tarpon Springs, Pinellas Co., Florida.
- E. f. pallidus* Young 1908. Type from Boulder, Colorado.
- E. f. peninsulae* (Thomas 1898). Type from Sierra Laguna, Baja California.
- E. f. wetmorei* Jackson 1916. Type from Maricao, Puerto Rico.

DIAGNOSIS

Greatest length of skull more than 17.4 mm; with 32 teeth; a combination of 4 upper cheek teeth and 2 upper incisors on each side; apex side of second triangle of M3 less than half height of anterior side of first triangle, ears short, barely reach end of snout when laid forward; tail nearly all enclosed within the interfemoral membrane; interfemoral membrane not covered with fur dorsally; length of forearm 46 mm or more; without a nose-leaf; without three white spots dorsally; dorsally bright red or rich brown with black ears, wings and interfemoral membrane (Hall and Kelson, 1959; Ingles, 1965).

Eptesicus fuscus - Big Brown Bat

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MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 105-130 mm; tail 39-58 mm; hind foot 9-13 mm; ear 13-19 mm; tragus 5-11 mm; forearm 42-52 mm; weight 13.6-23.0 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 18.0-19.5 mm; zygomatic breadth 12.5-13.0 mm; interorbital constriction 4.1-4.6 mm; breadth of braincase 9.1-9.7 mm (Hall, 1946).

Pelage. Upper parts brown, usually dark, and sometimes reddish brown; under parts paler than upper parts, sometimes cinnamon or buffy; black ears, wings and interfemoral membrane (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 2-1-1-3/3-1-2-3 (Ingles, 1965).

Locomotion. Flight is steady and slow (Hall, 1946).

GEOGRAPHIC RANGE

The range of the big brown bat extends from western Panama to northern Alberta, Canada, and from the Atlantic coast to the Pacific coast. The Bahama and Greater Antilles islands are also included in the range (Hall and Kelson).

HABITAT

Life zones. Lower Sonoran to the lower parts of the Canadian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Lasiurus borealis - Red Bat

NOMENCLATURE AND SYNONYMY

Lasiurus borealis (Müller 1776). Type from New York.

Synonyms:

Vespertilio borealis Müller 1776
Lasiurus borealis Miller 1897
Vespertilio noveboracensis Erxleben 1777
Vespertilio lasiurus Schreber 1781
Vespertilio rubellus Palisot de Beauvois 1796
Vespertilio rubra Ord 1815
Vespertilio tessellatus Rafinesque 1818
Vespertilio monachus Rafinesque 1818
Vespertilio rufus Warden 1829
Lasiurus funebris Fitzinger 1870
Myotis quebecensis Yourans 1930
Atalapha frantzii Peters 1871
Atalapha tellotis H. Allen 1891

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains four subspecies as defined by Hall and Kelson (1959):

- L. b. borealis* (Müller 1776). See above.
- L. b. frantzii* (Peters 1871). Type from Costa Rica.
- L. b. ornatus* Hall 1951. Type from Penuela, Veracruz.
- L. b. tellotis* (H. Allen 1891). Type from an unknown locality, probably some part of California.

DIAGNOSIS

Tail nearly all enclosed within the interfemoral membranes; tail vertebrae longer than forearm; with fewer than six cheek teeth on each side of the upper jaw; without a combination of four upper cheek teeth and two upper incisors at each side; ears when laid forward scarcely reaching to the end of the nose; ears broad and rounded, naked inside, densely furred outside on basal two-thirds; tragus triangular; forearm more than 35 mm; without a nose-leaf; without 3 white spots dorsally; brick or rusty red frequently with frosted yellowish fur; interfemoral membrane completely furred dorsally (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 91-112 mm; tail (1) 42 mm; hind foot (1) 6 mm; ear (1) 11 mm; forearm 37-44 mm (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 12.0-13.1 mm; zygomatic breadth (1) 8.7 mm; breadth of braincase (1) 7.3 mm; interorbital constriction (1) 4.3 mm (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Upper parts brick red to rusty red washed with white; underparts usually slightly paler; anterior part of shoulder with buffy white patch; hair black at base, middle yellowish band, and a tip of reddish color (Hall, 1946; Ingles, 1965).

Dentition. The dental formula is 1-1-2-3/3-1-2-3 (Ingles, 1965).

Sexual Dimorphism. Males usually more brightly colored than females (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The range of the red bat extends from Panama to southern Canada and from the Atlantic coast to the Pacific coast. The range is interrupted by a band running through the middle of central Mexico northward to Canada along the Rocky Mountains (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran through the Transition Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Lastiurus cinereus - Hoary Bat

NOMENCLATURE AND SYNONYMY

Lastiurus cinereus (Palisot de Beauvois 1796). Type from Philadelphia, Pennsylvania.

Synonyms:

Vespertilio cinereus Palisot de Beauvois 1796

Lastiurus cinereus H. Allen 1864

Vespertilio pruinosus Say 1823

Atalapha mexicana Saussure 1861

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains no subspecies.

DIAGNOSIS

Skull robust; rostrum broad, short; zygomatic arches widespread; with fewer than six cheek teeth on each side of the upper jaw; without a combination of four upper cheek teeth and two upper incisors at each side; ears when laid forward scarcely reaching to the end of the nose; tail nearly all enclosed within the interfemoral membrane; without a nose-leaf; hoary yellowish gray or brown with white tipped hairs; without three white spots dorsally; interfemoral membrane furred dorsally; forearm usually more than 47 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 126-146 mm; tail 53-63 mm; hind foot 9-14 mm; ear (2) 17-18 mm; tragus (2) 7-8 mm; forearm 46-55 mm; weight (3) 23.2-26.9 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 16.1-18.5 mm; zygomatic breadth (1) 12.4 mm; breadth of braincase (1) 9.9 mm; interorbital constriction (1) 5.2 mm (Hall, 1946; Ingles, 1965).

Pelage. Upper parts varying considerably in color but not geographically, yellowish brown strongly frosted with silver; underparts whitish on belly, pale brown on chest, yellowish on throat; ears rounded, partially furred, with black naked rims; white patches of fur at the wrist and elbow on the dorsal surface (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-1-2-3/3-1-2-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the hoary bat extends from Mexico north to northern Keewatin, Canada, and from the Atlantic coast between Nova Scotia and central Florida to the Pacific coast between southern British Columbia and northern Baja California (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through the Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Dasypterus ega - Southern Yellow Bat

NOMENCLATURE AND SYNONYMY

Dasypterus ega Thomas 1897. Type from Sierra Laguna, Baja California.

Synonyms: None

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains two subspecies as defined by Hall and Kelson (1959):

D. e. panamensis Thomas 1901. Type from Bogava (= Bugaba), Chiriqui, Panama.

D. e. xanthinus Thomas 1897. See above.

Handley (1960) revised the nomenclature for this species to the following:

Lasiurus ega xanthinus (Thomas) 1897.

DIAGNOSIS

Skull short, deep; depth of braincase including bullae approximately half greatest length; length of upper tooth-row less than 6.2 mm; upper pre-molars 1-1; upper incisors 1-1; metacarpal of 3rd, 4th, and 5th fingers successively much shortened; without nose-leaf; size small; total length less than 119 mm (Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length (2) 109-115 mm; forearm (2) 44.0-45.8 mm (Hall and Kelson, 1959).

Skull characteristics. Greatest length (1) 14.5 mm; zygomatic breadth (1) 10.4; breadth of braincase (1) 8.1 mm; length of upper tooth-row (1) 5.5 mm (Hall and Kelson, 1959).

Pelage. Highly variable, ranging from dark brownish washed with black to buffy white (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The range of the western yellow bat extends from Panama through most of Mexico and Baja California to extreme south central California (Hall and Kelson, 1959).

HABITAT

Life zones. Tropical into Upper Sonoran Life Zone (Hall and Kelson, 1959).

LIFE HISTORY SUMMARY

Corynorhinus townsendii - Townsend's Big-eared Bat

NOMENCLATURE AND SYNONYMY

Corynorhinus townsendii (Cooper 1837). Paratypes from Columbia River, Oregon.

Synonyms:

Plecotus townsendii Cooper 1837

Corynorhinus townsendii Handley 1955

Corynorhinus macrotis Miller 1897

Corynorhinus megalotis G. M. Allen 1916

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Vespertilioninae. This species contains seven subspecies as defined by Hall and Kelson (1959):

C. t. australis Handley 1955. Type from 2 mi. W Jacala, Hidalgo.

C. t. ingens Handley 1955. Type from Hewlitt Cave, 12 mi. W Fayetteville, Washington Co., Arkansas.

C. t. intermedius H. W. Grinnell 1914. Type from Auburn, 1,300 ft., Placer Co., California.

C. t. mexicanus G. M. Allen 1916. Type from near Pacheco, Chihuahua.

C. t. pallescens Miller 1897. Type from Kearn Canyon, Navajo Co., Arizona.

C. t. townsendii (Cooper 1837). See above.

C. t. virginianus Handley 1955. Type from Schoolhouse Cave, 4 2/5 mi. NE Riverton, 2,205 ft., Pendleton Co., West Virginia.

DIAGNOSIS

Skull slender, highly arched; lacrimal region smoothly rounded; auditory bullae much enlarged; rostrum narrow, evenly convex above; cheek teeth fewer than 6-6/6-6; upper premolars 2-2; ear much longer than head; ears joined basally across forehead; lappets absent from interauricular connecting band; metacarpal of 3rd, 4th, and 5th fingers successively shortened; muzzle bearing conspicuous glandular mass on either side between eye and nostril; underparts washed with tan to pale buff; hairs of dorsum grading from brown at tip to slate at base (Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 89-109 mm; forearm 39-44 mm (Hall and Kelson, 1959).

Skull characteristics. Greatest length 15.6-17.4 mm; zygomatic breadth 8-9 mm; breadth of braincase 7.6-8.6 mm; length of upper tooth row 6.0-6.5 mm (Hall and Kelson, 1959).

Pelage. Upper parts pinkish buff to blackish; underparts buffy to brownish (Hall and Kelson, 1959).

Dentition. The dental formula is 2-1-2-3/3-1-3-3 (Hall and Kelson, 1959).

Corynorhinus townsendii - Townsend's Big-eared Bat

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GEOGRAPHIC RANGE

The range of the Townsend's big-eared bat reaches from central Mexico north to central British Columbia and from the Rocky Mountains to the Pacific coast. A narrow band extending from western Texas and Oklahoma northeastwardly toward southern Illinois to western Virginia is also included in the range. Its range includes all of California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran into Canadian Life Zone (Hall and Kelson, 1959).

LIFE HISTORY SUMMARY
Antrozous pallidus - Pallid Bat

NOMENCLATURE AND SYNONYMY

Antrozous pallidus (Le Conte 1856). Type from El Paso, El Paso Co., Texas.

Synonyms:

Vespertilio pallidus Le Conte 1856

Antrozous pallidus H. Allen 1864

Antrozous minor Miller 1902

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Vespertilionidae; Subfamily Nyctophilinae. This species contains four subspecies as defined by Hall and Kelson (1959):

A. p. cantwelli V. Bailey 1936. Type from Rogersburg, Asotin Co., Washington.

A. p. minor Miller 1902. Type from Comondu, Baja California.

A. p. pacificus Merriam 1897. Type from Old Fort Tejon, 3,200 ft., Tehachapi Mts., Kern Co., California.

A. p. pallidus (Le Conte 1856). See above.

DIAGNOSIS

Skull with high, smooth braincase; rostrum relatively large, more than half as long as braincase; basisphenoidal pits absent; auditory bullae normally shaped and large; 28 teeth; with fewer than six cheek teeth on each side of the upper jaw; without a combination of four cheek teeth and two upper incisors at each side; ears wide apart and, when laid forward, reaching far beyond the nose; forearm 45-52 mm; tragus with wavy edge; each nostril under a horseshoe shaped ridge at the end of a spiral groove; no glandular lumps on rostrum; without a nose-leaf; tail nearly all enclosed within the interfemoral membrane; dull light yellow or light brown dorsally; membranes and ears slightly darker than dorsal fur; (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 92-135 mm; tail 40-51 mm; hind foot 10-14 mm; ear 23-37 mm; tragus 14-17 mm; forearm 48-60 mm; weight 12.7-19.4 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull measurements. Greatest length 19-24 mm; zygomatic breadth (3) 12.2-13.0 mm; interorbital constriction (3) 4.0-4.2 mm; breadth of braincase (3) 9.5-9.6 mm (Hall, 1946; Ingles, 1965).

Pelage. Upper parts creamy, yellowish, or light brown; underparts paler, sometimes almost whitish; ears and membranes are brownish colored and naked (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-1-1-3/2-1-2-3 (Ingles, 1965).

Antrozous pallidus - Pallid Bat

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MORPHOLOGICAL CHARACTERS (Cont'd)

Locomotion. The flight is relatively slow, 10-11 wing strokes per second (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The range of the pallid bat extends from Baja California and central Mexico northwestwardly to south-central British Columbia, and from the California Pacific coast southeastwardly to central Texas (Hall and Kelson, 1959).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Hall, 1946).

LIFE HISTORY SUMMARY

Tadarida brasiliensis - Brazilian Free-tailed Bat

NOMENCLATURE AND SYNONYMY

Tadarida brasiliensis (I. Geoff. St.-Hilaire 1824). Type from Brazil, by subsequent restriction, Curitiba, Parana.

Synonyms:

Nyctinomus brasiliensis I. Geoffroy St.-Hilaire 1824
Tadarida brasiliensis Thomas 1920
Dysopes nasutus Temminck 1827
Dysopes naso Wagner 1840
Nyctinomus antillarum Miller 1902
Nyctinomus bahamensis Rehn 1902
Tadarida constanzae Shamel 1931
Nycticea cynocephala Le Conte 1831
Molossus fuliginosus Cooper 1837
Tadarida intermedia Shamel 1931
Molossus mexicanus Saussure 1860
Nyctinomus mohavensis Merriam 1889
Tadarida texana Stager 1942
Nyctinomus murinus Gray 1827
Nyctinomus musculus Gundlach 1861

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Molossidae. This species contains nine subspecies as defined by Hall and Kelson (1959):

- T. b. antillarum* (Miller 1902). Type from Roseau, Dominica, West Indies.
T. b. bahamensis (Rehn 1902). Type from Governors Harbor, Eleuthera, Bahama Islands.
T. b. brasiliensis (I. Geoffroy St.-Hilaire 1824). See above.
T. b. constanzae Shamel 1931. Type from Constanza, Dominican Republic.
T. b. cynocephala (Le Conte 1831). Type from Georgia, Liberty Co.
T. b. intermedia Shamel 1931. Type from Valley of Comitán, Chiapas.
T. b. mexicana (Saussure 1860). Type from Cofre de Perote, 13,000 ft., Mexico.
T. b. murina (Gray 1827). Type from Jamaica.
T. b. muscula (Gundlach 1861). Paratypes from Cuba.

DIAGNOSIS

Breadth of anterior part of rostrum markedly greater than interorbital breadth; 32 teeth, upper incisors converging at the tips; ears not connected and not reaching to end of nose when laid forward; ear with little bumps on front edge; tail projecting behind the interfemoral membrane for at least one-third the tail length; total length less than 140 mm; forearm 44 mm or less; second phalanx of 4th digit more than 5.0 mm; without a distinct bump between the nostril and eye; without a nose-leaf (Hall and Kelson, 1959; Ingles, 1965).

Tadarida brasiliensis - Brazilian Free-tailed Bat

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MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 90-104 mm; forearm 36-46 mm (Ingles, 1965).

Skull characteristics. Greatest length 14.0-18.0 mm; zygomatic breadth 8.4-10.4 mm; length of upper tooth-row, 5.0-6.6 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts dark brown, bases of hair whitish; underparts slightly paler (Hall and Kelson, 1959).

Dentition. The dental formula is 1-1-2-3/3-1-2-3 (Ingles, 1965).

Sexual Dimorphism. Males have longer canine teeth than females (Ingles, 1965).

GEOGRAPHIC RANGE

The range for the Brazilian free-tailed bat extends from the southern half of the United States to South America. The Bahama, Greater Antilles, and Lesser Antilles islands are also included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. Upper and Lower Sonoran life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Tadarida femorosacca - Pocketed Free-tailed Bat

NOMENCLATURE AND SYNONYMY

Tadarida femorosacca (Merriam 1889). Type from Agua Caliente (= Palm Springs), Riverside Co., California.

Synonyms:

Nyctinomus femorosaccus Merriam 1889

Tadarida femorosacca Miller 1924

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Molossidae. This species contains no subspecies.

DIAGNOSIS

Bony palate with conspicuous median emargination extending back of roots of incisors; breadth of anterior part of rostrum barely greater than interorbital breadth; greatest length of skull 18.4 or more; M1 viewed from crown surface nearly square; total length less than 140 mm; forearm more than 44 mm but less than 55 mm; ear 19-24 mm; second phalanx of 4th digit less than 5.0 mm; without a nose-leaf; tail projecting behind the interfemoral membrane for at least one-third the tail length; ears connected across forehead and having small bumps on anterior surfaces; ears extending appreciably beyond muzzle when laid forward; pockets in the membrane by the femurs (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 98-118 mm; ear (notch) 21-24 mm; forearm 44.8-51.0 mm (Ingles, 1965).

Skull characteristics. Greatest length 18.2-19.4 mm; zygomatic breadth 9.6-10.4 mm; length of upper tooth-row 7.0-7.5 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts Vandyke brown, sometimes distinctly reddish; underparts slightly paler, sometimes with buffy wash (Hall and Kelson, 1959).

Dentition. The dental formula is 1-1-2-3/2-1-2-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the pocket free-tailed bat extends from central Mexico north-westwardly across southern Arizona and the Colorado desert of southern California. Baja California is also included in its range (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Hall and Kelson, 1959). In California this species is found in the Lower Sonoran Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Tadarida molossa - Big Free-tailed Bat

NOMENCLATURE AND SYNONYMY

Tadarida molossa (Pallas 1766). Type from "America," probably Surinam.

Synonyms:

Vespertilio molossus Pallas 1766
Tadarida molossa Hershkovitz 1949
Molossus caecus Rengger 1830
Nyctinomys macrotis Gray 1839
Dysopes auritus Wagner 1843
Nyctinomys megalotis Dobson 1876
Nyctinomus depressus Ward 1891
Promops affinis J. A. Allen 1900
Nyctinomus aequatorialis J. A. Allen 1914

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Molossidae. This species contains no subspecies.

DIAGNOSIS

Skull large, robust and with relatively long rostrum; without a nose-leaf; tail projecting behind the interfemoral membrane for at least one-third the tail length; ears connected across forehead and extending beyond the muzzle when laid forward; ears with wartlike bodies on the anterior edges (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 125-132 mm; ear (notch) 26-31 mm; forearm 58-64 mm (Ingles, 1965).

Skull characteristics. Greatest length 22.2-24.0 mm; zygomatic breadth 10-2-13.0 mm; length of upper tooth row 8.2-9.5 mm (Hall and Kelson, 1959).

Pelage. Upper parts dark brown; underparts slightly paler (Hall and Kelson, 1959).

Dentition. The dental formula is 1-1-2-3/2-1-2-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the big free-tailed bat extends from southern Nevada and southwestern Kansas southward through Baja California and Mexico to South America. This bat is also found in the Greater Antilles Islands and in central Iowa (Hall and Kelson, 1959).

HABITAT

Life zones. In California *Tadarida molossa* is found in the Upper Sonoran Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Eumops perotis - Greater Mastiff Bat

NOMENCLATURE AND SYNONYMY

Eumops perotis (Schinz 1821). Type locality, Villa Sao Salvador, Campos dos Goaytacassas (= Goitzcazes), Rio Parahyba (= Paraiba), Brazil.

Synonyms:

Molossus perotis Schinz 1821

Eumops perotis Miller 1906

Dysopes gigas Peters 1864

Molossus californicus Merriam 1890

CONTEXT AND CONTENT

Order Chiroptera; Suborder Microchiroptera; Family Molossidae. This species contains two subspecies as defined by Hall and Kelson (1959):

E. p. californicus (Merriam 1890). Type from Alhambra, Los Angeles Co., California.

E. p. perotis (Schinz 1821). See above.

DIAGNOSIS

Skull slender but robust; rostrum well developed; dorsal profile of skull almost straight; premaxillaries wholly lacking palatal branches; first upper premolars small but usually well formed, and usually crowded from normal position in dental arcade; no space between the upper incisors (incisors contiguous); without a nose-leaf; tail projecting behind the interfemoral membrane for at least one-third the tail length; ears large, united above nostrils and projecting forward, and extend slightly beyond nostril when laid forward; total length more than 140 mm; forearm 67-78 mm (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 157-184 mm; forearm 73-80 mm (Ingles, 1965).

Skull characteristics. Greatest length 30-33 mm; zygomatic breadth 17.2-19.8 mm; length of upper tooth-row 11.9-13.6 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts sooty brown; slightly paler below (Hall and Kelson, 1959).

Dentition. The dental formula is 1-1-2-3/2-1-2-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the greater mastiff bat extends from western Texas and northern Mexico northwestwardly across southwestern New Mexico and southern Arizona and from southern California's Alameda, San Benito, and Mariposa counties south to northern Baja California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower Sonoran Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Sylvilagus audubonii - Desert Cottontail

NOMENCLATURE AND SYNONYMY

Sylvilagus audubonii (Baird 1858). Type from San Francisco, San Francisco Co., California.

Synonyms:

Lepus audubonii Baird 1858
Sylvilagus auduboni Nelson 1907
Lepus sylvaticus J. A. Allen 1877
Lepus arizonae Mearns 1896
Lepus laticeinotus Elliot 1904
Lepus rufipes Elliot 1904
Lepus baileyi Merriam 1897
Lepus parvulus J. A. Allen 1904
Lepus floridanus Miller 1899

CONTEXT AND CONTENT

Order Lagomorpha; Family Leporidae. This species contains 12 subspecies as defined by Hall and Kelson (1959):

- S. a. arizonae* (J. A. Allen 1877). Type from Beals Spring, Yavapai Co., Arizona.
- S. a. audubonii* (Baird 1858). See above.
- S. a. baileyi* (Merriam 1897). Type from Spring Creek, E side Bighorn Basin, Bighorn Co., Wyoming.
- S. a. cedrophilus* Nelson 1907. Type from Cactus Flat, 20 mi. N Cliff, Grant Co., New Mexico.
- S. a. confinis* (J. A. Allen 1898). Type from Playa Maria, Baja California.
- S. a. goldmani* (Nelson 1904). Type from Culiacan, Sinaloa.
- S. a. minor* (Mearns 1896). Type from El Paso, El Paso Co., Texas.
- S. a. neomexicanus* Nelson 1907. Type from Fort Sumner, De Baca Co., New Mexico.
- S. a. parvulus* (J. A. Allen 1904). Type from Apam, Hidalgo.
- S. a. sanotidiegi* (Miller 1899). Type from Mexican Boundary Mon. No. 258, shore of Pacific Ocean, California.
- S. a. vallicola* Nelson 1907. Type from San Emigdio Ranch, Kern Co., California.
- S. a. warreni* Nelson 1907. Type from Coventry, Montrose Co., Colorado.

DIAGNOSIS

Supraorbital process not extending to the parietal bones, with prominently upturned edge, and antorbital blunt or notched; inflated tympanic bullae; palatal bridge usually with median spine on posterior border; interparietals not fused with parietals; ears at least twice as long as wide; ear from notch more than 60 mm; ears with dark tips; hind legs much longer than forelegs; hind foot less than 105 mm but more than 75 mm long; hairs on underside mostly white with some lead color at the bases; hairs on distal

Sylvilagus audubonii - Desert Cottontail

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DIAGNOSIS (Cont'd)

part of inside of ear sparse and only about 2 mm in length; rump gray and black, lightly washed brown (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 340-434 mm; tail 33-75 mm; hind foot 75-100 mm; ear from notch (dry) 58-80 mm; weight 637-1,191 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basilar length 49.2-55.7 mm; breadth of braincase 21.2-23.6 mm; zygomatic breadth 31.8-34.2 mm; postorbital constriction 10.6-12.9 mm (Hall, 1946; Ingles, 1965).

Pelage. Mixed brown and blackish hairs dorsally and whitish beneath; tail hairs white to roots; dark hairs on tips of ears; vibrissae always black but sometimes white tipped (Ingles, 1965).

Dentition. The dental formula is 2-0-3-3/1-0-2-3 (Hall and Kelson, 1959).

Sexual dimorphism. Females are larger than the males (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The desert cottontail's range extends from central Mexico northward through Wyoming to eastern Montana and central North Dakota. The range also includes southern Nevada, the southern two-thirds of California, and all of Baja California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Hall, 1946).

LIFE HISTORY SUMMARY

Lepus californicus - Black-tailed Jack Rabbit

NOMENCLATURE AND SYNONYMY

Lepus californicus Gray 1837. Type from "St. Antoine", California.

Synonyms:

Lepus californica Gray 1837
Lepus californicus Thomas 1898
Lepus merriami Mearns 1896
Lepus asellus Miller 1899
Lepus bennettii Gray 1843
Lepus texianus Waterhouse 1848
Lepus festinus Nelson 1904
Lepus martirensis Stowell 1895
Lepus melanotis Mearns 1890
Lepus richardsonii Bachman 1839
Lepus tularensis Merriam 1904

CONTEXT AND CONTENT

Order Lagomorpha; Family Leporidae. This species contains 17 subspecies as defined by Hall and Kelson (1959):

- L. c. altamirae* Nelson 1904. Type from Alta Mira, Tamaulipas.
- L. c. asellus* Miller 1899. Type from San Luis Potosi, San Luis Potosi.
- L. c. bennettii* Gray 1843. Type from San Diego, San Diego Co., California.
- L. c. californicus* Gray 1837. See above.
- L. c. curti* Hall 1951. Type from island 88 mi. S and 10 mi. W Matamoros, Tamaulipas.
- L. c. deserticola* Mearns 1898. Type from western edge Colorado Desert, at base of Coast Range Mts., Imperial Co., California.
- L. c. eremicus* J. A. Allen 1897. Type from Fairbank, Cochise Co., Arizona.
- L. c. festinus* Nelson 1907. Type from Irolo, Hidalgo.
- L. c. magdalenae* Nelson 1907. Type from Magdalena Island, Baja California.
- L. c. martirensis* Stowell 1895. Type from the San Pedro Martir Mountains of Baja California.
- L. c. melanotis* Mearns 1890. Type from Independence, Kansas.
- L. c. merriami* Mearns 1896. Type from Fort Clark, Kinney Co., Texas.
- L. c. richardsonii* Bachman 1839. Type from California.
- L. c. sheldoni* Burt 1933. Type from Carmen Island, Baja California.
- L. c. texianus* Waterhouse 1848. Type locality unknown.
- L. c. wallaxalla* Merriam 1904. Type from Touchet, Plains of the Columbia, Walla Walla Co., Washington.
- L. c. xanti* Thomas 1898. Type from Santa Anita, Baja California.

DIAGNOSIS

Skull with supraorbital processes; outer edge of supraorbital process usually curves inward and postorbital process width is usually much less than half its length, with only two to four crenulations on narrow end, with tips nearly always touching the skull; interparietals fused with parietals; six

DIAGNOSIS (Cont'd)

cheek teeth on each side above; ears at least twice as long as wide; ear more than 30 mm (from notch); hind feet usually less than 145 mm but more than 105 mm; dorsal black stripe on the brownish tail extends onto rump; dorsally grayish at all seasons; hind legs much longer than forelegs (Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Total length 465-630 mm; tail 50-135 mm; hind foot 112-145 mm; ear from notch (dry) 99-145 mm; weight 1.3-2.7 kg (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basilar length 66.0-77.4 mm; breadth of braincase 25.5-27.1 mm; zygomatic breadth 38.3-41.9 mm; postorbital constriction 11.2-12.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Ears with blackish tips; grayish to blackish dorsally, nearly white beneath; upper side of tail black, running up onto rump, buffy gray below (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-0-3-3/1-0-2-3 (Ingles, 1965).

Sexual dimorphism. Males average 1-2 percent smaller than females in linear measurements (Hall, 1946).

GEOGRAPHIC RANGE

The range of the black-tailed jack rabbit extends from central Mexico and Baja California northward to southern South Dakota and from central Missouri and Arkansas west to the Pacific coast of California and Oregon. The range includes most of California except the higher mountain communities (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower and Upper Sonoran life zones into the Transition Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY
Eutamias minimus - Least Chipmunk

NOMENCLATURE AND SYNONYMY

Eutamias minimus (Bachman 1839). Type from Green River, near mouth Big Sandy Creek, Sweetwater Co., Wyoming.

Synonyms:

Tamias minimus Bachman 1839
Eutamias minimus Miller and Rehn 1901
Eutamias atristriatus V. Bailey 1913
Tamias asiaticus J. A. Allen 1877
Eutamias pallidus Cary 1906
Eutamias caniceps Osgood 1900
Eutamias lectus J. A. Allen 1905
Eutamias consobrinus V. Bailey 1918
Tamias quadrivittatus J. A. Allen 1890
Eutamias amoenus Merriam 1905
Eutamias oreocetes Merriam 1897

CONTEXT AND CONTENT

Order Rodentia; Sciuromorpha; Family Sciuridae. This species contains 19 subspecies as defined by Hall and Kelson (1959):

- E. m. arizonensis* A. H. Howell 1922. Type from Prieto Plateau, south end Blue Range, Greenlee Co., Arizona.
- E. m. atristriatus* V. Bailey 1913. Type from Penasco Creek, 7,400 ft., 12 mi. E Cloudcroft, Sacramento Mts., New Mexico.
- E. m. borealis* (J. A. Allen 1877). Type from Fort Liard, Mackenzie.
- E. m. cacodemus* Cary 1906. Type from head of Corral Draw, Sheep Mtn., Big Badlands, South Dakota.
- E. m. caniceps* Osgood 1900. Type from Lake Laberge, Yukon.
- E. m. caryi* Merriam 1908. Type from Medano Ranch, San Luis Valley, Alamosa Co., Colorado.
- E. m. confinis* A. H. Howell 1925. Type from head of Trapper Creek, 8,500 ft., W slope Bighorn Mts., Wyoming.
- E. m. consobrinus* (J. A. Allen 1890). Type from Parleys Canyon, Wasatch Mts., near former site of Barclay, Utah.
- E. m. griseus* A. H. Howell 1925. Type from Farmer, Douglas Co., Washington.
- E. m. hudsonius* Anderson and Rand 1944. Type from Bird, Hudson Bay Railway, Mile 349, Manitoba.
- E. m. minimus* (Bachman 1839). See above.
- E. m. neglectus* (J. A. Allen 1890). Type from Montreal River, Ontario.
- E. m. operarius* Merriam 1905. Type from Gold Hill, 7,400 ft., Colorado.
- E. m. oreocetes* Merriam 1897. Type from Summit Mtn., at timberline, N of Summit Station, on Great Northern Railroad, Montana.
- E. m. pallidus* (J. A. Allen 1874). Type locality, Camp Thorne, near Glendive, Montana.
- E. m. pictus* (J. A. Allen 1890). Type from Kelton, Utah.

CONTEXT AND CONTENT (Cont'd)

- E. m. scrutator* Hall and Hatfield 1934. Type from near Blanco Mtn. 10,500 ft., White Mts., Mono Co., California.
E. m. selkirki Cowan 1946. Type from Paradise Mine, near Toby Creek, 19 mi. W Invermere, British Columbia.
E. m. silvaticus White 1952. Type from 3 mi. NW Sundance, 5,900 ft., Crook Co., Wyoming.

DIAGNOSIS

With infraorbital foramen piercing the zygomatic plate of the maxillary bone; length of skull 31.0-34.2 mm; skull with high, narrow braincase, strongly arched in lateral view; appressed zygomatic arches and narrow interorbital region; membrane between fore and hind limbs not present; with dark and light stripes on the side of the head (usually extending from nose to ear); stripes all well defined, the inner ones continuing to the base of the tail; tail hairs edged with lemon buffy; undertail grayish yellow to pale orange; front of ears fulvous, posterior half gray; hind foot normally less than 31 mm; tail 80 percent or more of head and body length; baculum 28 percent or less of length of shaft; diurnal (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 167-225 mm; tail 70-114 mm; hind foot 26-35 mm; ear 9-12 mm; weight 30-54 g (Hall, 1946; Hall and Kelson 1959; Ingles, 1965).

Skull characteristics. Greatest length 28.7-34.2 mm; zygomatic breadth 16.0-17.6 mm; cranial breadth 14.1-15.1 mm; interorbital constriction 6.3-7.1 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Short harsh, grayish fur with contrasting stripes; the dorsal stripe is black; the outer light stripe is white; all stripes extend to the base of the tail; ear nearly unicolored on back side blackish brown; tail lemon yellow or grayish yellow on underside; dark facial stripes are almost black at their centers; feet grayish white, washed with pale pinkish buff; underparts whitish (Hall, 1946; Ingles, 1965).

Baculum. Length 2.4-4.3 mm; distal half slightly laterally compressed; tip of baculum 28 percent or less of length of shaft (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the least chipmunk extends from southern Yukon across Canada to eastern Quebec and reaches southward into Wisconsin in the north-central part of the United States and wanders in amoeboid fashion through the western states from western North Dakota to southern New Mexico westward to northeastern California and central Washington (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Eutamias merriami - Merriam's Chipmunk

NOMENCLATURE AND SYNONYMY

Eutamias merriami (J. A. Allen 1889). Type from San Bernardino Mts., 4,500 ft., due north of San Bernardino, California.

Synonyms:

Tamias asiaticus J. A. Allen 1889

Eutamias merriami Merriam 1897

Tamias obscurus J. A. Allen 1890

Tamias pricei J. A. Allen 1895

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains five subspecies as defined by Hall and Kelson (1959):

E. m. kernensis Grinnell and Storer 1916. Type from Fay Creek, 4,100 ft., 6 mi. N Weldon, Kern Co., California.

E. m. meridionalis Nelson and Goldman 1909. Type from Agua de San Esteban, approximately 1,200 ft., about 25 mi. NW San Ignacio, Baja California.

E. m. merriami (J. A. Allen 1889). See above.

E. m. obscurus (J. A. Allen 1890). Type from Sierra San Pedro Martir, near Vallecitos, Baja California.

E. m. pricei (J. A. Allen 1895). Type from Portola, San Mateo Co., California.

DIAGNOSIS

With infraorbital foramen piercing the zygomatic plate of the maxillary bone; ears sparsely furred on convex surfaces in summer pelage; feet and ears long and slender; tail bushy and usually over 80 percent of head and body length; with dark and light stripes on the side of the head (usually extending from nose to ear); dark head stripes are brownish; postauricular white spot indistinct or absent and usually less than the area of the ear; body stripes lacking sharp contrast; diurnal (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 208-280 mm; tail 89-140 mm; hind foot 32.5-39.0 mm; ear 15.0-21.0 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 35.5-40.1 mm (Hall and Kelson, 1959).

Pelage. All light stripes gray and dark stripes brown, stripes lack clear demarcation; back side of ear is unicolored, grayish, or buffy; all brownish stripes on the head, with dull black spots only before and behind the eyes; postauricular spot is indistinct or absent; tail edgings white or light buff (Ingles, 1965).

Baculum. Shaft 4.9 mm in length, distal part slightly compressed laterally (Ingles, 1965).

Eutamias merriami - Merriam's Chipmunk

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MORPHOLOGICAL CHARACTERS (Cont'd)

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The Merriam chipmunk occurs in localized areas in northern and central Baja California and is found in the southern half of California (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran (Ingles, 1965).

LIFE HISTORY SUMMARY

Eutamias panamintinus - Panamint Chipmunk

NOMENCLATURE AND SYNONYMY

Eutamias panamintinus (Merriam 1893). Type from Johnson Canyon, near lower edge of pinon belt at approximately 5,000 ft., in vicinity of Hungry Bill's Ranch, Panamint Mts., California.

Synonyms:

Tamias panamintinus Merriam 1893

Eutamias panamintinus Merriam 1897

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuroomorpha; Family Scuridae. This species contains two subspecies as defined by Hall and Kelson (1959).

E. p. aorus Johnson 1943. Type from 1½ mi. SE Horse Spring, 5,000 ft., Kingston Range, northeastern San Bernardino Co., California.

E. p. panamintinus (Merriam 1893). See above.

DIAGNOSIS

Skull dorsally flattened and normally less than 37 mm but more than 31.5 mm; with infraorbital foramen piercing the zygomatic plate of the maxillary bone; ears rounded; hind foot normally less than 35 mm but more than 31 mm; bright reddish color dorsally with back of head and rump conspicuously grayish; belly not entirely white; outer dark stripes nearly as long as the other stripes, not tending to blend with the sides; with dark and light stripes on the side of the head (usually extending from nose to ear); lower dark stripe on the head nearly obsolete; diurnal (Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 190-220 mm; tail 70-102 mm; hind foot 28.0-32.5 mm; ear 18 mm; weight 45.0-62.3 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 33.0-35.3 mm; zygomatic breadth 18.2-19.7 mm; cranial breadth 15.3-16.4 mm; interorbital breadth 6.9-7.6 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Pelage. Summer pelage: top of head gray mixed with light pinkish cinnamon and bordered on sides of crown with fuscous; ocular streak blackish near eye, otherwise brown, as is submalar stripe, although it is shaded with fuscous; ears gray, shaded on posterior margin with buffy white; postauricular patches creamy white; median dorsal stripe black for short distance near middle of back, otherwise brown, like other dark dorsal stripes; median pair of light dorsal stripes grayish-white, lateral pair white; sides brown shading to cinnamon below; rump and thighs gray; feet pinkish buff, tinged with gray; tail above fuscous-black overlain with pinkish buff; tail beneath brown or clay color bordered with fuscous-black and tipped with pinkish buff; underparts buffy white. Winter pelage: much grayer, dark dorsal stripes less blackish (more brownish) and stripes less contrasting in color (Hall, 1946).

Eutamias panamintinus - Panamint Chipmunk

- 2 -

MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. Length is 2.2 mm; distal two-thirds compressed laterally (Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the panamint chipmunk in California is in Inyo and San Bernardino counties near the California-Nevada border, and extends into Nevada remaining close to the state line (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper Sonoran (Hall, 1946).

LIFE HISTORY SUMMARY
Eutamias umbrinus - Uinta Chipmunk

NOMENCLATURE AND SYNONYMY

Eutamias umbrinus (J. A. Allen 1890). Type from Blacks Fork, approximately 8,000 ft., Uinta Mts., Utah.

Synonyms:

Tamias umbrinus J. A. Allen 1890
Eutamias umbrinus Miller and Rehn 1901
Eutamias adstus J. A. Allen 1905
Eutamias speciosus Merriam 1897
Eutamias quadrivittatus Burt 1931

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains seven subspecies as defined by Hall and Kelson (1959):

- E. u. adstus* J. A. Allen 1905. Type from Brigg's (=Britt's) Meadow, 10,000 ft., Beaver Mts., Utah.
E. u. fremonti White 1953. Type from 31 mi. N Pinedale, 8,025 ft., Sublette Co., Wyoming.
E. u. inyoensis Merriam 1897. Type from Black Canyon, 8,200 ft., White Mts., Inyo Co., California.
E. u. montanus White 1953. Type from ½ mi. E and 3 mi. S Ward, 9,400 ft., Boulder Co., Colorado.
E. u. nevadensis Burt 1931. Type from Hidden Forest, 8,500 ft., Sheep Mts., Clark Co., Nevada.
E. u. sedulus White 1953. Type from Mt. Ellen, Henry Mts., Garfield Co., Utah.
E. u. umbrinus (J. A. Allen 1890). See above.

DIAGNOSIS

Diurnal; with dark and light stripes on the side of the head, usually extending from nose to ear; with infraorbital foramen piercing the zygomatic plate of the maxillary bone; belly not entirely white; outer dark stripes nearly as long as the other stripes, not tending to blend with the sides; grayish rump; lower dark stripe on the head complete from ear to vibrissae; inner light stripes usually not broader or more conspicuous than outer light stripes; lateral dark stripes are dark brown; grayish crown; tail 70-80 percent of head and body length; narrow cranial breadth; baculum half of shaft laterally compressed, and keel one-fourth of length of tip (Hall and Kelson, 1959; Ingles, 1965).

Morphological Characters

Standard measurements. Length 196-243 mm; tail 73-115 mm; hind foot 30-35 mm; ear 16-19 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 33.5-36.8 mm (Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Back of neck and crown grayish; outer light stripes pure white and usually not broader than the inner light stripes; except for dull black spots before and behind each eye, the dark facial stripes are brown but are nearly obsolete anteriorly; dorsal stripes well demarcated, outer dark stripes nearly or quite obsolete; dark stripes are more black than reddish but never grayish; tail edging buffy (Ingles, 1965).

Baculum. Length 2.5-3.0 mm; distal one-half to two-thirds of shaft strongly compressed laterally and curved downward to base of tip; width of base more than one-third the length of the shaft (Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the uinta chipmunk is localized in northwestern Wyoming, northwestern Colorado, central Utah, northwestern Arizona, central Nevada, and central-eastern California. Specimens have also been found in southeastern Idaho and southern Montana (Hall and Kelson, 1959).

HABITAT

Life zones. Canadian and Hudsonian life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Spermophilus variegatus - Rock Squirrel

NOMENCLATURE AND SYNONYMY

Spermophilus variegatus (Erxleben 1777). Type locality, Valley of Mexico, near City of Mexico.

Synonyms:

Sciurus variegatus Erxleben 1777
Spermophilus variegatus Nelson 1893
Sciurus buccatus Lichtenstein 1830
Spermophilus macrourus Bennett 1833
Spermophilus buckleyi Slack 1861
Citellus variegatus Elliot 1904
Spermophilus couchii Baird 1855
Sciurus grammurus Say 1823
Citellus grammurus Merriam 1903

CONTEXT AND CONTENT

Order Rodentia; Subfamily Sciuromorpha; Family Sciuridae. This species contains eight subspecies as defined by Hall and Kelson (1959):

- S. v. buckleyi* Slack 1861. Type from Packsaddle Mountain, Llano Co., Texas.
S. v. couchii Baird 1855. Type from Santa Catarina, a few miles W of Monterrey, Nuevo Leon.
S. v. grammurus (Say 1823). Type from Purgatory River, near mouth of Chacuaco Creek, Las Animas Co., Colorado.
S. v. robustus (Durrant and Hansen 1954). Type from Pass Creek, Deep Creek Mountains, 8,000 ft., Juab Co., Utah.
S. v. rupestris (J. A. Allen 1903). Type from Rio Sestin, northwestern Durango.
S. v. tularosae (Benson 1932). Type from French's Ranch, 5,400 ft., 12 mi. northwest of Carrizozo, Lincoln Co., New Mexico.
S. v. utah (Merriam 1903). Type from foot of Wasatch Mts., near Ogden, Weber Co., Utah.
S. v. variegatus (Erxleben 1777). See above.

DIAGNOSIS

Diurnal; without stripes on the side of the head; infraorbital foramen passing between the zygomatic plate and the rostrum; hind foot less than 68 mm but more than 49 mm; postorbital processes of skull projecting backward and downward; tail bushy; sides of zygomata flattened from side to side posteriorly but twisted anteriorly until they are flattened from top to bottom before reaching the notch in the zygomatic plate; without a light stripe on each side of the body that extends to the hips; tail more than half of head and body length; nape and shoulders without dark median area; conspicuously flecked dorsally, even in the light gray area; P3 about one-sixth size of P4 (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 430-525 mm; tail 160-252 mm; hind foot 50-65 mm; weight 580.3-795.5 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 56.0-67.7 mm; zygomatic breadth 36.3-38.9 mm; cranial breadth 23.9-25.2 mm; interorbital breadth 13.1-15.7 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Upper parts variegated black and white, often with buff; head and forepart of back black in many subspecies; tail mixed black or brown and buffy white (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the rock squirrel extends from northern Utah to central Mexico and from central Texas and western Oklahoma to southeastern California and southern Nevada. In California this species is found only in the Providence Mountains in the Mojave Desert (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper part of the Lower Sonoran through lower part of the Transition Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Spermophilus beecheyi - California Ground Squirrel

NOMENCLATURE AND SYNONYMY

Spermophilus beecheyi (Richardson 1829). Type from "neighborhood of San Francisco and Monterey, in California".

Synonyms:

Arctomys beecheyi Richardson 1829
Spermophilus beecheyi Cuvier 1831
Arctomys douglasii Richardson 1829
Citellus beecheyi Grinnell 1913
Citellus nesioticus Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains eight subspecies as defined by Hall and Kelson (1959):

- S. b. beecheyi* (Richardson 1829). See above.
- S. b. douglasii* (Richardson 1829). Type locality, bank of Columbia River, Oregon.
- S. b. fisheri* Merriam 1893. Type from South Fork of Kern River, 3 mi. above Onyx, California.
- S. b. nesioticus* (Elliot 1904). Type from (near Avalon) Santa Catalina Island, California.
- S. b. nudipes* (Huey 1931). Type from Hanson Laguna, Sierra Juarez, 5,200 ft., Baja California.
- S. b. parvulus* (A. H. Howell 1931). Type from Shepherd Canyon, Argus Mts., California.
- S. b. rupinarum* (Huey 1931). Type from Catavina, Baja California.
- S. b. sierrae* (A. H. Howell 1938). Type from Emerald Bay, Lake Tahoe, El Dorado Co., California.

DIAGNOSIS

Diurnal; without stripe on the side of the head; infraorbital foramen passing between the zygomatic plate and the rostrum; postorbital processes of skull projecting backward and downward; tail bushy; sides of zygomatics flattened from side to side posteriorly but twisted anteriorly until they are flattened from top to bottom before reaching the notch in the zygomatic plate; without a light stripe on each side of the body that extends to the hips; hind foot usually more than 49 mm but less than 68 mm; tail more than half of head and body length; nape and between the shoulders usually with dark median area; with mostly unflecked lighter fur on the sides of the neck and shoulders but with rump strongly flecked (Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 357-500 mm; tail 137-200 mm; hind foot 50-64 mm; ear 17-26 mm; weight (1) 651.7 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Greatest length 51.0-62.5 mm; zygomatic breadth (3) 34.5-38.0 mm; cranial breadth (3) 22.8-24.0 mm; interorbital breadth (3) 11.7-14.1 mm (Hall, 1946; Ingles, 1965).

Pelage. Head cinnamon or brown; upper parts brown flecked with whitish or buffy; sides of neck and shoulders white or whitish, this color extending backward in two divergent stripes separated by a triangular area of dark color; under sides light buff (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the California ground squirrel extends from northern Baja California through most of California (except the deserts), west-central Nevada, western Oregon, and south-central Washington (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower Sonoran Life Zone through the Canadian Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Spermophilus lateralis - Golden-mantled Ground Squirrel

NOMENCLATURE AND SYNONYMY

Spermophilus lateralis (Say 1823). Type locality, Arkansas River, near Canyon City, Colorado.

Synonyms:

Sciurus lateralis Say 1823
Spermophilus lateralis Cuvier 1831
Callospermophilus lateralis Hollister 1911
Spermophilus chrysodeirus Merriam 1893
Spermophilus bernardinus Merriam 1898
Citellus lateralis A. H. Howell 1936
Tamias castanurus Merriam 1890
Tamias chrysodeirus Merriam 1890
Tamias cinerascens Merriam 1890
Callospermophilus chrysodeirus Merriam 1901
Callospermophilus trepidus Taylor 1910
Tamias wortmani J. A. Allen 1895

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuroomorpha; Family Sciuridae. This species contains 14 subspecies as defined by Hall and Kelson (1959):

- S. l. arizonensis* (V. Bailey 1913). Type from Little Spring, 8,250 ft., San Francisco Mtn., Arizona.
- S. l. caryi* (A. H. Howell 1917). Type from 7 mi. S Fremont Peak, 10,400 ft., Wind River Mts., Fremont Co., Wyoming.
- S. l. bernardinus* Merriam 1893. Type from San Bernardino Peak, San Bernardino Co., California.
- S. l. certus* (Goldman 1921). Type from north base Charleston Peak, Clark Co., Nevada.
- S. l. chrysodeirus* (Merriam 1890). Type from Fort Klamath, Klamath Co., Oregon.
- S. l. cinerascens* (Merriam 1890). Type from Helena, 4,500 ft., Lewis and Clark Co., Montana.
- S. l. connectens* (A. H. Howell 1931). Type from Homestead, Oregon.
- S. l. lateralis* (Say 1823). See above.
- S. l. mitratus* (A. H. Howell 1931). Type from South Yolla Bolly Mtn., California.
- S. l. tesorum* (Hollister 1911). Type from head of Moose Pass, branch of the Smokey River, 7,000 ft., Alberta (near Moose Pass, British Columbia).
- S. l. trepidus* (Taylor 1910). Type from head of Big Creek, 8,000 ft., Pine Forest Mts., Humboldt Co., Nevada.
- S. l. trinitatis* (Merriam 1901). Type from E of Hoopa Valley, 5,700 ft., Trinity Mts., California.
- S. l. wortmani* (J. A. Allen 1895). Type from Kinney Ranch, Bitter Creek, Sweetwater Co., Wyoming.
- S. l. castanurus* (Merriam 1890). Type from Park City, Wasatch Mts., Summit Co., Utah.

DIAGNOSIS

Infraorbital foramen passing between the zygomatic plate and the rostrum; sides of zygomata flattened from side to side posteriorly but twisted anteriorly until they are flattened from top to bottom before reaching the notch in zygomatic plate; crown of skull sloping up to the nuchal line; metaloph on M1 and M2 joins protocone; small protolophid present on P4; membrane between fore and hind limbs not present; without stripes on the side of the head; light stripe between two long black stripes; head, shoulders, and underparts light yellowish or buffy; tail hairy or bushy; atlantoscularis dorsalis muscle present; diurnal; living in burrows in the ground (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 230-308 mm; tail 63-118 mm; hind foot 35-46 mm; weight 104.4-245.0 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 39.6-45.6 mm; zygomatic breadth 23.8-28.0 mm; cranial breadth 18.1-20.3 mm; interorbital breadth 8.3-11.2 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. A white or buffy stripe from shoulder to hip on each side of back; white stripe bordered below, and in most subspecies above, by black stripe; back gray, buff, cinnamon or fawn; "mantle" on head and shoulders varying from cinnamon buff to tawny or russett; underparts are buffy white, with hair plumbeous basally; on the throat, insides of legs, and over the feet the hair is buffy white to base; tail black above, mixed with a few hairs tipped with some shade of cinnamon, which color forms a border to the flattened tail that underneath is solidly reddish (Hall, 1946; Hall and Kelson, 1959). The golden-mantled ground squirrel has one molt each year. The male acquires new pelage before the female (Hall, 1946).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the golden-mantled ground squirrel spreads in amoeboid fashion throughout the western United States and Canada with the northern-most point of the range being in central British Columbia, the southern-most point being in southwestern New Mexico, the eastern-most point being in eastern Colorado, and the western-most point being in western Oregon (Hall and Kelson, 1959). In California this species is found in the Sierra Nevada, Salmon, Siskiyou, and San Bernardino mountains (Ingles, 1965).

HABITAT

Life zones. Pinon/juniper belt of the Upper Sonoran Life Zone through the Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Sciurus griseus - Western Gray Squirrel

NOMENCLATURE AND SYNONYMY

Sciurus griseus Ord 1818. Type locality, The Dalles, Columbia River, Wasco Co., Oregon.

Synonyms:

Sciurus griseus Ord 1818

Sciurus leporinus Audubon and Bachman 1841

Sciurus fossor Peale 1848

Sciurus heermanni Le Conte 1852

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Sciuridae. This species contains three subspecies as defined by Hall and Kelson (1959):

S. g. anthonyi Mearns 1897. Type from Campbells Ranch, Laguna Mts., San Diego Co., California.

S. g. griseus Ord 1818. See above.

S. g. nigripes Bryant 1889. Type from the coast region of San Mateo Co., California.

DIAGNOSIS

Infraorbital foramen passing between the zygomatic plate and the rostrum; postorbital processes of skull projecting backward and downward; sides of zygomata flattened from side to side all the way to the notch in zygomatic plate; five molariform teeth (rarely four) on each side of the upper jaw; P4 usually broader than long; membrane between fore and hind limbs not present; without stripes on the side of the head; tail over half of head and body length, bushy; no black line between the side and the belly; ears not tipped with long hairs; silver gray dorsally, white ventrally; diurnal; living in trees (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 500-575 mm; tail 240-290 mm; hind foot 72-82 mm; ear (crown) 28-36 mm; (Hall and Kelson, 1959).

Skull characteristics. Greatest length 65-70 mm (Ingles, 1965).

Pelage. Upper parts varying from dark gray to light gray, with yellowish or ochraceous wash; underparts varying from white to gray with tawny suffusion; tail gray but often with blackish or tawny suffusion; tail edged with white (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-0-2-3/1-0-1-3 (Hall and Kelson, 1959; Ingles, 1965).

Sciurus griseus - Western Gray Squirrel

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GEOGRAPHIC RANGE

The western gray squirrel is found in California from the Tehachapi Mountains north along the Sierra Nevada and in the Coast Ranges north from the Mexican border through western Oregon into central and western Washington (Ingles, 1965).

HABITAT

Life zones. Upper Sonoran and Transition life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Thomomys bottae - Botta Pocket Gopher

NOMENCLATURE AND SYNONYMY

Thomomys bottae (Evdoux and Gervais 1836). Type from coast of California. Hall and Kelson (1959) include this species in *Thomomys umbrinus* (Richardson 1829).

Synonyms: Scientific synonyms for this species include (cf. Hall and Kelson, 1959):

Oryctomys bottae Eydoux and Gervais 1836

Thomomys bottae Baird 1855

Geomys fulvus Woodhouse 1852

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Geomyidae. Hall and Kelson list 103 subspecies of this species as subspecies of *T. umbrinus*:

- T. b. abbotti* Huey 1928. Type from 1 mi. E El Rosario, Baja California.
- T. b. abstrusus* Hall and Davis 1935. Type from Fish Spring Valley, 2 mi. SE Tulle Peak, 7,000 ft., Nye Co., Nevada.
- T. b. acrostriatus* Grinnell 1935. Type from Valley of Mad River, 2,700 ft., 7 mi. above Ruth, Trinity Co., California.
- T. b. actuosus* Kelson 1951. Type from Corona, Lincoln Co., New Mexico.
- T. b. affinis* Huey 1945. Type from Jacumba, San Diego Co., California.
- T. b. agricolaris* Grinnell 1935. Type from Stralock Farm, 3 mi. W Davis, Yolo Co., California.
- T. b. alienus* Goldman 1938. Type from Mammoth, 2,400 ft., San Pedro River, Pinal Co., Arizona.
- T. b. angustidens* Baker 1953. Type from Sierra del Pino, 5,250 ft., 6 mi. N, 6 mi. W Acebuches, Coahuila.
- T. b. aridicola* Huey 1937. Type from Ajo Railroad right-of-way, about 2 mi. N Black Gap, 10 mi. S Gila Bend, Maricopa Co., Arizona.
- T. b. basilicae* Benson and Tillotson 1940. Type from La Mision, 2 mi. W Magdalena, Sonora.
- T. b. birdseyei* Goldman 1937. Type from Pine Valley Mts., 5 mi. E Pine Valley, 8,300 ft., Washington Co., Utah.
- T. b. bonnevilliei* Durrant 1946. Type from Fish Springs, 4,400 ft., Juab Co., Utah.
- T. b. boregoensis* Huey 1939. Type from Beatty Ranch, Borego Valley, San Diego Co., California.
- T. b. boreorarius* Durham 1952. Type from Swamp Point, 7,522 ft., 18½ mi. NW Bright Angel Point, North Rim of Grand Canyon, Coconino Co., Arizona.
- T. b. borjasensis* Huey 1945. Type from San Borjas Mission, Baja California.
- T. b. bottae* (Eydoux and Gervais 1836). See above.
- T. b. brevidens* Hall 1932. Type from Breen Creek, 7,000 ft., Kawich Range, Nye Co., Nevada.
- T. b. cactophilus* Huey 1929. Type from Punta Prieta, Baja California.
- T. b. comoae* Burt 1937. Type from Camoa, Rio Mayo, Sonora.
- T. b. cataviniensis* Huey 1931. Type from Catavina, Baja California.
- T. b. cedrinus* Huey 1955. Type from summit of Crossman Peak, Chemehuevi Mts., Mohave Co., Arizona.

CONTEXT AND CONTENT (Cont'd)

- T. b. cinereus* Hall 1932. Type from West Walker River, Smiths Valley, 4,700 ft., Lyon Co., Nevada.
- T. b. collis* Hooper 1940. Type from Shuman's Ranch, 30 mi S Grants, Valencia Co., New Mexico.
- T. b. comobabiensis* Huey 1937. Type from 5 mi NW Sells, 2,400 ft., Pima Co., Arizona.
- T. b. concolor* Hall and Davis 1935. Type from Pott's Ranch, 6,900 ft., Monitor Valley, Nye Co., Nevada.
- T. b. connectens* Hall 1936. Type from Clawson Dairy, 5 mi. N Albuquerque, 4,943 ft., Bernalillo Co., New Mexico.
- T. b. contractus* Durrant 1946. Type from Scipio, 5,315 ft., Millard Co., Utah.
- T. b. convergens* Nelson and Goldman 1934. Type from Costa Rica Ranch, delta of Sonora River, SW of Hermosillo, Sonora.
- T. b. convexus* Durrant 1939. Type from E side Clear Lake, 4,600 ft., Millard Co., Utah.
- T. b. crassus* Chittin 1941. Type from 1½ mi. W Niland, -180 ft., Imperial Co., California.
- T. b. cultellus* Nelson 1951. Type from Halls Peak, Mora Co., New Mexico.
- T. b. cunicularius* Huey 1945. Type from Los Palmitos (western end Pattie Basin), on southeastern basin of Sierra Juarez, Baja California.
- T. b. curtatus* Hall 1932. Type from San Antonio, 5,400 ft., Nye Co., Nevada.
- T. b. depressus* Hall 1932. Type from Dixie Meadows (S end of Humboldt Salt Marsh), 3,500 ft., Churchill Co., Nevada.
- T. b. desitus* Goldman 1936. Type from Big Sandy River, 2,000 ft., near Owen, Mohave Co., Arizona.
- T. b. detumidus* Grinnell 1935. Type from 1½ mi. S Pistol River, 250 ft., Curry Co., Oregon.
- T. b. divergens* Nelson and Goldman 1934. Type from 4 mi. W Huachinera, 4,000 ft., Rio Bavispe, Sonora.
- T. b. estanciae* Benson and Tillotson 1939. Type from La Estancia, 6 mi. N Nacori, Sonora.
- T. b. extenuatus* Goldman 1935. Type from Willcox, 4,000 ft., Cochise Co., Arizona.
- T. b. fulvus* (Woodhouse 1852). Type from San Francisco Mtn., Coconino Co., Arizona.
- T. b. fumosus* Hall 1932. Type from Milman Ranch, Moores Creek, 19 mi. SE Millett P.O., Nye Co., Nevada.
- T. b. gowleriensis* Huey 1937. Type from 7 mi E Papago Well, Pima Co., Arizona.
- T. b. guadalupensis* Goldman 1936. Type from McKittrick Canyon, 7,800 ft., Guadalupe Mts., Texas.
- T. b. homorus* Huey 1949. Type from 1 mi. E Rancho Lagunitas, Baja California.
- T. b. howelli* Goldman 1936. Type from Grand Junction, 4,600 ft., Mesa Co., Colorado.
- T. b. hualpaiensis* Goldman 1936. Type from Hualpai Peak, Hualpai Mts., 7,000 ft., Mohave Co., Arizona.
- T. b. hueyi* Goldman 1938. Type from Spud Rock Ranger Station, 7,400 ft., Rincon Mts., Pima Co., Arizona.
- T. b. humilis* Baker 1953. Type from 3 mi. W Hda. San Miguel, 2,200 ft., Coahuila.

CONTEXT AND CONTENT (Cont'd)

- T. b. imitabilis* Goldman 1939. Type from La Paz, Baja California.
T. b. incompus Goldman 1939. Type from San Jorge, near Pacific Coast W of Pozo Grande, about 25 mi. SW Comondú, Baja California.
T. b. ingens Grinnell 1932. Type from E side levee, 290 ft., 2 mi. due W Millux, Buena Vista Lake, Kern Co., California.
T. b. internatus Goldman 1936. Type from Salda, 7,000 ft., Chaffee Co., Colorado.
T. b. jojobae Huey 1945. Type from Sangre de Cristo, Baja California.
T. b. juarezensis Huey 1945. Type from Laguna Hanson, Sierra Juarez, Baja California.
T. b. lacrymalis Hall 1932. Type from Arlemont, 4,900 ft., Esmeralda Co., Nevada.
T. b. latus Hall and Davis 1935. Type from Cherry Creek, 6,500 ft., White Pine Co., Nevada.
T. b. levidensis Goldman 1942. Type from Manti, about 5,500 ft., Sanpete Co., Utah.
T. b. limpie Blair 1939. Type from Limpia Canyon, 1 mi. N Fort Davis, 4,700 ft., Jeff Davis Co., Texas.
T. b. litoris Burt 1940. Type from Stearns Point, Magdalena Bay, Baja California.
T. b. lorenzi Huey 1940. Type from 7 mi. N Boulder Creek, Santa Cruz Co., California.
T. b. lucidus Hall 1932. Type from Las Palmas Canyon, 200 ft., W Side Laguna Salada, Baja California.
T. b. lucrificus Hall and Durham 1938. Type from Eastgate, Churchill Co., Nevada.
T. b. minimus Durrant 1939. Type from Stansbury Island, Great Salt Lake, Tooele Co., Utah.
T. b. minor V. Bailey 1914. Type from Fort Bragg, Mendocino Co., California.
T. b. nanus Hall 1932. Type from S end Belted Range, 5½ mi. NW White Rock Spring, 7,200 ft., Nye Co., Nevada.
T. b. nesophilus Durrant 1936. Type from Antelope Island, Great Salt Lake, Davis Co., Utah.
T. b. nicholi Goldman 1938. Type from 20 mi. S Wolf Hole (road to Parashonts), 5,000 ft., Shivwits Plateau, Mohave Co., Arizona.
T. b. operosus Hatfield 1942. Type from Peebles Valley, 4,400 ft., 6 mi. N Yarnell, Yavapai Co., Arizona.
T. b. optabilis Goldman 1936. Type from Coventry, 6,500 ft., Naturita Creek Valley, Montrose Co., Colorado.
T. b. opulentus Goldman 1935. Type from Las Palomas, on the Rio Grande, Sierra Co., New Mexico.
T. b. paguatae Hooper 1940. Type from ½ mi. N Cebolleta (Seboyeta P.O.), Valencia Co., New Mexico.
T. b. pallascens Rhoads 1895. Type from Grapeland, San Bernardino Valley, San Bernardino Co., California.
T. b. parvulus Goldman 1938. Type from pass between Santa Catalina and Rincon Mts., 4,500 ft., Pima Co., Arizona.
T. b. patulus Goldman 1938. Type from bottomland along Hassayampa River, 2,000 ft., 2 M below Wickenburg, Maricopa Co., Arizona.
T. b. pervarius Goldman 1938. Type from Lloyd Ranch, 35 mi. S Marfa, 4,200 ft., Presidio Co., Texas.

CONTEXT AND CONTENT (Cont'd)

- T. b. piutensis* Grinnell and Hill 1936. Type from French Gulch, 6,700 ft., Piute Mts., 2½ mi. NE Claraville, Kern Co., California.
- T. b. planorum* Hooper 1940. Type from 1½ mi. SW San Mateo, Valencia Co., New Mexico.
- T. b. powelli* Durrant 1955. Type from Hall Ranch, Salt Gulch, 8 mi. W Boulder, 6,000 ft., Garfield Co., Utah.
- T. b. proximarinus* Huey 1945. Type from Boca la Playa mesa bordering the sea, 16 mi. W Santo Tomas, Baja California.
- T. b. retractus* Baker 1953. Type from Fortín, 3,300 ft., 20 mi. N, 2 mi. E San Geronimo, Coahuila.
- T. b. rhizophagus* Huey 1949. Type from Las Flores, 7 mi. S Bahía de Los Angeles, Baja California.
- T. b. robustus* Durrant 1946. Type from Orr's Ranch, 4,300 ft., Skull Valley, Tooele Co., Utah.
- T. b. rufidulus* Hoffmeister 1955. Type from 2 mi. E Joseph City, Navajo Co., Arizona.
- T. b. ruidosae* Hall 1932. Type from Ruidoso, 6,700 ft., Lincoln Co., New Mexico.
- T. b. rupestris* Chattin 1941. Type from 2 mi. E Clemens Well, 1,131 ft., Riverside Co., California.
- T. b. ruricola* Huey 1949. Type from 4 mi. N Santa Catarina Landing, Baja California.
- T. b. russeolus* Nelson and Goldman 1909. Type from San Angel, WSW San Ignacio, Baja California.
- T. b. sanotidiegi* Huey 1945. Type from Balboa Park, San Diego, California.
- T. b. saxatilis* Grinnell 1934. Type from 1 mi. N Susanville, 4,400 ft., Lassen Co., California.
- T. b. scotophilus* Davis 1940. Type from 1½ mi. W Bat Cave, Sierra Diablo, Hudspeth Co., Texas.
- T. b. sevierei* Durrant 1946. Type from Swasey Spring, 6,500 ft., House Mtn., Millard Co., Utah.
- T. b. siacovalis* Huey 1945. Type from El Cajon Canyon, 3,200 ft., E base Sierra San Pedro Martir, Baja California.
- T. b. silvifugus* Grinnell 1935. Type from 16 mi. due E Patricks Point, near Coyote Peak, 3,000 ft., Humboldt Co., California.
- T. b. stansburyi* Durrant 1946. Type from South Willow Creek, Stansbury Mts., 7,500 ft., Tooele Co., Utah.
- T. b. tivius* Durrant 1937. Type from Oak Creek Canyon, 6 mi. E Oak City, 6,000 ft., Millard Co., Utah.
- T. b. trumbullensis* Hall and Davis 1934. Type from 3 mi. S Nixon Spring, Mt. Trumbull, Mohave Co., Arizona.
- T. b. vanrossemei* Huey 1934. Type from Punta Penascosa, Sonora.
- T. b. vesous* Hall and Davis 1935. Type from S slope Mt. Jefferson, Toiyah Range, 9,000 ft., Nye Co., Nevada.
- T. b. villai* Baker 1953. Type from 7 mi. S, 2 mi. E Boquillas, 1,800 ft., Coahuila.
- T. b. virgineus* Goldman 1937. Type from Beaverdam Creek, 1,500 ft., near confluence with Virgin River at Littlefield, Arizona.
- T. b. wahwahensis* Durrant 1937. Type from Wah Wah Springs, 30 mi. W Milford, 6,500 ft., Beaver Co., Utah.
- T. b. winthropi* Nelson and Goldman 1934. Type from Hermosillo, Sonora.
- T. b. xerophilus* Huey 1945. Type from near Diablito Spring, summit San Matias Pass between Sierra Juarez and Sierra San Pedro Martir, Baja California.

DIAGNOSIS

Snout and rostrum broad and deep, sloping up gradually in front of the premolars; incisive foramen is posterior to the anterior opening of the infraorbital canal; distinct sphenoidal fissure present; interparietal relatively small; lambdoidal suture usually approximately straight in region of interparietal; zygomatic arch made up of jugal in middle extent; anterior prism of P4 rounded; incisors not grooved or with only a fine sulcus on inner side; posterior enamel plate present and complete on M1, M2, and M3; ears rounded; postauricular dark patch usually about the same size as the round ear (some races much larger); hind foot, male, usually less than 34 mm; female, usually less than 30 mm; basal end of baculum (viewed dorsally) undivided; normally eight mammae, 2 pairs pectoral, two pairs inguinal (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 132-273 mm; tail 42-100 mm; hind foot 22-37 mm; ear 5-8 mm; weight 70.3-201.5 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basilar length 24.3-39.5 mm; zygomatic breadth 19-29 mm; least interorbital constriction 5.6-7.5 mm; mastoidal breadth 16.9-23.6 mm (Hall, 1946; Ingles, 1965).

Pelage. Varies from black to almost white according to subspecies; not sharply bicolored but underparts paler than upper parts (Hall and Kelson, 1959).

Baculum. Length 9.1-13.0 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the botta pocket gopher extends from northern Mexico and Baja California northwestwardly to southwestern Oregon and from eastern Colorado to the Pacific coast of California and extreme southwestern Oregon (Hall and Kelson, 1959). This species is found in all of California except the high mountains, sagebrush area, and parts of the dry deserts (Ingles, 1965).

HABITAT

Life zones. Lower Sonoran into lower part of the Arctic-Alpine Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Perognathus inornatus - San Joaquin Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus inornatus Merriam 1889. Type from Fresno, Fresno Co., California.

Synonyms:

Perognathus inornatus Merriam 1889

Perognathus longimembris Taylor 1912

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains three subspecies as defined by Hall and Kelson (1959):

P. i. inornatus Merriam 1889. See above.

P. i. neglectus Taylor 1912. Type from McKittrick, 1,111 ft., Kern Co., California.

P. i. stillmani von Bloeker 1937. Type from W side Arroyo Seco, 150 ft., 4 mi S Soledad, Monterey Co., California.

DIAGNOSIS

Interparietal bone usually not as wide as the interorbital width; auditory bullae nearly meeting anteriorly; mastoids large and projecting posteriorly distinctly beyond the level of the occiput; interparietal width about 3.5 mm; occiput not deeply indented laterally by mastoids; nasals short; coronoid process of mandible large; pelage soft without stiff coarse hairs on flanks; underparts white; tail with terminal hairs 3-6 mm long; tail faintly bicolored, nearly unicolored; sole of hind foot usually with some hairs near the ankle; external fur-lined cheek pouches; hind foot normally 20 mm or less (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 128-160 mm; tail 63-78 mm; hind foot 18-21 mm; ear 4-7 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 24-28 mm (Ingles, 1965).

Pelage. Pelage soft; upper parts ochraceous buff to pinkish overlaid with blackish hairs, extent of overlay changing over-all tone in the several subspecies; lateral line moderately well marked; underparts white; tail faintly bicolored; sometimes patches of lighter hairs at the base of the ear (Hall and Kelson, 1959; Ingles, 1965).

Baculum. Length 6.1 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the San Joaquin pocket mouse extends through the Salinas and San Joaquin valleys of California (Ingles, 1965).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Perognathus baileyi - Bailey's Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus baileyi Merriam 1894. Type from Magdalena, Sonora.

Synonyms:

Perognathus baileyi Merriam 1894

Perognathus knekus Elliot 1903

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains seven subspecies as defined by Hall and Kelson (1959):

P. b. baileyi Merriam 1894. See above.

P. b. domensis Goldman 1928. Type from Castle Dome, 1,400 ft., at base of Castle Dome Peak, Yuma Co., Arizona.

P. b. extimus Nelson and Goldman 1930. Type from Tres Pachitas, 700 ft., 36 mi. S La Paz, Baja California.

P. b. fornicatus Burt 1932. Type from Monserrate Island, Gulf of California, Baja California.

P. b. hueyi Nelson and Goldman 1929. Type from San Felipe, northeastern Baja California.

P. b. insularis Townsend 1912. Type from Tiburon Island, Gulf of California, Sonora.

P. b. rudinoris Elliot 1903. Type from San Quintin, Baja California.

DIAGNOSIS

Skull large and heavily constructed; mastoid side of parietal approximately equal to other long sides; auditory bullae barely apposed anteriorly; auditory bullae separated anteriorly by nearly the full width of the basisphenoid; interparietal relatively large; interparietal breadth approximately equal to least interorbital breadth; mastoids deeply indenting the occiput, but projecting somewhat beyond the plane of the occiput; lower premolar equal to or slightly smaller than the last molar; tail long, pectillate and strongly crested; external fur-lined cheek pouches; sole of hind foot usually naked to the heel; pelage usually harsh; rump without conspicuous spines or bristles; grayish dorsally (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 200-231 mm; tail 110-136 mm; hind foot 26-28 mm; ear (crown) 9-11 mm (Ingles, 1965).

Skull characteristics. Greatest length 29.5-33.0 mm (Ingles, 1965).

Pelage. Upper parts grayish and washed with yellowish or tawny; underparts white or almost so; tail buffy above, whitish below, dorsal stripe of tail only a little narrower than light ventral stripe (Hall and Kelson, 1959; Ingles, 1965).

Perognathus baileyi - Bailey's Pocket Mouse

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MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. Length 10-11 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of Bailey's pocket mouse extends from Baja California and the extreme northwestern corner of Mexico to southwestern Arizona and the extreme southeastern corner of California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Hall and Kelson, 1959).

LIFE HISTORY SUMMARY

Perognathus penicillatus - Desert Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus penicillatus Woodhouse 1852. Type from 1 mi. SW Parker, Yuma Co., Arizona.

Synonyms:

Perognathus penicillatus Woodhouse 1852

Perognathus eremicus Mearns 1898

Perognathus pricei J. A. Allen 1894

Perognathus stephensi Merriam 1894

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains eight subspecies as defined by Hoffmesiter and Lee (Revision of the pocket mice, *Perognathus penicillatus*. J. Mammal. 48:361-380):

P. p. angustirostris Osgood 1900. Type from Carrizo Creek, western edge Colorado Desert, Imperial Co., California.

P. p. atrodorsalis Dalquest 1951. Type from 7 km. W Presa de Guadalupe, San Luis Potosi.

P. p. eremicus Mearns 1898. Type from Fort Hancock, Hudspeth Co., Texas.

P. p. pricei J. A. Allen 1894. Type from Oposura (Moctezuma), Sonora.

P. p. seri Nelson 1912. Type from Tiburon Island, Sonora.

P. p. sobrinus Goldman 1939. Type from 7 mi. above Bunkerville, along the Virgin River, Clark Co., Nevada.

P. p. stephensi Merriam 1894. Type from Mesquite Valley, near Triangle Spring, -13 ft., northwest Death Valley, Inyo Co., California.

P. p. penicillatus Woodhouse 1852. See above.

DIAGNOSIS

Sole of hind foot usually naked to the heel; pelage usually harsh; rump often with inconspicuous bristles but no spines; interparietal bone as wide as or wider than interorbital width; auditory bullae separated anteriorly by nearly the full width of the basisphenoid; usually less than 210 mm total length; yellowish brown dorsally; tail sometimes annulated and crested with a buffy tuft, 15-25 mm long; hind foot usually less than 26 mm; tail bicolored; mastoids hardly projecting to the posterior level of the occiput; occiput very deeply indented by the mastoids laterally; mastoidal side of parietal shorter than any other side (rarely about equal to squamosal side); ascending branches of supraoccipital wide on top of skull; rostrum robust and high; fur-lined exterior cheek pouches (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 153-216 mm; tail 91-129 mm; hind foot 21-28 mm; ear (notch), less than 10 mm; weight 13.9-32.8 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Greatest length 25.0-29.0 mm; mastoidal breadth 12.2-14.4 mm; interorbital breadth 6.1-7.2 mm (Hall, 1946; Ingles, 1965).

Pelage. Upper parts yellowish-brown to yellowish-gray; underparts white to buffy; lateral line obscure or absent; tail markedly crested, white below proximal to tuft; upper side of tail and tuft dusky (Hall and Kelson, 1959).

Baculum. Length 9.7-12.5 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. Males average about 4 percent larger than females in linear measurements and about 20 percent greater in weight (Hall, 1946).

GEOGRAPHIC RANGE

The range of the desert pocket mouse extends from northern Mexico to southwestern Texas across southern New Mexico, Arizona, Nevada, California and northeastern Baja California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Perognathus fallax - San Diego Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus fallax Merriam 1889. Type from Reche Canyon, 1,250 ft., 3 mi. SE Colton, San Bernardino Co., California.

Synonyms: None.

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains three subspecies as defined by Hall and Kelson (1959):

P. f. fallax Merriam 1889. See above.

P. f. inopinus Nelson and Goldman 1929. Type from Turtle (San Bartolome) Bay, Baja California.

P. f. pallidus Mearns 1901. Type from Mountain Spring, half way up the east slope of the Coast Range Mountains, on the Mexican boundary, Imperial Co., California.

DIAGNOSIS

Sole of hind foot usually naked to the heel; pelage usually harsh, interparietal bone as wide as or wider than the interorbital width, anterior angle obsolete; auditory bullae separated anteriorly by nearly the full width of the basisphenoid; buffy or fulvous lateral line (sometimes faintly represented) along the body between the belly and sides; ear 7-11 mm from notch; tail tuft 12-16 mm long; black grooved hairs on the rump (may be inconspicuous until fur is raised by rubbing it backward) and long white spines on the hips; skull usually less than 27.5 mm; mastoids large, deeply indenting the sides of the occiput, but barely projecting beyond the level of the occiput; skull with arched braincase; external fur-lined cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 176-200 mm; tail 88-118 mm; hind foot 21-26 mm; ears (notch) 7-9 mm (Ingles, 1965).

Skull characteristics. Greatest length 26-27 mm (Ingles, 1965).

Pelage. Pelage harsh, often with black, grooved hairs or spines on the rump and white spines on the hips; upper parts rich brown becoming blackish over the rump; under parts white or whitish; lateral line buffy; tail crested, distinctly bicolored, dorsal stripe narrower than light ventral stripe (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the San Diego pocket mouse extends from northern Baja California to southwestern California (San Diego, Imperial, and Riverside counties) (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Perognathus californicus - California Pocket Mouse

NOMENCLATURE AND SYNONYMY

Perognathus californicus Merriam 1889. Type from Berkeley, Alameda Co., California.

Synonyms:

Perognathus californicus Merriam 1889

Perognathus armatus Merriam 1889

Perognathus femoralis J. A. Allen 1891

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Perognathinae. This species contains eight subspecies as defined by Hall and Kelson (1959):

P. c. bensoni von Bloeker 1938. Type from Stonewall Creek, 1,300 ft., about 6.3 mi. NE Soledad, Monterey Co., California.

P. c. bernardinus Benson 1930. Type from 2 mi. E Strawberry Peak, 5,750 ft., San Bernardino Mts., San Bernardino Co., California

P. c. californicus Merriam 1889. See above.

P. c. dispar Osgood 1900. Type from Carpenteria, Santa Barbara Co., California.

P. c. femoralis J. A. Allen 1891. Type from Dulzura, San Diego Co., California.

P. c. marinensis von Bloeker 1938. Type from Indian Harbor, 50 ft., 1½ mi. S Marina, Monterey Co., California.

P. c. mesopolitus Elliot 1903. Type from Pinon, 5,000 ft., Sierra San Pedro Martir, Baja California.

P. c. oehrns Osgood 1904. Type from Santiago Spring, 16 mi. SW McKittrick, Kern Co., California.

DIAGNOSIS

Sole of hind foot usually naked to the heel; pelage usually harsh; interparietal bone as wide as or wider than the interorbital width; auditory bullae separated anteriorly by nearly the full width of the basisphenoid; buffy or fulvous lateral line along the body between the belly and the sides; white bristles only on hips and rump; mastoids exceedingly small and not reaching the posterior level of the occiput; occiput deeply indented by the sides of the mastoids; braincase markedly vaulted; interparietal approximately twice as long as broad; lower premolar but little larger than last molar; ears much elongated; external fur-lined cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 190-224 mm; tail 103-143 mm; hind foot 24-29 mm; ear 9-14 mm (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 28-30 mm (Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Pelage harsh; upper parts brownish gray flecked with fulvous; underparts and feet yellowish white; tail crested, bicolored; conspicuous white, grooved hairs or spines on the rump; long black or buffy hairs at the forward base of the ear nearly as long as ear; definite fulvous stripe along sides (Hall and Kelson, 1959; Ingles, 1965).

Baculum. Length 9.7-10.8 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the California pocket mouse extends from central-northern Baja California to south of San Francisco Bay and west of the Sierra Nevada Range in California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower Sonoran into the Transition Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Dipodomys ordii - Ord's Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys ordii Woodhouse 1853. Type locality, El Paso, El Paso Co., Texas.

Synonyms:

Dipodomys ordii Woodhouse 1853
Dipodomys chapmani Mearns 1890
Perodipus ordi Merriam 1894
Dipodomys compactus True 1889
Dipodops longipes Merriam 1890
Perodipus monoensis Grinnell 1919
Dipodomys montanus Baird 1855
Perodipus obscurus J. A. Allen 1903
Dipodomys oklahomae Trowbridge and Whitaker 1940
Dipodops richardsoni J. A. Allen 1891
Dipodops sennetti J. A. Allen 1891
Perodipus montanus Merriam 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Dipodomysinae. This species contains 37 subspecies as defined by Hall and Kelson (1959):

- D. o. attenuatus* Bryant 1939. Type from mouth Santa Helena Canyon, 2,146 ft., Big Bend of the Rio Grande, Brewster Co., Texas.
- D. o. celeripes* Durrant and Hall 1939. Type from Trout Creek, 4,600 ft., Juab Co., Utah.
- D. o. chapmani* Mearns 1890. Type from Fort Verde, Yavapai Co., Arizona.
- D. o. cinderensis* Hardy 1944. Type from approximately 4,000 ft., immediately N of the northern of two large cinder cones, Diamond Valley, 10 mi. N St. George, Washington Co., Utah.
- D. o. cineraceus* Goldman 1939. Type from Dolphin Island, Great Salt Lake, 4,250 ft., Boxelder Co., Utah.
- D. o. columbianus* (Merriam 1894). Type from Umatilla, at mouth of Umatilla River, Plains of Columbia, Umatilla Co., Oregon.
- D. o. compactus* True 1889. Type from Padre Island, Cameron Co., Texas.
- D. o. cupidineus* Goldman 1924. Type from Kanab Wash, at southern boundary of Kaibab Indian Reservation, Mohave Co., Arizona.
- D. o. durranti* Setzer 1949. Type from Jaumave, Tamaulipas.
- D. o. eveus* Goldman 1933. Type from Salida, 7,000 ft., Chaffee Co., Colorado.
- D. o. extractus* Setzer 1949. Type from 1 mi. E Samalayuca, 4,500 ft., Chihuahua.
- D. o. fetusus* Durrant and Hall 1939. Type from 2 mi. N Panaca, 4,800 ft., Lincoln Co., Nevada.
- D. o. fremonti* Durrant and Setzer 1945. Type from Torrey, 7,000 ft., Wayne Co., Utah.

CONTEXT AND CONTENT (Cont'd)

- D. o. idoneus* Setzer 1945. Type from San Juan, 12 mi. W Lerdo, 3,800 ft., Durango.
- D. o. inaquosus* Hall 1941. Type from 11 mi. E and 1 mi. N Jungo, 4,200 ft., Humboldt Co., Nevada.
- D. o. largus* Hall 1951. Type from Mustang Island, 14 mi. SW Port Aransas, Aransas Co., Texas.
- D. o. longipes* (Merriam 1890). Type from foot of Echo Cliffs, Painted Desert, Coconino Co., Arizona.
- D. o. luteolus* (Goldman 1917). Type from Casper, Natrona Co., Wyoming.
- D. o. marshalli* Goldman 1937. Type from Bird Island, Great Salt Lake, 4,300 ft., Utah.
- D. o. medius* Setzer 1949. Type from Santa Rosa, Guadalupe Co., New Mexico.
- D. o. monoensis* (Grinnell 1919). Type from Pellisier Ranch, 5,600 ft., 5 mi. N Benton Station, Mono Co., California.
- D. o. montanus* Baird 1855. Type from Fort Massachusetts (now Fort Garland), Costilla Co., Colorado.
- D. o. nexilis* Goldman 1933. Type from 5 mi. W Naturita, Montrose Co., Colorado.
- D. o. obscurus* (J. A. Allen 1903). Type from Rio Sestin, northwest Durango.
- D. o. oklahomae* Trowbridge and Whitaker 1940. Type from north bank South Canadian River, 2½ mi. S Norman, Cleveland Co., Oklahoma.
- D. o. ordii* Woodhouse 1853. See above.
- D. o. pallidus* Durrant and Setzer 1945. Type from Old Lincoln Highway, 18 mi. SW Orr's Ranch, Skull Valley, 4,400 ft., Tooele Co., Utah.
- D. o. palmeri* (J. A. Allen 1881). Type from San Luis Potosi, State of San Luis Potosi.
- D. o. panguitohensis* Hardy 1942. Type from 1 mi. S Panguitch, 6,666 ft., Garfield Co., Utah.
- D. o. parvabullatus* Hall 1951. Type from 88 mi. S and 10 mi. W Matamoros, Tamaulipas.
- D. o. priscus* Hoffmeister 1942. Type from Kinney Ranch, 21 mi. S Bitter Creek, 7,100 ft., Sweetwater Co., Wyoming.
- D. o. richardsoni* (J. A. Allen 1891). Type from one of the sources of Beaver River, probably Harper Co., Oklahoma.
- D. o. sanrafaeli* Durrant and Setzer 1945. Type from 1½ mi. N Price, 5,567 ft., Carbon Co., Utah.
- D. o. sennetti* (J. A. Allen 1891). Type from Santa Rosa, 85 mi. SW Corpus Christi, Cameron Co., Texas.
- D. o. terrosus* Hoffmeister 1942. Type from Yellowstone River, 5 mi. W Forsyth, 2,750 ft., Rosebud Co., Montana.
- D. o. uintensis* Durrant and Setzer 1945. Type from Red Creek, 6,700 ft., 2 mi. N Fruitland, Duchesne Co., Utah.
- D. o. utahensis* (Merriam 1904). Type from Ogden, Weber Co., Utah.

DIAGNOSIS

Tip of tail with tuft of long hairs over 10 mm in length; with four functional toes and a small claw or toe about a third of the way from the tip of the inside toe (outside on skins) to the ankle; lower incisors awl-

DIAGNOSIS (Con't)

shaped, each tooth usually less than 1 mm wide; dark tail stripe about as wide as the lateral white stripe and does not extend to the end of the caudal vertebrae; tail ratio to head and body about 120-130 percent; maxillary arch with prominent angles; tail crested about 40 percent of the way up from the tip; relatively short rostrum; moderate sized bullae; wide interparietal, wide maxillary arm of the zygomatic arch; external fur lined cheek pouches (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 208-281 mm; tail 100-163 mm; hind foot 35-45 mm; ear (crown) 9-13 mm; weight 33.8-65.0 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 35.1-37.8 mm; greatest breadth 22.4-24.8 mm; interorbital breadth 10.8-12.7 mm (Hall, 1946; Ingles, 1965).

Pelage. Pelage varies among subspecies: cinnamon buff to pinkish buff upper parts; strongly mixed with blackish or lightly to moderately mixed with dusky; white supraorbital spots small to large in size; black arietiform facial markings well developed to obsolete; tail bicolored; underparts lighter than upper parts (Hall, 1946).

Baculum. Length 11.3 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. Males average only slightly more than one percent larger than females in linear measurements of the skull and external parts, and a little less than four percent more in weight (Hall, 1946).

GEOGRAPHIC RANGE

The range of Ord's kangaroo rat extends from central Mexico to southwestern Saskatchewan and southeastern Alberta and from the Great Plains states to eastern California, eastern Oregon and southeastern Washington (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Dipodomys panamintinus - Panamint Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys panamintinus (Merriam 1894). Type from head Willow Creek, Panamint Mts., Inyo California.

Synonyms:

Perodipus panamintinus Merriam 1894
Dipodomys panamintinus Grinnell 1921
Dipodomys mohavensis Grinnell 1918
Perodipus leucogenys Grinnell 1919

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Dipodominae. This species contains five subspecies as defined by Hall and Kelson (1959):

- D. p. argusensis* Huey 1945. Type from Junction Ranch, 5,725 ft., Argus Mts., Inyo Co., California.
- D. p. caudatus* Hall 1946. Type from 6 mi. S Granite Well, 3,800 ft., Providence Mts., San Bernardino Co., California.
- D. p. leucogenys* (Grinnell 1919). Type from Pellisier Ranch, 5,600 ft., 5 mi. N Benton Station, Mono Co., California.
- D. p. mohavensis* (Grinnell 1918). Type from ½ mi. E of Railway Station at Warren, 3,275 ft., about 5 mi. N Mohave, Kern Co., California.
- D. p. panamintinus* (Merriam 1894). See above.

DIAGNOSIS

Skull usually less than 45 mm; width of maxillary arch usually more than 5 mm; auditory bullae small; lower incisors awl-shaped, each tooth usually less than 1 mm wide; pinna of ear small; hind foot ordinarily more than 42.5 mm; with four functional toes and a small claw or toe about a third of the way from the tip of the inside toe (outside on skins) to the ankle; tail about 140 percent of head and body; total length usually more than 280 mm; tip of tail with tuft of long hairs 10 mm or more in length; external furred cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 285-334 mm; tail 156-202 mm; hind foot 42-48 mm; ear (crown) 10-15 mm; weight 63.0-94.3 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 35.8-42.0 mm; greatest breadth 23.6-26.0 mm; interorbital breadth 12.3-13.9 mm (Hall, 1946; Ingles, 1965).

Pelage. Ears sometimes almost black; light cheek patches, sometimes obscured by dusky dark whisker patches, may or may not join over the nose; large white spot behind ear; upper parts slightly lighter than sayal brown; underparts light; tail bicolored (Hall, 1946; Ingles, 1965).

Dipodomys panamintinus - Panamint Kangaroo Rat

- 2 -

MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. Length 10.7 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

Sexual dimorphism. Males average slightly more than 2 percent larger than females in linear measurements, and in weight about 14 percent heavier (Hall, 1946).

GEOGRAPHIC RANGE

The range of the Panamint kangaroo rat extends from San Bernardino County north through eastern California to Sierra County and includes eastern Nevada (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Lower Sonoran to lower Transition Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Dipodomys agilis - Agile Kangaroo Rat

NOMENCLATURE AND SYNONYMY

Dipodomys agilis Gambel 1848. Type from Los Angeles, Los Angeles Co., California.

Synonyms:

Dipodomys agilis Gambel 1848

Dipodomys wagneri Le Conte 1853

Perodipus cabezonae Merriam 1904

Perodipus perplexus Merriam 1907

Perodipus streatorum Merriam 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Sciuromorpha; Family Heteromyidae; Subfamily Dipodomysinae. This species contains seven subspecies as defined by Hall and Kelson (1959):

D. a. agilis Gambel 1848. See above.

D. a. cabezonae (Merriam 1904). Type from Cabezon, San Geronimo Pass, Riverside Co., California.

D. a. fuscus Boulware 1943. Type from 2½ mi. N La Purisima Mission, 600 ft., Santa Barbara Co., California.

D. a. martirensis Huey 1927. Type from La Grulla (east side of valley), 7,500 ft., Sierra San Pedro Martir, Baja California.

D. a. perplexus (Merriam 1907). Type from Walker Basin, 3,400 ft., Kern Co., California.

D. a. plectilis Huey 1951. Type from mouth of canyon San Juan de Dios, Baja California.

D. a. simulans Merriam 1904. Type from Dulzura, San Diego Co., California.

DIAGNOSIS

Skull narrow across maxillary processes of zygomatic arches; maxillary arch weakly angled, width usually over 4 mm; lower incisors awl-shaped, each tooth usually less than 1 mm wide; tail ratio to head and body about 155 percent; tip of tail with tuft of long hairs over 10 mm in length; with four functional toes and a small claw or toe about a third of the way from the tip of the inside toe (outside on skins) to the ankle; external fur-lined cheek pouches (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 265-319 mm; tail 155-197 mm; hind foot 40-46 mm; ear (crown) 13-15 mm; average weight less than 70 g (Ingles, 1965).

Skull characteristics. Maxillary width 4.1-5.3 mm; nasals 13.2-15.0 mm (Ingles, 1965).

Pelage. Dusky cinnamon buff; tail tuft and crest is dull brownish black, with gray at the bases of the hairs; tail bicolored; underparts light in color (Ingles, 1965).

Dipodomys agilis - Agile Kangaroo Rat

- 2 -

MORPHOLOGICAL CHARACTERS (Cont'd)

Baculum. Length 9.6 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the agile kangaroo rat extends from northwestern Baja California in a band along the Pacific coast to southwestern California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran into Transition Life Zone (Grinnell, 1922).

LIFE HISTORY SUMMARY

Reithrodontomys megalotis - Western Harvest Mouse

NOMENCLATURE AND SYNONYMY

Reithrodontomys megalotis (Baird 1858). Type from between Janos, Chihuahua, and San Luis Springs, Grant Co., New Mexico.

Synonyms:

- Reithrodon megalotis* Baird 1858
- Reithrodontomys megalotis* J. A. Allen 1893
- Reithrodontomys saturatus* J. A. Allen and Chapman 1897
- Reithrodontomys amoles* A. H. Howell 1914
- Reithrodontomys arizonensis* J. A. Allen 1893
- Reithrodontomys astecus* J. A. Allen 1893
- Rhithrodontomys catalinae* Elliot 1904
- Reithrodontomys dychei* J. A. Allen 1895
- Reithrodon longicauda* Baird 1858
- Reithrodontomys pallidus* Rhoads 1893
- Reithrodontomys kiamathensis* Merriam 1899
- Rhithrodontomys peninsulae* Elliot 1903

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains 17 subspecies as defined by Hall and Kelson (1959):

- R. m. alticolus* Merriam 1901. Type from Cerro San Felipe, 10,000 ft., Oaxaca.
- R. m. amoles* A. H. Howell 1914. Type from Pinal de Amoles, approximately 7,500 ft., Queretaro.
- R. m. arizonensis* J. A. Allen 1895. Type from Rock Creek, 8,000 ft., Chiricahua Mts., Cochise Co., Arizona.
- R. m. astecus* J. A. Allen 1893. Type from La Plata, San Juan Co., New Mexico.
- R. m. caryi* A. H. Howell 1935. Type from Medano Ranch, 15 mi. NE Mosca, Alamosa Co., Colorado.
- R. m. catalinae* (Elliot 1904). Type from Santa Catalina Island (near Avalon), Santa Barbara Islands, California.
- R. m. distichlis* von Bloeker 1937. Type from salt marsh at mouth of Salinas River, Monterey Co., California.
- R. m. dychei* J. A. Allen 1895. Type from Lawrence, Douglas Co., Kansas.
- R. m. hooperi* Goodwin 1954. Type from Rancho del Cielo, 5 mi. NW Gomez Farias, 3,500 ft., Tamaulipas.
- R. m. limicola* von Bloeker 1932. Type from Playa del Rey, Los Angeles Co., California.
- R. m. longicaudus* (Baird 1858). Type from Petaluma, Sonoma Co., California.
- R. m. megalotis* (Baird 1858). See above.
- R. m. peninsulae* (Elliot 1903). Type from San Quintin, Baja California.
- R. m. rarus* Goldman 1939. Type from north end Stansbury Island, 4,250 ft., Great Salt Lake, Tooele Co., Utah.
- R. m. santacruzae* Pearson 1951. Type from Prisoners Harbor, Santa Cruz Island, Santa Barbara Co., California.

CONTEXT AND CONTENT (Cont'd)

R. m. saturatus J. A. Allen and Chapman 1897. Type from Las Vigas, 8,000 ft., Veracruz.

R. m. zacatecae Merriam 1901. Type from Sierra de Valparaiso, Zacatecas.

DIAGNOSIS

Skull comparatively smooth; anterior zygomatic plate not projecting anteriorly enough to be visible from above; posterior border of palate truncate; skull with broad zygomatic plate and broad pterygoid fossa; first primary fold of M3 distinctly shorter than second primary fold, extending less than halfway across crown; worn occlusal surface of left M3 C-shaped; no distinct labial ridge on M1-2; major fold and second primary fold in M1-2 meet but do not coalesce; with longitudinal grooves on front face of upper incisors; tail distinctly bicolored; tail slender, scaly, scantily haired, approximately equal to or longer than head and body length; soles of hind feet with six tubercles; underparts grayish white, often buffy tinged (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 118-170 mm; tail 55-96 mm; hind foot 14-20 mm; ear 10-18 mm; weight 8.9-15.0 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 20.5-22.0 mm; greatest breadth 9.6-10.5 mm; interorbital constriction 2.9-3.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Brownish or buffy and black above, sometimes forming an indistinctly bordered dark dorsal band; underparts varying from white to grayish tinged with buff; sides buffy; tail bicolored; light underside being more extensive than dark upper side; buffy tones purest on cheeks, shoulders and flanks, ears buffy or fuscous (Hall and Kelson, 1959; Ingles, 1965).

Dentition. The dental formula is $1-0-0-3/1-0-0-3$ (Ingles, 1965).

Sexual dimorphism. There is no variation in linear measurements but females average 12 percent heavier than males (Hall, 1946).

GEOGRAPHIC RANGE

The range of the western harvest mouse extends from central Oaxaca in Mexico north to southern Alberta and British Columbia and from north-eastern Arkansas and southwestern Wisconsin to the Pacific coast between northern Baja California and southern Oregon (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran to Hudsonian (Ingles, 1965).

LIFE HISTORY SUMMARY

Peromyscus californicus - California Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus californicus (Gambel 1848). Type from Monterey, Monterey Co., California.

Synonyms:

Mus californicus Gambel 1848

Peromyscus californicus Rhoads 1895

Peromyscus insignis Rhoads 1895

Hesperomys parasiticus Baird 1858

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains five subspecies as defined by Hall and Kelson (1959):

P. c. benitoensis Grinnell and Orr 1934. Type from near Cook Post Office, 1,300 ft., Bear Valley, San Benito Co., California.

P. c. californicus (Gambel 1848). See above.

P. c. insignis Rhoads 1895. Type from Dulzura, San Diego Co., California.

P. c. mariposae Grinnell and Orr 1934. Type from El Portal, 2,500 ft., Mariposa Co., California.

P. c. parasiticus (Baird 1858). Type from Santa Clara Valley, Santa Clara Co., California.

DIAGNOSIS

Without longitudinal grooves on upper incisors; mouse-like; coronoid process of the jaw lower than the condyloid process; tail usually more than 90 percent of head and body length; hind foot 25 mm or more; tail usually not sharply bicolored; premaxillary bones extending posteriorly to the nasals; M1 with no anterostyle outside the first primary fold, outer anterocunules as large as or larger than the paracone; skull large; braincase well inflated; tympanic bullae large, well inflated; molars robust; pelage long, lax; tail well haired but scaly annulations visible; two simple involutions apparent on labial sides of partly worn M1 and M2; ears conspicuous (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 220-226 mm; tail 117-148 mm; hind foot 25-29 mm; ear 20-28 mm (Ingles, 1965).

Skull characteristics. Greatest length 29.0-32.1 mm (Ingles, 1965).

Pelage. Upper parts approximately russet mixed with dark brown, the color varying with subspecies; underparts pale (approaching white), often with buffy pectoral spot; feet white or almost so; orbital ring dusky; tail bicolored, but usually not sharply so (Hall and Kelson, 1959).

Baculum. Length about 17 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Peromyscus californicus - California Mouse

- 2 -

GEOGRAPHIC RANGE

The range of the California mouse extends from northwestern Baja California following the Coastal Range to east of San Francisco Bay and the Sierra Nevada Range to Fresno County in California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper Sonoran (Ingles, 1965).

LIFE HISTORY SUMMARY

Peromyscus maniculatus - Deer Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus maniculatus (Wagner 1845). Type locality, the Moravian settlement in Labrador.

Synonyms:

Hesperomys maniculatus Wagner 1845
Peromyscus maniculatus Bangs 1898
Hesperomys arcticus Coues 1877
Hesperomys bairdii Coues 1877
Peromyscus canadensis Bangs 1896
Sitomys americanus Miller 1893
Peromyscus texanus Mearns 1896
Hesperomys austerus Baird 1855
Peromyscus akeleyi Elliot 1899
Mus bairdii Hoy and Kennicott 1857
Peromyscus sonoriensis Osgood 1904
Hesperomys leucopus Mearns 1890
Peromyscus catalinae Elliot 1903
Peromyscus cineritius J. A. Allen 1898
Peromyscus oresterus Elliot 1903
Peromyscus leucopus Rhoads 1896
Peromyscus dubius J. A. Allen 1898
Peromyscus exiguus J. A. Allen 1898
Hesperomys gambelii Baird 1858
Peromyscus geronimensis J. A. Allen 1898
Hesperomys gracilis Le Conte 1855
Peromyscus hylaenus Osgood 1908
Peromyscus sitkenensis Cowan 1935
Sitomys keeni Rhoads 1894
Peromyscus labacula Elliot 1903
Sitomys macrorhinus Rhoads 1894
Hesperomys sonoriensis Le Conte 1853
Peromyscus luteus Osgood 1905
Sitomys insolatus Rhoads 1894
Peromyscus oreas Bangs 1898
Peromyscus michiganensis J. A. Allen 1896
Peromyscus perimekurus Elliot 1903

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae.
This species contains 66 subspecies as defined by Hall and Kelson (1959):

- P. m. abietorum* Bangs 1896. Type from James River, Nova Scotia.
P. m. algidus Osgood 1909. Type from head of Lake Bennett (site of old Bennett City), British Columbia.
P. m. alpinus Cowan 1937. Type from Mt. Revelstoke, 6,000 ft., 19 mi. NE Revelstoke, British Columbia.

CONTEXT AND CONTENT (Cont'd)

- P. m. anacapae* von Bloeker 1942. Type from Fish Camp, West Anacapa Island, Ventura Co., California.
- P. m. angustus* Hall 1932. Type from Beaver Creek, 15 mi. NW Alberni, Vancouver Island, British Columbia.
- P. m. anticostiensis* Moulthrop 1937. Type from Fox Bay, E end Anticosti Island, Quebec.
- P. m. argentatus* Copeland and Church 1906. Type from Grand Harbor, Grand Manan Island, New Brunswick.
- P. m. artemisiae* (Rhoads 1894). Type from Ashcroft, British Columbia.
- P. m. assimilis* Nelson and Goldman 1931. Type from Coronadas Island, Baja California.
- P. m. austerus* (Baird 1855). Type from Old Fort Steilacoom, Pierce Co., Washington.
- P. m. bairdii* (Hoy and Kennicott 1857). Type from Bloomington, McLean Co., Illinois.
- P. m. balaclavae* McCabe and Cowan 1945. Type from Balaclava Island, British Columbia.
- P. m. beresfordi* Guiguet 1955. Type from Beresford Island, British Columbia.
- P. m. blandus* Osgood 1904. Type from Escalon, Chihuahua.
- P. m. borealis* Mearns 1890. Type from Fort Simpson, Mackenzie, N.W.T.
- P. m. cancrivorus* McCabe and Cowan 1945. Type from Table Island, Queen Charlotte Sound, British Columbia.
- P. m. carli* Guiguet 1955. Type from Cox Island, British Columbia.
- P. m. catalinae* Elliot 1903. Type from near Avalon, Santa Catalina Island, Santa Barbara Islands, Los Angeles Co., California.
- P. m. cineritius* J. A. Allen 1898. Type from San Roque Island, Baja California.
- P. m. clementis* Mearns 1896. Type from Pyramid Cove, SE end San Clemente Island, Santa Barbara Islands, California.
- P. m. coolidgei* Thomas 1898. Type from Santa Anita, cape region of Baja California.
- P. m. dorsalis* Nelson and Goldman 1931. Type from Natividad Island, Baja California.
- P. m. doylei* McCabe and Cowan 1945. Type from Doyle Island, Gordon Group, British Columbia.
- P. m. dubius* J. A. Allen 1898. Type from Todos Santos Island, Baja California.
- P. m. elusus* Nelson and Goldman 1931. Type from Santa Barbara Island, Ventura Co., California.
- P. m. eremus* Osgood 1909. Type from Pleasant Bay, Grindstone Island, Magdalen Islands, Quebec.
- P. m. exiguus* J. A. Allen 1898. Type from San Martin Island, Baja California.
- P. m. exterius* Nelson and Goldman 1931. Type from San Nicolas Island, Santa Barbara Co., California.
- P. m. fulvus* Osgood 1904. Type from city of Oaxaca, Oaxaca.
- P. m. gambelii* (Baird 1858). Type from Monterey, Monterey Co., California.
- P. m. georgiensis* Hall 1938. Type from Vananda, Texada Island, Georgia Strait, British Columbia.

CONTEXT AND CONTENT (Cont'd)

- P. m. geronimensis* J. A. Allen 1898. Type from San Geronimo Island, Baja California.
- P. m. gracilis* (Le Conte 1855). Type from Michigan.
- P. m. hollisteri* Osgood 1909. Type from Friday Harbor, San Juan Island, San Juan Co., Washington.
- P. m. hueyi* Nelson and Goldman 1932. Type from small island in Gonzaga Bay, Baja California.
- P. m. hylaeus* Osgood 1908. Type from Hollis, Kasaan Bay, Prince of Wales Island, Alaska.
- P. m. inclarus* Goldman 1939. Type from Fremont Island, 4,250 ft., Great Salt Lake, Weber Co., Utah.
- P. m. interdictus* Anderson 1932. Type from Forbidden Plateau, near E edge Strathcona Park, N of Mt. Albert Edward, about 17 mi. W Comox, 4,200 ft., Vancouver Island, British Columbia.
- P. m. isolatus* Cowan 1935. Type from Pine Island, Queen Charlotte Sound, N end Vancouver Island, British Columbia.
- P. m. keeni* (Rhoads 1894). Type from Massett, Graham Island, Queen Charlotte Islands, British Columbia.
- P. m. labecula* Elliot 1903. Type from Ocotlan, Jalisco.
- P. m. macrorhinus* (Rhoads 1894). Type from mouth of Skeena River, British Columbia.
- P. m. magdaleneae* Osgood 1909. Type from Magdalena Island, Baja California.
- P. m. maniculatus* (Wagner 1845). See above.
- P. m. margaritae* Osgood 1909. Type from Margarita Island, Baja California.
- P. m. maritimus* McCabe and Cowan 1945. Type from largest of Moore Islands, British Columbia.
- P. m. nebrascensis* (Coues 1877). Type from Deer Creek, Nebraska.
- P. m. rubiterrae* Rhoads 1896. Type from summit Roan Mtn., 6,370 ft., Mitchell Co., North Carolina.
- P. m. oreas* Bangs 1898. Type from Mount Baker Range, 6,500 ft., British Columbia, near boundary of Whatcom County, Washington.
- P. m. osgoodi* Mearns 1890. Type from Calf Creek, Custer Co., Montana.
- P. m. osarkianum* Black 1935. Type from 3 mi. S Winslow, Washington Co., Arkansas.
- P. m. pallascens* J. A. Allen 1896. Type from San Antonio, Bexar Co., Texas.
- P. m. plumbeus* C. F. Jackson 1939. Type from Pigou River, N shore Gulf of St. Lawrence, Saguenay Co., Quebec.
- P. m. pluvialis* McCabe and Cowan 1945. Type from northern island, Goose Island Group, British Columbia.
- P. m. rubidus* Osgood 1901. Type from Mendocino City, Mendocino Co., California.
- P. m. rubriventer* McCabe and Cowan 1945. Type from Ruth Island, Hunter Islands, British Columbia.
- P. m. rufinus* (Merriam 1890). Type from San Francisco Mtn., 9,000 ft., Coconino Co., Arizona.
- P. m. sanctaerosae* von Bloeker 1940. Type from Elderberry Canyon, Santa Rosa Island, Santa Barbara Co., California.
- P. m. santacruzae* Nelson and Goldman 1931. Type from Santa Cruz Island, Santa Barbara Co., California.
- P. m. sartiniensis* Guiguet 1955. Type from Sartine Island, British Columbia.

CONTEXT AND CONTENT (Cont'd)

P. m. saturatus Bangs 1897. Type from Saturna Island, Gulf of Georgia, between Victoria and Vancouver City, British Columbia.

P. m. saxamans McCabe and Cowan 1945. Type from Duncan Island, British Columbia.

P. m. serratus Davis 1939. Type from Mill Creek, 14 mi. W Challis, Custer Co., Idaho.

P. m. sonoriensis (Le Conte 1853). Type from Santa Cruz, Sonora.

P. m. streatori Nelson and Goldman 1931. Type from San Miguel Island, Santa Barbara Co., California.

P. m. triangularis Guiguet 1955. Type from Triangle Island.

DIAGNOSIS

Without longitudinal grooves on upper incisors; mouse-like; usually less than 260 mm total length; hind foot 24 mm or less; tail usually more than 70 percent of head and body length; coronoid process of the jaw lower than the condyloid process; tail bicolored, brown dorsally; ear usually 21 mm or less (from notch), less than hind foot length; more brownish dorsally than grayish, yellowish, or buffy; sole partially haired near the heel; M1 with anterocone inclined toward labial side, outer anterocone tending to be more rounded than angular, posterior end of tooth not indented; premaxillae do not extend posteriorly to the nasals; skull smooth and delicately built; braincase somewhat arched and well inflated; tympanic bullae moderate to small; rostrum slender, short, and tapered (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 121-222 mm; tail 46-123 mm; hind foot 17-25 mm; ear 12-20 mm; weight 15.4-30.0 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 24-26.5 mm; greatest breadth 11.0-12.3 mm; interorbital constriction 3.7-4.4 mm (Hall, 1946; Ingles, 1965).

Pelage. Upper parts varying with subspecies but, in general, usually varying from grayish buff to deep reddish brown overlaid in varying degree by dusky; underparts white; tail clothed with short hairs, sharply bicolored, dark above light below; feet whitish; ears have a fine edge of whitish and often a whitish or light reddish preauricular tuft of hairs. There are three pelages: juvenile, subadult and adult. The first pelage is distinctly gray and the color becomes progressively richer, that is, buffier, with succeeding molts (Hall, 1946; Hall and Kelson, 1959).

Baculum. Length approximately 7 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual Dimorphism. Using specimens from *P. m. gambelli* and *P. m. sonoriensis* found in Nevada, females averaged 2-5 percent larger than males in total length and 4-19 percent heavier (Hall, 1946).

GEOGRAPHIC RANGE

The range of the deer mouse extends from central Mexico to northern Canada, and from the Pacific coast to the Atlantic coast in the United States excluding the southeastern United States (Hall and Kelson, 1959).

Peromyscus maniculatus - Deer Mouse

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HABITAT

Life zones. Lower Sonoran into the Artic-Alpine Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY
Peromyscus boylii - Brush Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus boylii (Baird 1855). Type from Middle Fork of American River, near present town of Auburn, Eldorado Co., California.

Synonyms: *boylii* may be spelled as *boylei* by some authors as seen in Hall and Kelson (1959).

Hesperomys boylii Baird 1855
Peromyscus boylii Mearns 1896
Sitomys robustus J. A. Allen 1893
Peromyscus attwateri J. A. Allen
Peromyscus bellus Bangs 1896
Hesperomys astecus Saussure 1860
Peromyscus spicilegus J. A. Allen 1897
Peromyscus levipes Merriam 1898
Peromyscus sagax Elliot 1903
Peromyscus beatae Thomas 1903
Peromyscus madrensis Merriam 1898
Sitomys rowleyi J. A. Allen 1893
Sitomys major Rhoads 1893
Peromyscus gaurus Elliot 1903
Peromyscus parasiticus Elliot 1904
Peromyscus metallicola Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricitinae. This species contains 13 subspecies as defined by Hall and Kelson (1959):

- P. b. attwateri* J. A. Allen 1895. Type from Turtle Creek, Kerr Co., Texas.
- P. b. astecus* (Saussure 1860). Type from southern Mexico.
- P. b. boylii* (Baird 1855). See above.
- P. b. cordilleræ* Dickey 1928. Type from Mt. Cacaguatique, 3,500 ft., Dept. San Miguel, El Salvador.
- P. b. evides* Osgood 1904. Type from Juquila, Oaxaca.
- P. b. glasselli* Burt 1932. Type from San Pedro Nolasco Island, Gulf of California, Sonora.
- P. b. levipes* Merriam 1898. Type from Mt. Malinche, 8,400 ft., Tlaxcala.
- P. b. madrensis* Merriam 1898. Type from Maria Madre Island, Tres Marias Islands, Nayarit.
- P. b. rowleyi* (J. A. Allen 1893). Type from Noland Ranch, N side San Juan River, San Juan Co., about 1½ mi. above Four Corners, Utah.
- P. b. sacarensis* Dickey 1928. Type from San Jose del Sacare, 3,600 ft., Chalatenango, El Salvador.
- P. b. stimulus* Osgood 1904. Type from San Blas, Nayarit.
- P. b. spicilegus* J. A. Allen 1897. Type from Mineral San Sebastian, Mascota, Jalisco.
- P. b. utahensis* Durrant 1946. Type from 5 mi. above lower power station, 5,800 ft., Millcreek Canyon, Salt Lake Co., Utah.

DIAGNOSIS

Without longitudinal grooves on upper incisors; mouselike; usually less than 260 mm total length; tail usually more than 70 percent of head and body length; coronoid process of the jaw lower than the condyloid process; tail 90-120 mm long and not usually sharply bicolored; hind foot 24 mm or less; ear usually 21 mm or less (from notch), less than hind foot length; more brownish dorsally than grayish, yellowish, or buffy; sole partially haired near heel; M1 with anterocone wide and not noticeably inclined toward the labial side but deeply indented at the major fold, slightly indented at the minor fold, conules on the anterocone about the same size; premaxillary bones extending posteriorly to the end of the nasals; rostrum depressed; zygomata narrowing anteriorly; braincase rounded and inflated (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 180-238 mm; tail 91-123 mm; hind foot 20-26 mm; ear (notch) 13-21 mm; weight 25.5-35.6 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 27.1-28.5 mm; greatest breadth 12.4-13.2 mm; interorbital constriction 4.1-4.5 mm (Hall, 1946).

Pelage. Upper parts varying according to subspecies from dark, rich tawny or brownish to grayish buffy or cinnamon, purest on sides; underparts white or creamy; sometimes with buffy pectoral spot or suffusion; tail well haired, brownish above, white below; feet white (Hall and Kelson, 1959).

Baculum. Length 13.5 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the brush mouse extends from Honduras northward to southern Oregon and from northwestern Arkansas westward to the California coast (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran to Transition Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Peromyscus truei - Pinon Mouse

NOMENCLATURE AND SYNONYMY

Peromyscus truei (Shufeldt 1885). Type from Fort Wingate, McKinley Co., New Mexico.

Synonyms:

Hesperomys truei Shufeldt 1885
Peromyscus truei Thomas 1894
Hesperomys megalotis Merriam 1890
Peromyscus lastus Elliot 1904
Peromyscus dyselius Elliot 1898
Peromyscus gratus Merriam 1898
Sitomys gilberti J. A. Allen 1893
Peromyscus sagax Elliot 1903
Peromyscus pavidus Elliot 1903
Peromyscus zelotes Osgood 1904
Sitomys martirensis J. A. Allen 1893
Peromyscus hemionotis Elliot 1903
Peromyscus montipinoris Elliot 1904

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae.
This species contains 14 subspecies as defined by Hall and Kelson (1959):

- P. t. chlorus* Hoffmeister 1941. Type from Lost Horse Mine, S end Little San Bernardino Mts., 69 mi. E Riverside, Riverside Co., California.
P. t. dyselius Elliot 1898. Type from Portola, San Mateo Co., California.
P. t. erasmus Finley 1952. Type from 8 mi. NE Durango, 6,200 ft., Durango.
P. t. gentilis Osgood 1904. Type from Lagos, Jalisco.
P. t. gilberti (J. A. Allen 1893). Type from Bear Valley, San Benito Co., California.
P. t. gratus Merriam 1898. Type from Tlalpan, Distrito Federal, Mexico.
P. t. lagunae Osgood 1909. Type from La Laguna, Sierra Laguna, Baja California.
P. t. martirensis (J. A. Allen 1893). Type from Sierra San Pedro Martir, 7,000 ft., Baja California.
P. t. montipinoris Elliot 1904. Type from Lockwood Valley, near Mt. Pinos, Ventura Co., California.
P. t. nevadensis Hall and Hoffmeister 1940. Type from ½ mi. W Debbs Creek, 6,000 ft., Pilot Peak, Elko Co., Nevada.
P. t. preblei V. Bailey 1936. Type from Crooked River, 20 mi. SE (=12 mi. S, 6 mi. E) Prineville, Oregon.
P. t. sequoiensis Hoffmeister 1941. Type from 1 mi. W Guerneville, Sonoma Co., California.
P. t. truei (Shufeldt 1885). See above.
P. t. zapotecae Hooper 1957. Type from 1 mi. E Tlacolula, 5,700 ft., Oaxaca.

DIAGNOSIS

Tympanic bullae large and well inflated; braincase vaulted; zygomata slightly convergent anteriorly; coronoid process of the jaw lower than the condyloid process; premaxillary bones extending to or sometimes posterior to (1 mm or more) the nasals; without longitudinal grooves on upper incisors; M1 with compressed anterocone inclined toward the labial side, the outer conule smaller than the major cones but noticeably larger than the inner conule; ear usually 21 mm or more (from notch), about equal to or more than hind foot length; hind foot usually 24 mm or less; tail bicolored, usually more than 90 percent of head and body length; usually less than 260 mm total length; mouselike (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 170-231 mm; tail 76-123 mm; hind foot 20-27 mm; ear (notch) 18-27 mm; weight 20.0-29.1 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Greatest length 27.0-31.1 mm; greatest breadth 12.7-13.6 mm; interorbital constriction 4.3-4.7 mm (Hall, 1946; Ingles, 1965).

Pelage. Fur long and silky; upper parts approximately grayish brown but varying much geographically; underparts white or whitish; lateral line usually distinct; feet white; tail bicolor, brownish or dusky above, whitish below (Hall and Kelson, 1959).

Baculum. Length approximately 14.7 mm (Ingles, 1965).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the pinon mouse begins in southern Mexico and continues northward as a centrally located narrow band to the United States border at which point it extends as far north as central Oregon, as far east as southeastern Colorado, and to the Pacific coast in California. The northern part of Baja California and its southern tip are also included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. Upper parts of the Upper Sonoran through the lower parts of the Transition Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Sigmodon hispidus - Hispid Cotton Rat

NOMENCLATURE AND SYNONYMY

Sigmodon hispidus Say and Ord 1825. Type from St. Johns River, Florida.

Synonyms:

Sigmodon hispidus Say and Ord 1825

Sigmodon baileyi J. A. Allen 1903

Sigmodon berlandieri Baird 1855

Sigmodon borucae J. A. Allen 1897

Sigmodon austerulus Bangs 1902

Sigmodon mascotensis J. A. Allen 1897

Sigmodon colimae J. A. Allen 1897

Arvicola texiana Audubon and Bachman 1853

Hesperomys toltecus Saussure 1860

Sigmodon zanjonensis Goodwin 1932

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains 33 subspecies as defined by Hall and Kelson (1959):

S. h. alfredi Goldman and Gardner 1947. Type from I. N. Pruitt Farm, near William's Corner, 11 mi. N Springfield, Baca Co., Colorado.

S. h. arizonae Mearns 1890. Type from Fort Verde, Yavapai Co., Arizona.

S. h. baileyi J. A. Allen 1903. Type from La Cienega de las Vacas, 8,500 ft., Durango.

S. h. berlandieri Baird 1855. Type from Rio Nazas, Coahuila.

S. h. borucae J. A. Allen 1897. Type from Boruca, near Rio Diquis, 1,600 ft., about 12 mi. from Pacific Coast, Puntarenas, Costa Rica.

S. h. chiriquensis J. A. Allen 1904. Type from Boqueron, Chiriqui, Panama.

S. h. cienegae A. B. Howell 1919. Type from Bullock's Ranch, 4 mi. E Fort Lowell, Pima Co., Arizona.

S. h. confinis Goldman 1918. Type from Safford, Graham Co., Arizona.

S. h. exspatus G. M. Allen 1920. Type from Big Pine Key, one of the southern Florida Keys, Monroe Co., Florida.

S. h. floridanus A. H. Howell 1943. Type from Canal Point, Palm Beach Co., Florida.

S. h. furvus Bangs 1903. Type from La Ceiba, Atlantida, Honduras.

S. h. griseus J. A. Allen 1903. Type from lowlands east of Lake Nicaragua, Chontales, Nicaragua.

S. h. hispidus Say and Ord 1825. See above.

S. h. inesoratus Elliot 1903. Type from Ocotlan, Jalisco.

S. h. insulicola A. H. Howell 1943. Type from Captiva Island, Lee Co., Florida.

S. h. ischyryus Goodwin 1956. Type from "El Arco" Gorge of Rio Grande, Santo Domingo Chontecomatlan, District of Yauhtepec, 2,600 ft., Oaxaca.

S. h. jacksoni Goldman 1918. Type from 3 mi. N Fort Whipple, 5,000 ft., near Prescott, Yavapai Co., Arizona.

S. h. komareki Gardner 1948. Type from Woodville, 616 ft., Jackson Co., Alabama.

CONTEXT AND CONTENT (Cont'd)

- S. h. littoralis* Chapman 1889. Type from East Peninsula, opposite Micco, Brevard Co., Florida.
S. h. major V. Bailey 1902. Type from Sierra de Choix, 50 mi. (probably 10 or 15 mi.) NE Choix, Sinaloa.
S. h. mascotensis J. A. Allen 1897. Type from Mineral San Sebastian, Mascota, Jalisco.
S. h. micronod V. Bailey 1902. Type from Puerto Morelos, Quintana Roo.
S. h. obvelatus Russell 1952. Type from 5 mi. S Alpuycá, 3,700 ft., Morelos.
S. h. plenus Goldman 1928. Type from Parker, 350 ft., Yuma Co., Arizona.
S. h. saturatus V. Bailey 1902. Type from Teapa, Tabasco.
S. h. solus Hall 1951. Type from island 88 mi. S, 10 mi. W Matamoros, Tamaulipas.
S. h. spadiceipygus Bangs 1898. Type from Cape Sable, Monroe Co., Florida.
S. h. texianus (Audubon and Bachman 1853). Type from Brazos River, Texas.
S. h. toltecus (Saussure 1860). Type from mountains of Veracruz.
S. h. tonalenis V. Bailey 1902. Type from Tonala, Chiapas.
S. h. virginianus Gardner 1946. Type from Triplet, 160 ft., Brunswick Co., Virginia.
S. h. zanjonensis Goodwin 1932. Type from Zanjón, 9,000 ft., Quezaltenango, Guatemala.
S. h. eremicus Mearns 1897. Type from Cienega Well, 30 mi. S Monument No. 204, Mexican boundary line, on east bank Colorado River, Sonora.

DIAGNOSIS

Short swollen rostrum; premaxillae projecting behind nasals; well developed spinous process projecting anteriorly from outer wall of antorbital foramen; anterior margin of zygomatic plate concave, temporal ridges being continued as supraorbital ridge; interpterygoid space spatulate; skull relatively long and narrow; mastoid breadth usually less than 46 percent of basal length; skull with a deep notch at the antorbital foramen; palate extending behind the M3; without longitudinal grooves on upper incisors; cheek teeth semi-hypsodont; flat grinding surfaces of the molars have roughly S- or sigma-shaped ridges; ears nearly covered with hair; guard hairs at the lower anterior edge of the ear more than half as long as the ear; tail sparsely haired with scales clearly showing, less than half the total length; foot soles naked; pelage grizzled, blackish fur tipped with brown; mammae in five pairs; ratlike (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 224-365 mm; tail 81-166 mm; hind foot 28-41 mm; ear 16-24 mm; weight 117.4-241.0 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length (2) 33.9-50.0 mm; breadth of braincase (2) 14.9-16.5 mm; interorbital constriction (1) 5.0 mm (Hall, 1946).

Pelage. Upper parts coarsely grizzled; blackish or dark brownish hairs interspersed with buffy or grayish hairs, varying in over-all tone, according to subspecies; sides usually only slightly paler; underparts usually pale

Sigmodon hispidus - Hispid Cotton Rat

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MORPHOLOGICAL CHARACTERS (Cont'd)

to dark grayish, sometimes faintly washed with buff; tail coarsely annulated, sparsely haired; forefeet buffy; hind feet whitish or light buffy (Hall, 1946; Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Hall, 1946).

GEOGRAPHIC RANGE

The range of the hispid cotton rat extends from Panama north to Kansas and from eastern California through southern Arizona and New Mexico to the Atlantic coast between South Carolina and Florida and touching the coastline again in Virginia (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Neotoma fuscipes - Dusky-footed Wood Rat

NOMENCLATURE AND SYNONYMY

Neotoma fuscipes Baird 1858. Type from Petaluma, Sonoma Co., California.

Synonyms:

Neotoma fuscipes Baird 1858

Neotoma splendens True 1894

Neotoma macrotis Thomas 1893

Neotoma monchrourea Rhoads 1894

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae.
This species contains 11 subspecies as defined by Hall and Kelson (1959):

N. f. amecetens Elliot 1898. Type from Portola, San Mateo Co., California.

N. f. bullator Hooper 1938. Type from 2 mi. S San Miguel, 620 ft., San Luis Obispo Co., California.

N. f. fuscipes Baird 1858. See above.

N. f. luciana Hooper 1938. Type from Seaside, Monterey Co., California.

N. f. macrotis Thomas 1893. Type from San Diego, San Diego Co., California.

N. f. martirensis Orr 1934. Type from Valladares, 2,700 ft., Sierra San Pedro Martir, Baja California.

N. f. monochrourea Rhoads 1894. Type from Grants Pass, Josephine Co., Oregon.

N. f. perplexa Hooper 1938. Type from Sweeney's Ranch, 22 mi. S Los Banos, Merced Co., California.

N. f. riparia Hooper 1938. Type from Kincaid's Ranch, 2 mi. NE Vernalis, Stanislaus Co., California.

N. f. simplex True 1894. Type from Fort Tejon, Kern Co., California.

N. f. streator Merriam 1894. Type from Carbondale, Amador Co., California.

DIAGNOSIS

Skull large, long, relatively narrow; premaxillary tongues long; faint to moderate supraorbital ridge present; interpterygoid fossa usually narrow, or variable in shape anteriorly; audit bullae large; maxillary tooth row slightly narrower posteriorly than anteriorly; palate not extending posteriorly beyond the M3; without longitudinal grooves on upper incisors; molars with little "puddles" of dentine surrounded by enamel on the flat grinding surface; posterior external angle of the M3 bent posteriorly at about a 45 degree angle; tail scaly or with hairs less than 10 mm long; hind foot normally more than 31 mm; hind foot naked from heel along the outside to the posterior tubercle; usually more than 260 mm total length; hairs on throat white to roots; guard hairs at the lower anterior edge of the ear less than half as long as the ear; ratlike; tail almost as long as head and body (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 335-470 mm; tail 152-241 mm; hind foot 32-47 mm (Hall and Kelson, 1959; Ingles, 1965).

Neotoma fuscipes - Dusky-footed Wood Rat

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MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Basilar length 36.3-44.7 mm (Ingles, 1965).

Pelage. Upper parts ochraceous buff; darkened dorsally by dusky hairs, usually much grayer on face; underparts white, sometimes washed with tawny or pale buff, hairs plumbeous basally except on throat, chest and inguinal region where hairs are white to roots; feet and ankles usually dusky, sometimes white distally; tail dark above sometimes lighter below but not sharply bicolored (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the dusky-footed wood rat extends from northwestern Baja California northward through most of California west of the Sierra Nevada into western Oregon (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper Sonoran into the Transition Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY

Neotoma cinerea - Bushy-tailed Wood Rat

NOMENCLATURE AND SYNONYMY

Neotoma cinerea (Ord 1815). Type locality, near Great Falls, Cascade Co., Montana.

Synonyms:

Mus cinereus Ord 1815
Neotoma cinerea Baird 1858
Tenoma cinerea Elliot 1904
Neotoma arizonae Merriam 1893
Neotoma cinnamomea J. A. Allen 1895
Myoxus drummondii Richardson 1828
Neotoma occidentalis Baird 1855
Neotoma fuscus Elliot 1903
Neotoma orolestes Merriam 1894
Neotoma grangeri J. A. Allen 1894
Neotoma rupicola J. A. Allen 1894
Neotoma sawamans Osgood 1900

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Cricetinae. This species contains 14 subspecies as defined by Hall and Kelson (1959):

- N. c. acraia* (Elliot 1904). Type from Jordan Hot Springs, near Kern River, Sierra Nevada, Tulare Co., California.
- N. c. alticola* Hooper 1940. Type from Parker Creek (= Shields Creek, U. S. Forest Service map, 1932 edition), 5,500 ft., Warner Mts., Modoc Co., California.
- N. c. arizonae* Merriam 1893. Type from Keams Canyon, Navajo Co., Arizona.
- N. c. cinerea* (Ord 1815). See above.
- N. c. cinnamomea* J. A. Allen 1895. Type from Kinney Ranch, Bitter Creek, Sweetwater Co., Wyoming.
- N. c. drummondii* (Richardson 1828). Type locality, probably near Jasper House, Alberta.
- N. c. fusca* True 1894. Type from Fort Umpqua, Douglas Co., Oregon.
- N. c. lucida* Goldman 1917. Type from Charleston Peak, Charleston Mts., Clark Co., Nevada.
- N. c. macrodon* Kelson 1949. Type from east side confluence Green and White rivers, 4,700 ft., 1 mi. SE Ouray, Uintah Co., Utah.
- N. c. occidentalis* Baird 1855. Type from Shoalwater (=Willapa) Bay, Pacific Co., Washington.
- N. c. orolestes* Merriam 1894. Type from Saguache Valley, 20 mi. W Saguache, Saguache Co., Colorado.
- N. c. pulla* Hooper 1940. Type from Kohnenberger's Ranch, South Fork Mtn., 3,200 ft., Trinity Co., California.
- N. c. rupicola* J. A. Allen 1894. Type from Corral Draw, 3,700 ft., Pine River Indian Reservation, Black Hills, South Dakota.
- N. c. sawamans* Osgood 1900. Type from Bennett City, head Lake Bennett, British Columbia.

DIAGNOSIS

Skull with relatively short braincase; anterior palatine foramina longer than palatal bridge; sphenopalatine vacuities present or absent, but relatively constant within a series; palate not extending posteriorly beyond the M3; without longitudinal grooves on upper incisors; M1 with deep anterointernal reentrant angle; M3 anterior closed triangle and two confluent posterior loops; molars with little "puddles" of dentine surrounded by enamel on the flat grinding surface; first cheek-tooth only slightly wider than last tooth; tail covered with hair more than 20 mm long; hind foot furred from heel to posterior tubercle; usually more than 260 mm total length; large dermal gland, which secretes distinctive odor, on middle of abdomen; guard hairs at the lower anterior edge of the ear less than half as long as the ear; ratlike; tail about three-fourths of length of head and body (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 282-470 mm; tail 120-223 mm; hind foot 33-52 mm; weight 218.0-584.7 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Basilar length 38.1-50.5 mm; zygomatic breadth 23.3-30.4 mm; interorbital breadth 5.4-6.8 mm (Hall, 1946).

Pelage. Upper parts varying from pale gray lightly washed with buff to dark brownish black; underparts varying from white to pinkish or buff; tail dusky above, much paler (usually whitish) below (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Females are smaller than males (Hall, 1946).

GEOGRAPHIC RANGE

The range of the bushy-tailed wood rat extends from southern Yukon south to northern Arizona and New Mexico and from central North and South Dakota west to the Pacific coast between central British Columbia and northern California. The animal is also found in the Sierra Nevada mountains in eastern California (Hall and Kelson, 1959; Ingles, 1965).

HABITAT

Life zones. Upper Sonoran through the Hudsonian Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Microtus montanus - Montane Vole

NOMENCLATURE AND SYNONYMY

Microtus montanus (Peale 1848). Type from headwaters of the Sacramento River, near Mt. Shasta, Siskiyou Co., California.

Synonyms:

Arvicola montana Peale 1848
Microtus montanus Trouessart 1897
Arvicola longirostris Baird 1858
Microtus nanus Merriam 1891
Microtus canicaudus Miller 1897
Microtus dutcheri V. Bailey 1898
Microtus nevadensis V. Bailey 1898

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Microtinae. This species contains 18 subspecies as defined by Hall and Kelson (1959):

- M. m. amosus* Hall and Hayward 1941. Type from Torrey, Wayne Co., Utah.
M. m. arizonensis V. Bailey 1898. Type from Springerville, Apache Co., Arizona.
M. m. canescens V. Bailey 1898. Type from Conconully, Okanogan Co., Washington.
M. m. canicaudus Miller 1897. Type from McCoy, Willamette Valley, Polk Co., Oregon.
M. m. oodiensis S. Anderson 1954. Type from 3 1/5 mi. E and 3/5 mi. S Cody, 5,020 ft., Park Co., Wyoming.
M. m. dutcheri V. Bailey 1898. Type from Big Cottonwood Meadows, 10,100 ft., SE of Mt. Whitney, Inyo Co., California.
M. m. fuscus Hall 1935. Type from Hiko, 4,000 ft., Pahrnagat Valley, Lincoln Co., Nevada.
M. m. fusus Hall 1938. Type from 2 1/2 mi. E Cochetopa Pass, Saguache Co., Colorado.
M. m. micropus Hall 1935. Type from Cleveland Ranch, 6,000 ft., Spring Valley, White Pine Co., Nevada.
M. m. montanus (Peale 1848). See above.
M. m. nanus (Merriam 1891). Type from Pahsimeroi Mts., head of Pahsimeroi River, 9,350 ft., Custer Co., Idaho.
M. m. nevadensis V. Bailey 1898. Type from Ash Meadows, Nye Co., Nevada.
M. m. nexus Hall and Hayward 1941. Type from West Canyon, Oquirrh Range, Utah Co., Utah.
M. m. pratensis Hall and Kelson 1951. Type from 6 mi. E Hamilton, 3,700 ft., Ravalli Co., Montana.
M. m. rivularis V. Bailey 1898. Type from St. George, Washington Co., Utah.
M. m. undosus Hall 1935. Type from Lovelock, Pershing Co., Nevada.
M. m. yosemite Grinnell 1914. Type from Yosemite Valley, 4,000 ft., Mariposa Co., California.
M. m. zygomaticus S. Anderson 1954. Type from Medicine Wheel Ranch, 9,000 ft., 28 mi. E Lovell, Big Horn Co., Wyoming.

DIAGNOSIS

Skull rugose, heavily ridged in adults; anterior part of the incisive foramen clearly wider than the posterior part; posterior edge of the palate not a transverse shelf; palate with many small holes; upper incisors not grooved or equally bicolored longitudinally (yellow inside, white outside); M3 with four projections on the lingual side; angle between the last two projections on lingual side of M3 wider than deep; M3 often with a pronounced "heel" posteriorly; M2 without a rounded posterior loop on the lingual side; four loops in all; ears nearly concealed, with no ear patch of black fur; tail not laterally compressed; tail usually longer than 10 mm beyond the extended hind legs; tail usually less than one-third of total length, nearly unicolored, sometimes more or less bicolored; hind feet 26 mm or less; six plantar tubercles; cheek teeth not rooted (Hall, 1946; Ingles; 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 140-192 mm; tail 30-70 mm; hind foot 18-25 mm; ear 10-17 mm; weight 37.3-85.0 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Condylobasal length 25.0-33.2 mm; zygomatic breadth 14.0-18.8mm; interorbital breadth 3.3-4.0 mm; mastoidal breadth 11.4-14.1 mm (Hall, 1946).

Pelage. Upper parts some shade of brownish, often with buffy or grayish wash, and a mixture of black-tipped hairs; sides lighter and more buffy; venter white to gray, sometimes with buffy; tail bicolor, blackish brown to black above, grayish below (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Males average larger than females by a little more than one percent in external measurements, five percent in weight, and by about one percent in measurements of length of skull (Hall, 1946).

GEOGRAPHIC RANGE

The range of the montane vole extends from central British Columbia south to northwestern New Mexico and central-eastern Arizona and from central Montana, eastern Wyoming and central Colorado west to include northeastern California, most of Oregon, and eastern Washington (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran through Canadian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Microtus californicus - California Vole

NOMENCLATURE AND SYNONYMY

Microtus californicus (Peale 1848). Type from vicinity of San Francisco Bay, California, probably at San Francisquito Creek, near Palo Alto, Santa Clara Co.

Synonyms:

Arviola californica Peale 1848
Microtus californicus Trouessart 1897
Arviola edam Le Conte 1853
Arviola townbridgii Baird 1858
Microtus scirpensis V. Bailey 1900

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Microtinae. This species contains 16 subspecies as defined by Hall and Kelson (1959):

- M. c. aequivocatus* Osgood 1928. Type from San Quintin, Baja California.
- M. c. aestuarinus* R. Kellogg 1918. Type from Grizzly Island, Solano Co., California.
- M. c. californicus* (Peale 1848). See above.
- M. c. constrictus* V. Bailey 1900. Type from Cape Mendocino, Humboldt Co., California.
- M. c. eximius* R. Kellogg 1918. Type from Lierly's Ranch, 2,340 ft., 4 mi. S Mt. Sanhedrin, Mendocino Co., California.
- M. c. grinnelli* Huey 1931. Type from Sangre de Cristo in Valle San Rafael on W base Sierra Juarez, Baja California.
- M. c. halophilus* von Bloeker 1937. Type from Moss Landing, Monterey Co., California.
- M. c. hyperathrus* Elliot 1903. Type from La Grulla, San Pedro Martir Mts., Baja California.
- M. c. kernensis* R. Kellogg 1918. Type from Fay Creek, 4,100 ft., Kern Co., California.
- M. c. mariposae* R. Kellogg 1918. Type from 1 3/4 mi. W El Portal, 1,800 ft., Mariposa Co., California.
- M. c. mohavensis* R. Kellogg 1918. Type from Victorville, 2,700 ft., San Bernardino Co., California.
- M. c. paludicola* Hatfield 1935. Type from Melrose Marsh, Alameda Co., California.
- M. c. sanotidiegi* R. Kellogg 1918. Type from Escondido, 640 ft., San Diego Co., California.
- M. c. scirpensis* V. Bailey 1900. Type from spring near Shoshone, 1,560 ft., on Amargosa River, eastern Inyo Co., California.
- M. c. stephensi* von Bloeker 1932. Type from Playa del Rey, Los Angeles Co., California.
- M. c. vallicola* V. Bailey 1898. Type from Lone Pine Creek, 4,500 ft., where it cuts through Alhambra Hills near Lone Pine, Inyo Co., California.

DIAGNOSIS

Incisive foramen nearly parallel with the posterior half, usually slightly wider than the anterior half, rounded at both ends and widest at the middle; posterior edge of the palate not a transverse shelf; palate with many small holes; upper incisors not grooved or equally bicolored longitudinally; M3 with four projections on lingual side; angle between the last two projections of the lingual side of M3 wider than deep; M3 often with a pronounced "heel" posteriorly; cheek teeth not rooted; tail not laterally compressed; tail usually longer than 10 mm beyond the extended hind legs; tail usually less than 50 percent of head and body length; hind foot 26 mm or less; six plantar tubercles (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 157-214 mm; tail 44-67 mm; hind foot 20.0-25.5 mm; ear 15 mm; weight average 53.0 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 26.0-29.5 mm (Ingles, 1965).

Pelage. Upper parts vary from tawny olive through cinnamon brown, with mixture of long, dark overhairs that vary from light seal brown to black; sides lighter, with fewer long overhairs; venter neutral gray, often with white tipped hairs; tail bicolor, clove brown to black above, grayish below (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the California vole extends from northern Baja California through most of California to central Oregon (Hall and Kelson, 1959).

HABITAT

Life zones. Lower and Upper Sonoran life zones (Ingles, 1965).

LIFE HISTORY SUMMARY

Microtus longicaudus - Long-tailed Vole

NOMENCLATURE AND SYNONYMY

Microtus longicaudus (Merriam 1888). Type from Custer, 5,500 ft., Black Hills, Custer Co., South Dakota.

Synonyms:

Arviola longicaudus Merriam 1888
Microtus longicaudus J. A. Allen 1895
Microtus mordax Merriam 1908
Arviola alticolus Merriam 1890
Microtus angusticeps V. Bailey 1898
Arviola leucophaeus J. A. Allen 1894
Microtus macrurus Merriam 1898
Arviola mordax Merriam 1891
Microtus vellerosus J. A. Allen 1899
Microtus cautus J. A. Allen 1899

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Microtinae.
This species contains 14 subspecies as defined by Hall and Kelson (1959):

- M. l. abditus* A. B. Howell 1923. Type from Walker's Ranch, Pleasant Valley, 8 mi. S Tillamook, Tillamook Co., Oregon.
- M. l. alticola* (Merriam 1890). Type from Little Spring, 8,200 ft., San Francisco Mtn., Coconino Co., Arizona.
- M. l. angusticeps* V. Bailey 1898. Type from Crescent City, Del Norte Co., California.
- M. l. baileyi* Goldman 1938. Type from Greenland Spring, head of Bright Angel Creek, 8,000 ft., Grand Canyon National Park, Coconino Co., Arizona.
- M. l. bernardinus* Merriam 1908. Type from Dry Lake, 9,000 ft., San Bernardino Mts., San Bernardino Co., California.
- M. l. halli* Hayman and Holt 1931. Type from Godman (=Goodman) Springs, 5,700 ft., Blue Mts., Columbia Co., Washington.
- M. l. latus* Hall 1931. Type from Wisconsin Creek, 8,500 ft., Toyabee Mts., Nye Co., Nevada.
- M. l. leucophaeus* (J. A. Allen 1894). Type from Graham Mts., Graham Co., Arizona.
- M. l. littoralis* Swarth 1933. Type from Shakan, Prince of Wales Island, Alaska.
- M. l. longicaudus* (Merriam 1888). See above.
- M. l. macrurus* Merriam 1898. Type from Lake Cushman, Olympic Mts., Mason Co., Washington.
- M. l. mordax* (Merriam 1891). Type from Sawtooth (or Alturas) Lake, 7,200 ft., east base of Sawtooth Mts., Blaine Co., Idaho.
- M. l. sierrae* R. Kellogg 1922. Type from Tuolumne Meadows, 8,600 ft., Yosemite National Park, California.
- M. l. vellerosus* J. A. Allen 1899. Type from upper Liard River, British Columbia.

Diagnosis

Skull relatively smooth, not heavily ridged; incisive foramen is narrower posteriorly but is not abruptly constricted; posterior edge of the palate not a transverse shelf; palate with many small holes; upper incisors not grooved or equally bicolored longitudinally (yellow inside, white outside); M3 with four projections on the lingual side; angle between the last two projections on the lingual side of M3 wider than deep; M3 often with a pronounced "heel" posteriorly; cheek teeth not rooted; middle upper molar with four closed triangles; tail not laterally compressed; tail usually longer than 10 mm beyond extended hind legs; tail usually more than 50 percent of head and body length and more or less bicolored; hairs on tip of tail 3-5 mm; hind foot 26 mm or less; six plantar tubercles (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 155-221 mm; tail 50-93 mm; hind foot 19-26 mm; ear 13-14 mm; weight 39.0-58.4 g (Hall, 1946; Ingles, 1965).

Skull characteristics. Condylbasilar length 25.6-30.0 mm; zygomatic breadth 14.0-13.8 mm; interorbital breadth 3.5-3.9 mm; mastoid breadth 11.5-13.6 mm (Hall, 1946; Ingles, 1965).

Pelage. Upper parts vary from dull grayish bistre through brownish gray to dark sepia brown, all with mixture of numerous black tipped hairs; sides slightly paler causing more reddish back to stand out as a wide band; venter plumbeous with light to heavy wash of whitish to dull buffy; tail long, indistinctly to distinctly bicolored, brownish to black above, soiled whitish to gray below (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Males average slightly larger than females in length of hind foot and in eight cranial measurements; however, in total length, length of tail, and weight, the females are a fraction of one percent larger (Hall, 1946).

GEOGRAPHIC RANGE

The range of the long-tailed vole extends from eastern Alaska through most of British Columbia south to include most of New Mexico and from the Pacific coast between northern California and southeastern Alaska to the Rocky Mountains (Hall and Kelson, 1959).

HABITAT

Life zones. Transition through the Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY
Ondatra zibethicus - Muskrat

NOMENCLATURE AND SYNONYMY

Ondatra zibethicus (Linnaeus 1766). Type from eastern Canada.

Synonyms:

Castor zibethicus Linnaeus 1766
Ondatra zibethicus Link 1795
Ondatra americana Tiedemann 1808
Fiber zibethicus Sabine 1823
Fiber macrodon Merriam 1897
Fiber niger Brass 1911
Fiber occipitalis Elliot 1903
Fiber osoyoosensis Lord 1863
Fiber spatulatus Osgood 1900

CONTEXT AND CONTENT

Order Rodentia; Suborder Myomorpha; Family Cricetidae; Subfamily Microtinae.
This species contains 15 subspecies as defined by Hall and Kelson (1959):

- O. z. albus* (Sabine 1823). Type from Cumberland House, Saskatchewan.
- O. z. aquilonius* (Bangs 1899). Type from Rigolet, Hamilton Inlet, Labrador.
- O. z. bernardi* Goldman 1932. Type from 4 mi. S Gadsden, Yuma Co., Arizona.
- O. z. cinnamominus* (Hollister 1910). Type from Wakeeney, Trego Co., Kansas.
- O. z. goldmani* Huey 1938. Type from Saint George, Washington Co., Utah.
- O. z. macrodon* (Merriam 1897). Type from Lake Drummond, Dismal Swamp, Norfolk Co., Virginia.
- O. z. mergens* (Hollister 1910). Type from Fallon, Churchill Co., Nevada.
- O. z. occipitalis* (Elliot 1903). Type from Florence, Lane Co., Oregon.
- O. z. osoyoosensis* (Lord 1863). Type from Lake Osoyoos, British Columbia.
- O. z. pallidus* (Mearns 1890). Type from Fort Verde, Yavapai Co., Arizona.
- O. z. ripensis* (V. Bailey 1902). Type from Eddy, near Carlsbad, Eddy Co., New Mexico.
- O. z. rivalis* (Bangs 1895). Type from Burbridge, Plaquemines Parish, Louisiana.
- O. z. spatulatus* (Osgood 1900). Type from Lake Marsh, Yukon.
- O. z. zalophus* (Hollister 1910). Type from Becharof Lake, Alaska Peninsula, Alaska.
- O. z. zibethicus* (Linnaeus 1766). See above.

DIAGNOSIS

Skull rough; squamosals enlarged at expense of parietals; posterior border of palate terminating in median spinous process; M1 with six triangles between anterior loop and posterior loop; first one of six triangles not closed; anterior loop bilobed and with deep reentrant angles; M3 with three outer salient angles; incisors with anterior faces smooth; roots of lower incisors on outside of cheek teeth; molars rooted in adults; eyes small; ears short; tail laterally compressed, relatively long, and more or less naked but with well developed swimming-fringe below; hind foot more than

DIAGNOSIS (Cont'd)

50 mm, partly webbed; hind foot much larger than forefoot, with conspicuous swimming fringes; fur thick and soft; mammae eight to ten or even eleven, two pairs inguinal, others pectoral (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 409-620 mm; tail 170-295 mm; hind foot 62-88 mm; ear (crown) 13-20 mm; weight 541-1,575 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Basilar length 46.0-54.0 mm; zygomatic breadth 34.6-44.0 mm (Hall and Kelson, 1959; Ingles, 1965).

Pelage. Upper parts vary from a bright rusty red through several shades of brown to almost black; sides from bright rusty red to Prout's brown; venter from whitish to broccoli brown with washes of varying intensities of rufous, cinnamon and brownish; feet pinkish gray to dark brown (Hall and Kelson, 1959).

Dentition. The dental formula is 1-0-0-3/1-0-0-3 (Ingles, 1965).

Sexual dimorphism. Cranial measurements are two to three percent larger in males (Hall, 1946).

GEOGRAPHIC RANGE

The range of the muskrat extends from Alaska and Canada south to the Atlantic coast of North Carolina, to the Gulf of Mexico coast between Alabama and Texas, and to the Pacific coast of Oregon. The range spreads in amoeboid fashion through California, Nevada, Arizona, New Mexico, and Texas (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran through the Canadian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Erethizon dorsatum - Porcupine

NOMENCLATURE AND SYNONYMY

Erethizon dorsatum (Linnaeus 1758). Type locality, eastern Canada.

Synonyms:

Hystrix dorsata Linnaeus 1758

Erethizon dorsatum F. Cuvier 1822

Erethizon epixanthum Swenk 1916

Erethizon epixanthus Brandt 1835

Erethizon (sic) dorsatus True 1884

CONTEXT AND CONTENT

Order Rodentia; Suborder Hystricomorpha; Superfamily Erethizontoidea; Family Erethizontidae. This species contains seven subspecies as defined by Hall and Kelson (1959):

E. d. bruneri Swenk 1916. Type from 3 mi. E Mitchell, Scotts Bluff Co., Nebraska.

E. d. couesi Mearns 1897. Type from Fort Whipple, Yavapai Co., Arizona.

E. d. dorsatum (Linnaeus 1758). See above.

E. d. epixanthum Brandt 1835. Type locality, California.

E. d. myops Merriam 1900. Type from Portage Bay, Alaska Peninsula, Alaska.

E. d. nigrescens J. A. Allen 1903. Type from Shesley River, British Columbia.

E. d. pinum Bangs 1900. Type from L'Anse au Loup, Strait of Belle Isle, Labrador.

DIAGNOSIS

Nasals extending far behind premaxillae; well developed sagittal crest in adults; infraorbital canal about twice the area of the foramen magnum; zygoma uncomplicated; jugal deeper anteriorly; mandible with low coronoid and angular processes; length of diastema more than that of the upper cheek teeth; incisors above and below smooth and red on anterior face; upper cheek teeth with one persistent internal and one persistent external fold, two additional outer folds tend to become isolated with wear; tail less than a third of total length; foot soles naked; four clawed digits on forefeet and five clawed digits on hind feet; mammae in three pairs, one pair pectoral and two pairs abdominal; upper parts yellowish or, rarely, black; hair of three kinds: quills, hair, fur (Hall, 1946; Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 648-860 mm; tail 148-300 mm; hind foot 86-124 mm; ear about 27 mm; weight 4.5-12.7 kg (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 90-110 mm; zygomatic breadth 68.1-78.3 mm; mastoid breadth 42.5-49.0 mm; least interorbital breadth 26.4-37.4 mm (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. The hair is of three kinds: (1) quills up to 75 mm long and 2 mm in diameter, white or light yellowish-white except for about the distal 10 mm, which is black, (2) hair up to 175 mm long, which is distally yellow, basally white and black in the middle half (in an occasional specimen the base is also black), (3) fur, in winter-taken specimens up to 100 mm long, black except for the basal third, which is white. In winter this fur projects beyond and conceals the quills. In summer-taken specimens the fur is absent or short. On the underside of the body, throat, chin, cheeks posteriorly to the level of the eyes and nose, quills are lacking, the fur is shorter than elsewhere, and the coarser hairs lack the distal yellowish pigment and are black throughout their length (Hall, 1946).

Dentition. The dental formula is 1-0-1-3/1-0-1-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the porcupine extends from the eastern two-thirds of Alaska and most of Canada south to the Atlantic coast of Virginia and to the Pacific coast of extreme northern California, and continues southward through most of California into northern Mexico. The range of the porcupine does not include the southeastern states or most of Texas (Hall and Kelson, 1959).

HABITAT

Life zones. Upper Sonoran through Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Urocyon cinereoargenteus - Gray Fox

NOMENCLATURE AND SYNONYMY

Urocyon cinereoargenteus (Schreber 1775). Type locality, eastern North America.

Synonyms:

Canis cinereo argenteus Schreber 1775

Urocyon cinereo-argenteus Rhoads 1894

Urocyon virginianus Schreber 1775

Vulpes pensylvanicus Boddaert 1784

Canis nigristrostris Lichtenstein 1850

Urocyon guatemalae Miller 1899

Urocyon californicus Merriam 1899

CONTEXT AND CONTENT

Order Carnivora; Family Canidae. This species contains 15 subspecies as defined by Hall and Kelson (1959).

U. c. borealis Merriam 1903. Type from Marlboro, 7 mi. from Monadnock, Cheshire Co., New Hampshire.

U. c. californicus Mearns 1897. Type from Tahquitz Valley, San Jacinto Mts., Riverside Co., California.

U. c. cinereoargenteus (Schreber 1775). See above.

U. c. nigristrostris (Lichtenstein 1850). Type from Real Arriba, Estado Mexico.

U. c. costaricensis Goodwin 1938. Type from Sabanilla de Pirris, Province of San Jose, Costa Rica.

U. c. floridanus Rhoads 1895. Type from Tarpon Springs, Hillsboro Co., Florida.

U. c. fraterculus Elliot 1896. Type from San Felipe, Yucatan.

U. c. furvus G. M. Allen and Barbour 1923. Type from 3 mi. W Balboa, Canal Zone.

U. c. guatemalae Miller 1899. Type from Nenton, Huehuetenango, Guatemala.

U. c. madrensis Burt and Hooper 1941. Type from Carimechi, Rio Mayo, Chihuahua.

U. c. ocythous Bangs 1899. Type from Platteville, Grant Co., Wisconsin.

U. c. orinomus Goldman 1938. Type from Orizaba, Veracruz.

U. c. peninsularis Huey 1928. Type from San Ignacio, Cape Region, Baja California.

U. c. scottii Mearns 1891. Type from Pinal Co., Arizona.

U. c. townsendi Merriam 1899. Type from Baird, Shasta Co., California.

DIAGNOSIS

Skull less than 160 mm; skull with lyre- or U-shaped temporal ridges; mandible with a distinct step; postorbital processes thin and concave on dorsal surface; 42 teeth; tail as long as or longer than hind foot; with a band of coarse black hairs running dorsally down to the black tip of tail; tail triangular in cross section; tail more than 12 inches (300 mm) in length; glandular area on top of tail in its middle third; hind foot less

DIAGNOSIS (Cont'd)

than 150 mm; gray dorsally; less than 100 pounds (45.4 kg); fox-like (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 800-1,125 mm; tail 275-443 mm; hind foot 100-150 mm; ear (crown) 60-100 mm; weight 2.4-3.6 kg (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 110-131 mm; mastoidal breadth (2) 41.1-41.2 mm; zygomatic breadth (2) 58.5-63.0 mm; least interorbital breadth (2) 21.3-23.8 mm (Hall, 1946; Ingles, 1965).

Pelage. Throat white; face gray; sides of neck, lower flanks and underparts of tail rusty; tail with median dorsal streak of black hair; upper parts gray (Hall and Kelson, 1959).

Dentition. The dental formula is 3-1-4-2/3-1-4-3 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the gray fox extends from northeast and central Canada to South America excluding the northwestern United States (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran through Transition Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY
Bassariscus astutus - Ringtail

NOMENCLATURE AND SYNONYMY

Bassariscus astutus (Lichtenstein 1830). Type from near city of Mexico.

Synonyms:

Bassariscus astutus Lichtenstein 1830
Bassariscus astutus Coues 1887
Bassariscus albipes Elliot 1904
Bassariscus flavus Rhoads 1894
Bassariscus saxicola Merriam 1897
Bassariscus raptor Baird 1859

CONTEXT AND CONTENT

Order Carnivora; Family Procyonidae; Subfamily Procyoninae. This species contains 14 subspecies as defined by Hall and Kelson (1959):

- B. a. astutus* (Lichtenstein 1830). See above.
- B. a. arizonensis* Goldman 1932. Type from Cosper Ranch, about 12 mi. south of Blue, 5,000 ft., Greenlee Co., Arizona.
- B. a. bolei* Goldman 1945. Type from Chilpancingo, Guerrero.
- B. a. consitus* Nelson and Goldman 1932. Type from La Salada, 40 mi. S Uruapan, Michoacan.
- B. a. flavus* Rhoads 1894. Type from Texas, exact locality unknown.
- B. a. insulicola* Nelson and Goldman 1909. Type from San Jose Island, Gulf of California, Baja California.
- B. a. macedougalli* Goodwin 1956. Type from La Ventosa, Salina Cruz, coastal lowlands, 20 km S Tehuantepec, Oaxaca.
- B. a. nevadensis* Miller 1913. Type from El Dorado Canyon, Clark Co., Nevada.
- B. a. octavus* Hall 1926. Type from San Luis River, 1,700 ft., near Escondido, San Diego Co., California.
- B. a. palmarius* Nelson and Goldman 1909. Type from Comondú, Baja California.
- B. a. raptor* (Baird 1859). Type from Glen Ellen, Sonoma Co., California.
- B. a. saxicola* Merriam 1897. Type from Espiritu Santo Island, Gulf of California, Baja California.
- B. a. willetti* Stager 1950. Type from Riverside Mountains, Riverside Co., California.
- B. a. yumanensis* Huey 1937. Type from Tinajas Altas, Gila Mts., Yuma Co., Arizona.

DIAGNOSIS

Skull elongate; postorbital processes well developed from frontal, moderately from zygomata; temporal crests uniting, if at all, only posteriorly to form sagittal crest; palate ending about posterior plane of M2; auditory bullae moderately inflated; posterior border of maxillary portion of zygoma lying at plane of M1; foramen ovale opening somewhat downward; muzzle moderately elongate; P1-3 unicuspid; P4 sectorial with well developed blade; deuterocone present posterior to protocone of P4; M1 variable, subquadrate to triangular, broader than long; canines doglike, smooth, slightly curved, not sculptured; cusps in larger molariform teeth with high connecting ridges; upper carnassial irregular in outline with prominent deuterocone; cutting edges of I1

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DIAGNOSIS (Cont'd)

and 12 normally smooth; ears relatively long with well developed bursa; margins of ears somewhat produced anteroexternally; tail longer than body, distinctly annulated; feet with five toes, 2nd, 3rd, 4th, and 5th digits of fore and hind limbs densely haired on lower surface behind and around digital pads; claws short, straight, semi-retractile; body elongate; baculum with rounded apex (Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 616-811 mm; tail 310-438 mm; hind foot 57-78 mm; ear (crown) 40-50 mm; weight 870-1,100 g (Hall and Kelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 74-80 mm; zygomatic breadth 46.3-52.0 mm; mastoidal breadth 33.4-35.4 mm; least interorbital constriction (2) 14.1-15.3 mm (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Pelage. Light buff overcast with blackish and dark brownish pigment in the tips of the overhairs; the eye is ringed with black except that in some animals the back part of the superior border is white; the supraorbital, suborbital, subauricular patches, and upper lips are white, as also are the underparts, except that the belly may be tinged with light buff; the tail is ringed, usually with eight white rings and eight black rings, plus a black tip; the black rings are incomplete, being absent on the underside of the tail, which is flattened (Hall, 1946).

Dentition. The dental formula is 3-1-4-2/3-1-4-2 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the ringtail extends from Baja California and southern Mexico northward to southwest Oregon and from Texas and central Kansas to the Pacific coast as far north as southwest Oregon. Most of California is included in its range (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran to lower parts of the Canadian Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY
Procyon lotor - Raccoon

NOMENCLATURE AND SYNONYMY

Procyon lotor (Linnaeus 1758). Type locality, Pennsylvania.

Synonyms:

Ursus lotor Linnaeus 1758
Procyon lotor Illiger 1815
Lotor vulgaris Tiedemann 1808
Procyon annulatus G. Fischer 1814
Procyon obscurus Wiegmann 1837
Procyon gularis Hamilton-Smith 1848
Procyon brachyurus Burmeister 1850
Procyon nivea Gray 1837
Procyon hernandezii Wagler 1831
Procyon hudsonicus Brass 1911
Procyon psora Gray 1842
Procyon proteus Brass 1911
Procyon pallidus Merriam 1900
Procyon pumilus Miller 1911

CONTEXT AND CONTENT

Order Carnivora; Family Procyonidae; Subfamily Procyoninae. This species contains 24 subspecies as defined by Hall and Kelson (1959):

- P. l. auspicatus* Nelson 1930. Type from Marathon, Key Vaca, Monroe Co., Florida.
P. l. crassidens Hollister 1914. Type from Talamanca, Limon, Costa Rica.
P. l. dickeyi Nelson and Goldman 1931. Type from Barra de Santiago, Ahuachapan, El Salvador.
P. l. elucus Bangs 1898. Type from Oak Lodge, East Peninsula opposite Micco, Brevard Co., Florida.
P. l. excoelsus Nelson and Goldman 1930. Type from Owyhee River (near mouth of North Fork), Malheur Co., Oregon, 10 mi. W Fairylawn, Owyhee Co., Idaho.
P. l. fuscipes Mearns 1914. Type from Las Moras Creek, 1,011 ft., Fort Clark, Kinney Co., Texas.
P. l. grinnelli Nelson and Goldman 1930. Type from La Paz, Baja California.
P. l. hernandezii Wagler 1831. Type from Tlalpam, Valley of Mexico.
P. l. hirtus Nelson and Goldman 1930. Type from Elk River, Sherburne Co., Minnesota.
P. l. inesperatus Nelson 1930. Type from Upper Matecumbe Key, Monroe Co., Florida.
P. l. incautus Nelson 1930. Type from Torch Key, Big Pine Key Group, Monroe Co., Florida.
P. l. litoreus Nelson and Goldman 1930. Type from Saint Simon Island, Glynn Co., Georgia.
P. l. lotor (Linnaeus 1758). See above.

CONTEXT AND CONTENT (Cont'd)

- P. l. marinus* Nelson 1930. Type from near Chokoloskee, Collier Co., Florida.
- P. l. maritimus* Dozier 1948. Type from Blackwater National Wildlife Refuge, Dorchester Co., Maryland.
- P. l. megalodous* Lowery 1943. Type from Marsh Island, Iberia Parish, Louisiana.
- P. l. mexicanus* Baird 1858. Type from Espia, Chihuahua.
- P. l. pacificus* Merriam 1899. Type from Lake Keechelus, 3,000 ft., Kittitas Co., Washington.
- P. l. pallidus* Merriam 1900. Type from New River, about 6 mi. W Imperial, Imperial Co., California.
- P. l. psora* Gray 1842. Type from Sacramento, Sacramento Co., California.
- P. l. punilus* Miller 1911. Type from Ancon, Canal Zone, Panama.
- P. l. shufeldti* Nelson and Goldman 1931. Type from La Tuxpena, Champoton, Campeche.
- P. l. solutus* Nelson and Goldman 1931. Type from Hilton Head Island, Beaufort Co., South Carolina.
- P. l. vancouverensis* Nelson and Goldman 1930. Type from Quatsino Sound, Vancouver Island, British Columbia.
- P. l. varius* Nelson and Goldman 1930. Type from Castleberry, Conecuh Co., Alabama.

DIAGNOSIS

Skull with short rostrum; rounded dorsal profile; braincase relatively large; hard palate extends behind the molars; posterior part of I3 usually with an independent cusp; upper molariform teeth with sharp, coniform cusps; M1 quadrituberculate and no accessory cusplet in cingulum; tail is round, shorter than the body, and is marked by six white rings, six black rings, and a black tip; the rings go all the way around the tail; all feet with five clawed digits; sole of hind foot is naked; forefeet and forearms are relatively long; pelage has long guard hairs and short, soft underfur; hair on nape normal not directed forward; black mask, dark grayish color dorsally (Hall, 1946; Hall and Nelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 603-950 mm; tail 190-405 mm; hind foot 83-138 mm; ear 45-65 mm; weight 0.95-22.0 kg (Hall, 1946; Hall and Nelson, 1959; Ingles, 1965).

Skull characteristics. Greatest length 93.6-136.5 mm; zygomatic breadth 58.3-89.7 mm; least interorbital breadth 43.1-46.3 mm; mastoidal breadth 63.5-73.5 mm (Hall, 1946; Hall and Nelson, 1959).

Pelage. Upper parts iron gray to blackish, more or less suffused with buff, rusty, or "orange rufous," especially on nape; tip of head grizzled; face with sharply delimited black mask usually reaching from cheeks across eyes and muzzle, with median extensions downward to rhinarium and upward on forehead, but more or less interrupted between eyes, in some subspecies; facial mask bordered by conspicuous white lines extending from near middle of forehead backward under ears or to sides of neck; sides of muzzle, lips and chin white; underparts thinly overlaid with long grayish or buffy over-

Procyon lotor - Raccoon

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MORPHOLOGICAL CHARACTERS (Cont'd)

hairs, only partly concealing dense brownish underfur; throat crossed by distinct blackish or brownish area, separated from muzzle; ears clothed with short grayish or buffy hairs, with black areas varying in size and distinctness at posterior base; forearms and thighs similar to underparts, but hind legs blackish near heels; forefeet whitish; hind feet usually whitish, but dusky of ankles sometimes extending down on metatarsus; tail above with five to seven conspicuous black rings and a black tip, alternating with broader grayish or buffy rings, the black rings less sharply defined and sometimes interrupted below (Hall and Kelson, 1959).

Baculum. Strongly bowed and recurved at distal end (Hall and Kelson, 1959).

Dentition. The dental formula is 3-1-4-2/3-1-4-2 (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the raccoon extends from Panama to northern Alberta and from the Atlantic coast between southern Quebec and Florida to the Pacific coast between Vancouver and Baja California. The range does not include Montana south to northwestern New Mexico or from New Mexico west to southeastern California or central Baja California; however, this species is found along the Colorado River (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran into the Hudsonian Life Zone (Hall, 1946).

LIFE HISTORY SUMMARY

Mustela frenata - Long-tailed Weasel

NOMENCLATURE AND SYNONYMY

Mustela frenata Lichtenstein 1831. Type from Ciudad Mexico, Mexico.

Synonyms:

Mustela frenata Lichtenstein 1831
Mustela brasiliensis Sevestianoff 1813
Putorius mexicanus Coues 1877
Putorius alleni Merriam 1896
Putorius arizonensis Mearns 1891
Mustela noveboracensis Hall 1927
Mustela costaricensis Goldman 1912
Putorius frenatus Merriam 1896
Mustela longicauda Bonaparte 1938
Putorius macrophonus Elliot 1905
Putorius xanthogenys Merriam 1896
Mustella tropicalis J. A. Allen 1916
Putorius noveboracensis Emmons 1840
Mustella fusca Audubon and Bachman 1842
Putorius agilis Audubon and Bachman 1853
Putorius occisor Bangs 1899
Mustela peninsulae Howell 1913
Putorius longicauda Bangs 1896
Putorius peninsulae Rhoads 1894
Putorius tropicalis Merriam 1896
Mustela primulina Jackson 1913
Putorius saturatus Merriam 1896
Putorius washingtoni Merriam 1896
Mustela xanthogenys Gray 1843

CONTEXT AND CONTENT

Order Carnivora; Family Mustelidae. This species contains 34 subspecies as defined by Hall and Kelson (1959):

- M. f. alleni* Merriam 1896. Type from Custer, Custer Co., South Dakota.
M. f. altifrontalis Hall 1936. Type from Tillamook, Tillamook Co., Oregon.
M. f. arizonensis (Mearns 1891). Type from San Francisco Forest (then (1886?) Yavapai Co.), Arizona.
M. f. arthuri Hall 1927. Type from Remy, St. James Parish, Louisiana.
M. f. costaricensis Goldman 1912. Type from San Jose, Costa Rica.
M. f. effera Hall 1936. Type from Ironside, 4,000 ft., Malheur Co., Oregon.
M. f. frenata Lichtenstein 1831. See above.
M. f. goldmani (Merriam 1896). Type from Pinabete, Chiapas.
M. f. inyoensis Hall 1936. Type from Carl Walter's Ranch, 2 mi. N Independence, Inyo Co., California.
M. f. latirostra Hall 1936. Type from San Diego, San Diego Co., California.
M. f. leucoparia (Merriam 1896). Type from Patzcuaro, Michoacan.
M. f. longicauda Bonaparte 1938. Type locality, possibly Carlton House, Saskatchewan.

CONTEXT AND CONTENT (Cont'd)

- M. f. macrophonus* (Elliot 1905). Type from Achotal, Veracruz.
M. f. munda (Bangs 1899). Type from Point Reyes, Marin Co., California.
M. f. neomexicana (Barber and Cockerell 1898). Type from Armstrongs Lake, Mesilla, Dona Ana Co., New Mexico.
M. f. nevadensis Hall 1936. Type from 3 mi. E Baker, White Pine Co., Nevada.
M. f. nicaraguae J. A. Allen 1916. Type from Matagalpa, Nicaragua.
M. f. nigriauris Hall 1936. Type from 2½ mi. E Santa Cruz, Santa Cruz Co., California.
M. f. noveboracensis (Emmons 1840). Type locality, Williamstown, Berkshire Co., Massachusetts.
M. f. oocisor (Bangs 1899). Type from Bucksport, Hancock Co., Maine.
M. f. olivacea Howell 1913. Type from Autaugaville, Autauga Co., Alabama.
M. f. oregonensis (Merriam 1896). Type from Grants Pass, Rogue River Valley, Josephine Co., Oregon.
M. f. oribasus (Bangs 1899). Type from source of Kettle River, 7,500 ft., on the summit between middle fork of Kettle River and Cherry Creek at Pinnacles, British Columbia.
M. f. panamensis Hall 1932. Type from Rio Indio, Canal Zone, near Gatun, Panama.
M. f. peninsulae (Rhoads 1894). Type from Hudson's (14 mi. N Tarpon Springs) Pasco Co., Florida.
M. f. perda (Merriam 1892). Type from Teapa, Tabasco.
M. f. perotae Hall 1936. Type from 12,500 ft., Cofre de Perote, Veracruz.
M. f. primulina Jackson 1913. Type from 5 mi. NE Avilla, Jasper Co., Missouri.
M. f. pulchra Hall 1936. Type from Buttonwillow, Kern Co., California.
M. f. saturata (Merriam 1896). Type from Siskiyou, Jackson Co., Oregon.
M. f. spadix (Bangs 1896). Type from Fort Snelling, Hennepin Co., Minnesota.
M. f. texensis Hall 1936. Type from Kerr Co., Texas.
M. f. tropicalis Merriam 1896. Type from Jico, Veracruz.
M. f. washingtoni (Merriam 1896). Type from Trout Lake, Mt. Adams, Washington.
M. f. xanthogenys Gray 1843. Type probably from bank of Sacramento River below mouth of Feather River, or possibly from north shore of San Francisco Bay, California.

DIAGNOSIS

Tail as long as or longer than hind foot; less than 100 pounds; not dog-, fox-, or cat-like; tail without alternating light and dark bands; 34 teeth; dorsally brown or pure white; without webs between all toes; without black and white stripes on the head; last upper molar wider than long; belly and throat white or yellowish; frequently but not always, with a white spot or other white markings on the face; except for a black-tipped tail, the animal may be pure white in winter; tail usually more than 45 percent of head and body length; more or less yellow ventrally; postglenoid length less than 47 percent of the condylobasal length; tympanic bullae are well inflated and project below the squamosal bone anterior to the bullae; adult skull has well developed sagittal crest; plantigrade and without fully retractile claws (Hall, 1946; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 300-550 mm; tail 113-165 mm; hind foot 35-47 mm; ear (crown) 13 mm; weight 122-308 g (Hall, 1946; Hall and Kelson, 1959; Ingles, 1965).

Skull measurements. Basilar length (of Hensel) (2) 37.7-45.0 mm; least interorbital breadth (2) 8.8-10.4 mm; mastoidal breadth (2) 20.6-25.1 mm; zygomatic breadth 22.7-29.0 mm (Hall, 1946).

Pelage. Summer: uniform brown above and yellowish white on medial sides of the legs, parts of the feet, proximal fourth of underside of tail; the chin, lower lips, and sometimes upper lips are whitish; some individuals have a white spot only between the eyes and the nose, and others have a large white spot also in front of each ear; winter: may be pure white, basal part of undertail frequently whitish or yellowish; black tip of tail at all times (Hall, 1946; Ingles, 1965).

Dentition. The dental formula is 3-1-3-1/3-1-3-2 (Ingles, 1965).

Sexual dimorphism. Males larger than the females, and about twice as heavy (Hall, 1946).

GEOGRAPHIC RANGE

The range of the long-tailed weasel extends from central Canada to South America, excluding southeastern California, southern Nevada, most of Arizona, and Baja California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran into the Hudsonian Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Spilogale putorius - Eastern Spotted Skunk

NOMENCLATURE AND SYNONYMY

Spilogale putorius (Linnaeus 1758). Type locality, South Carolina.

Synonyms:

Viverra putorius Linnaeus 1758

Spilogale putorius Coues 1875

Spilogale ringens Merriam 1890

Spilogale ambarvalis Bangs 1898

Spilogale indianola Merriam 1890

Mephitis interrupta Rafinesque 1820

Mephitis quaterlinearis Winans 1859

CONTEXT AND CONTENT

Order Carnivora; Family Mustelidae. This species contains four subspecies as defined by Hall and Kelson (1959):

S. p. ambarvalis Bangs 1898. Type from Oak Lodge, opposite Micco, Brevard Co., Florida.

S. p. indianola Merriam 1890. Type from Indianola, Matagorda Bay, Texas.

S. p. interrupta (Rafinesque 1820). Type locality, Upper Missouri (River?).

S. p. putorius (Linnaeus 1758). See above.

DIAGNOSIS

Pelage black with four to six white stripes broken into spots on upper parts; tail shorter than head and body; skull flattened in longitudinal dorsal outline, of nearly equal height in frontal and parietal regions; mastoid bullae highly inflated; occiput widened and shallow; posterior margin of palate nearly on a line with posterior borders of upper molars; inferior margin of mandible relatively straight; anterior and posterior borders of M1 each less than outside length of P4; in M1 hypoconid low, ectoconid low; the infraorbital canal opens above the anterior half of P4; the metaconule of M1 is not distinct (Hall, 1946; Hall and Kelson, 1959).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 182-563 mm; tail 68-219 mm; hind foot 33-56 mm; ear (notch) (2) 22-24 mm; weight 224-269 g (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Basilar length 34-56 mm; least interorbital constriction (2) 12.5-15.0 mm; mastoidal breadth (3) 26.2-31.3 mm; zygomatic breadth (3) 29.3-35.7 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Black with occasional brownish tint to the blackish parts; four to six white stripes broken into segments on back, sides and head; white patch on forehead; white tip on bushy tail with one or two white spots at its base (Hall, 1946; Ingles, 1965).

Dentition. The dental formula is 3-1-3-1/3-1-3-2 (Hall and Kelson, 1959).

Spilogale putorius - Eastern Spotted Skunk

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MORPHOLOGICAL CHARACTERS (Cont'd)

Sexual dimorphism. The male is about twice as heavy as the female (Hall, 1946).

GEOGRAPHIC RANGE

The range of the spotted skunk extends from Costa Rica north to the extreme southwestern corner of British Columbia and northern Minnesota and in the east from south-central Pennsylvania in the north and Florida in the south west to the Pacific coast between southwestern British Columbia and Baja California. The animal is not found in the deserts of southeastern California (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran Life Zone into the Transition Life Zone (Ingles, 1965).

LIFE HISTORY SUMMARY
Mephitis mephitis - Striped Skunk

NOMENCLATURE AND SYNONYMY

Mephitis mephitis (Schreber 1776). Type locality, eastern Canada (= Quebec).

Synonyms:

Viverra mephitis Schreber 1776
Mephitis mephitis J. A. Allen et al., 1902
Viverra mephitica Shaw 1792
Mephitis americana Desmarest 1818
Mephitis avia Bangs 1898
Mephitis mephitica Bangs 1895
Mephitis estor Merriam 1890
Mephitis occidentalis Baird 1858
Mephitis mimesotae Brass 1911
Chincha occidentalis A. H. Howell 1901
Mephitis mesomelas Lichtenstein 1832
Viverra nigra Peale and Palisot de Beauvois 1796
Mephitis putida Boitard 1842
Mephitis olida Boitard 1842
Mephitis fetidissima Boitard 1842
Mephitis frontata Coues 1875
Mephitis dentata Brass 1911
Chincha platyrhino A. H. Howell 1901
Mephitis spissigrada Bangs 1898
Mephitis foetulenta Elliot 1899
Mephitis varians Gray 1837

CONTEXT AND CONTENT

Order Carnivora; Family Mustelidae. This species contains 13 subspecies as defined by Hall and Kelson (1959):

- M. m. avia* Bangs 1898. Type from San Jose, Mason Co., Illinois.
- M. m. elongata* Bangs 1895. Type from Micco, Brevard Co., Florida.
- M. m. estor* Merriam 1890. Type from Little Spring, 8,200 ft., N base San Francisco Mt., Coconino Co., Arizona.
- M. m. holzneri* Mearns 1897. Type from San Isidro Ranch, Baja California, within 2 mi. of border of San Diego Co., California.
- M. m. hudsonica* Richardson 1829. Type locality, plains of Saskatchewan, Canada.
- M. m. major* (A. H. Howell 1901). Type from Fort Klamath, Klamath Co., Oregon.
- M. m. mephitis* (Schreber 1776). See above.
- M. m. mesomelas* Lichtenstein 1832. Type locality, Louisiana.
- M. m. nigra* (Peale and Palisot de Beauvois 1796). Type locality, Maryland.
- M. m. notata* (A. H. Howell 1901). Type from Trout Lake, Mount Adams, Washington.
- M. m. occidentalis* Baird 1858. Type from Petaluma, Sonoma Co., California.
- M. m. spissigrada* Bangs 1898. Type from Sumas, British Columbia.
- M. m. varians* Gray 1837. Type locality, Texas.

DIAGNOSIS

Large anal glands; tail shorter than head and body; black pelage marked with white stripes on upper parts, and part of the long-haired tail often is white; five clawed digits on each foot; skull highly arched and deepest in the frontal region; mastoidal bullae relatively uninflated; posterior margin of palate nearly on a line with posterior borders of upper molars; posterior margin of bony plate without a distinct notch; tympanic bullae relatively little inflated; anteroposterior and transverse diameters of M1 each about equal to (usually more than) outside length of P4; infraorbital canal opening above posterior half of P4; metaconule of M1 not distinct; inferior margin of mandible curved; angle of mandible developed as a flattened face in a vertical plane producing a "step" or concavity in the inferior margin; coronoid process high and vertically inclined; in M1, hypoconid high, entoconid high (Hall, 1946).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 568-800 mm; tail 184-393 mm; hind foot 60-90 mm; ear 24-36 mm; weight 0.9-3.4 kg (Hall, 1946; Hall and Kelson, 1959).

Skull characteristics. Greatest length 69-87 mm; zygomatic breadth 40.0-52.5 mm; mastoidal breadth 33.8-44.8 mm; least interorbital breadth 19.8-24.2 mm (Hall, 1946; Ingles, 1965).

Pelage. Mostly black; white on top of head and neck, in most individuals white extending posteriorly (usually separating into two stripes), in some individuals over all of top and sides of tail; white areas on body are entirely white hair (Hall and Kelson, 1959).

Dentition. The dental formula is 3-1-3-1/3-1-3-2 (Ingles, 1965).

Sexual dimorphism. Females smaller by as much as 15 percent in some linear measurements (Hall and Kelson, 1959).

GEOGRAPHIC RANGE

The range of the striped skunk extends from northern Mexico to southern Mackenzie and southern Quebec and from the Atlantic coast between southern Quebec and Florida to the Pacific coast between extreme northern Baja California and extreme southern British Columbia. The animal is not found in southeastern California or southern Nevada except along the Colorado River (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran Life Zone into the Canadian Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Lynx rufus - Bobcat

NOMENCLATURE AND SYNONYMY

Lynx rufus (Schreber 1777). Type locality, New York.

Synonyms:

Felis rufa Schreber 1777
Lynx rufus Rafinesque 1817
Lynx montanus Rafinesque 1817
Lynx baileyi Merriam 1890
Lynx rufa Elliot 1901
Lynx fasciatus Bangs 1899
Lynx floridanus Rafinesque 1817
Lynx gigas Bangs 1897
Lynx uinta Merriam 1902
Felis maculata Horsfield and Vigors 1829
Lynx texensis J. A. Allen 1895

CONTEXT AND CONTENT

Order Carnivora; Family Felidae. This species contains 11 subspecies as defined by Hall and Kelson (1959):

- L. r. baileyi* Merriam 1890. Type from Moccasin Spring, north of Colorado River, Coconino Co., Arizona.
- L. r. californicus* Mearns 1897. Type from San Diego, San Diego Co., California.
- L. r. escuinapae* J. A. Allen 1903. Type from Escuinapa, Sinaloa.
- L. r. fasciatus* Rafinesque 1817. Type locality, "Northwest Coast."
- L. r. floridanus* Rafinesque 1817. Type locality, Florida.
- L. r. gigas* Bangs 1897. Type from 15 mi. back of Bear River, Nova Scotia.
- L. r. pallescens* Merriam 1899. Type from S side Mt. Adams, near Trout Lake, Skamania Co., Washington.
- L. r. peninsularis* Thomas 1893. Type from Santa Anita, Baja California.
- L. r. rufus* (Schreber 1777). See above.
- L. r. superiorenensis* Peterson and Downing 1952. Type from McIntyre Township, near Port Arthur, Ontario.
- L. r. texensis* J. A. Allen 1829. Type from Mexico.

DIAGNOSIS

Tail more than half the length of hind foot; less than 100 pounds; cat-like; 28 teeth; ear tufts of long hair; digitigrade with fully retractile claws; hind foot usually less than 190 mm; tail barred dorsally; skull robust; sagittal crests lyrate; lambdoidal crest andinion well developed; tympanic bullae large; postorbital process prominent; presphenoid elongate; anterior condyloid foramen confluent with foramen lacerum posterius (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 710-1,252 mm; tail 95-195 mm; hind foot 143-223 mm; ear (crown) 50-90 mm; weight 5.7-31.0 kg (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS (Cont'd)

Skull characteristics. Greatest length 114.5-149.5 mm; least interorbital breadth 23.8-25.7 mm; orbitonasal length 51-59.3 mm; mastoidal breadth 46.5-58.1 mm; zygomatic breadth 75.2-107.1 mm; length of tympanic bulla 22.0-26.3 mm (Hall, 1946; Hall and Kelson, 1959).

Pelage. Upper parts grayish, buffy, or reddish usually with black spots; color most intense mid-dorsally, becoming lighter laterally; rump and hind legs buffy; ears blackish outside and whitish inside with white spot near tip, tufted; eyelids white; underparts and inner side of legs whitish, with black spots; tail with distinct black rings, tipped with black above, whitish below (Hall and Kelson, 1959).

Dentition. The dental formula is 3-1-2-1/3-1-2-1 (Ingles, 1965).

Locomotion. Cursorial; digitigrade; walk 1 m/sec; gallop (occasional) 5 m/sec (Ingles, 1965; Kavanau, 1971).

Sexual dimorphism. Males average about 3 percent larger in linear measurements, and also larger in external measurements (Hall, 1946).

GEOGRAPHIC RANGE

The range of the bobcat includes the contiguous United States, all of Baja California, most of Mexico and southern-most Canada (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran through Canadian life zones (Hall, 1946).

LIFE HISTORY SUMMARY

Odocoileus hemionus - Mule Deer

NOMENCLATURE AND SYNONYMY

Odocoileus hemionus (Rafinesque 1817). Type locality, mouth of Big Sioux River, South Dakota.

Synonyms:

Cervus hemionus Rafinesque 1817
Dama hemionus J. A. Allen 1902
Cervus auritus Warden 1820
Cervus macrotis Say 1823
Caracus virgultus Hallock 1899
Odocoileus cerrosensis Merriam 1898
Odocoileus hemionus Lydekker 1915
Cervus levisii Peale 1848
Caracus punctulatus Gray 1852
Cervus richardsonii Audubon and Bachman 1853
Eucervus pusilla Gray 1873
Odocoileus columbianus Merriam 1898
Dorcelaphus crooki Mearns 1897
Dorcelaphus hemionus Mearns 1897
Mazama hemionus Lydekker 1898

CONTEXT AND CONTENT

Order Artiodactyla; Suborder Ruminantia; Super family Cervoidea; Family Cervidae. This species contains 11 subspecies as defined by Hall and Kelson (1959):

- O. h. californica* (Caton 1876). Type locality, near Gaviota Pass, 1,050 ft., 40 mi. up the coast (west) from Santa Barbara, Santa Barbara Co., California.
- O. h. cerrosensis* (Merriam 1898). Type from Cerros (=Cedros) Island, off W coast Baja California.
- O. h. columbiana* (Richardson 1829). Type locality, mouth of Columbia River, Oregon.
- O. h. crooki* (Mearns 1897). Type from summit Dog Mtns., 6,129 ft., Hidalgo Co., New Mexico.
- O. h. eremica* (Mearns 1897). Type from Sierra Seri, near Gulf of California, Sonora.
- O. h. fuliginata* (Cowan 1933). Type from Barona Ranch, 30 mi. E San Diego, San Diego Co., California.
- O. h. hemionus* (Rafinesque 1817). See above.
- O. h. inyoensis* (Cowan 1933). Type from Kid Mtn., 11,000 ft., 10 mi. W Big Pine, Inyo Co., California.
- O. h. peninsulae* (Lydekker 1898). Type from between La Laguna and Victoria Mtn., about 6,000 ft., Sierra Laguna, Baja California.
- O. h. sheldoni* (Goldman 1939). Type from Tiburon Island, Sonora.
- O. h. sitkensis* (Merriam 1898). Type from Sitka, Alaska.

DIAGNOSIS

Lachrymal bones not in contact with nasal bones; upper incisors absent; tail round and short with a black tip (sometimes with a black stripe running from the rump to the tip); with two or more toes on each foot; metatarsal gland usually more than 3 inches long; dichotomously branched antlers in males; antlers distally cylindrical; antlers with short sub-basal snag, beam curving outwards and upwards; no brow or bez tines; without two white bands crossing the throat; without a neck mane; white rump patch extending onto the rump above the base of the tail (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 1,160-1,800 mm; tail 106-230 mm; hind foot 325-585 mm; ear (crown) 118-250 mm (Hall and Kelson, 1959).

Skull characteristics. Basilar length 202-288 mm; zygomatic breadth 92-133 mm (Hall and Kelson, 1959).

Pelage. Upper parts (summer) reddish or yellowish tawny, (winter) dark brownish or rufous gray, speckled with whitish; dark brown patch extending nearly to eyes on forehead; brown patch on each side of nose; remainder of face white or gray; ears black on front border, whitish on inner surface; inner sides of buttocks and legs, abdomen, and throat white; remainder of underparts blackish brown; tail black tipped, white elsewhere above and below, or black above and white below (Hall and Kelson, 1959).

Dentition. The dental formula is 0-0-3-3/3-1-3-3 (Hall and Kelson, 1959; Ingles, 1965).

Sexual dimorphism. Females without antlers (Hall, 1946).

GEOGRAPHIC RANGE

The range of the mule deer extends from Baja California and northern Mexico to southern Mackenzie and southern Yukon and from Minnesota to the Pacific coast between Baja California and southeastern Alaska (Hall and Kelson, 1959).

HABITAT

Life zones. Lower Sonoran into the Hudsonian Life Zone (Hall, 1946; Ingles, 1965).

LIFE HISTORY SUMMARY

Ovis canadensis - Mountain Sheep

NOMENCLATURE AND SYNONYMY

Ovis canadensis Shaw 1804. Type locality, mountains on Bow River, near Exshaw, Alberta.

Synonyms:

Ovis canadensis Shaw 1804
Nemorhoedus palmeri Cragin 1900
Ovis californianus Douglas 1829
Ovis dalli Kowarzik 1913
Ovis cervina Elliot 1904
Ovis mexicanus Merriam 1901
Ovis sheldoni Merriam 1916
Ovis nelsoni Merriam 1897

CONTEXT AND CONTENT

Order Artiodactyla; Suborder Ruminantia; Superfamily Bovoidea; Family Bovidae. This species contains seven subspecies as defined by Hall and Kelson (1959):

- O. o. auduboni* Merriam 1901. Type from Upper Missouri, South Dakota.
- O. o. californiana* Douglas 1829. Type locality, near Mount Adams, Yakima Co., Washington or Falls of the Columbia, near mouth of Deschutes River.
- O. o. canadensis* Shaw 1804. See above.
- O. o. cremnobates* Elliot 1904. Type from Mattomi, Sierra San Pedro Martir, Baja California.
- O. o. mexicana* Merriam 1901. Type from Lago de Santa Maria, Chihuahua.
- O. o. nelsoni* Merriam 1897. Type from Grapevine Mountains, on boundary between Inyo Co., California, and Esmeralda Co., Nevada.
- O. o. weemsi* Goldman 1937. Type from Cajon de Tecomaja, 2,000 ft., Sierra de la Giganta, about 30 mi. S Cerro de la Giganta, Baja California.

DIAGNOSIS

Lachrymal bones in contact with nasal bones; length of nasals in males usually more than 105 mm, in females usually more than 85 mm; upper incisors absent; lower canine spatulate and looks like incisor; permanent, large spiraled horns in males, slender and falcate in females; gray or brown short hairs; less than 500 pounds (227.2 kg) (Hall and Kelson, 1959; Ingles, 1965).

MORPHOLOGICAL CHARACTERS

Standard measurements. Length 1,166-1,953 mm; tail 70-150 mm; hind foot 276-482 mm; weights to 156 kg (Hall and Kelson, 1959).

Skull characteristics. Basilar length 226-285 mm; zygomatic breadth 107-135 mm; mastoidal breadth 71-96 mm (Hall and Kelson, 1959).

Ovis canadensis - Mountain Sheep

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MORPHOLOGICAL CHARACTERS (Cont'd)

Pelage. Upper parts brownish, becoming darker on sides, neck, chest, legs, and tail; middorsal line continued onto tail; yellowish patch on brow; face brown; sides of face grayish; nose, inside of ears, and underparts grayish; snout with small naked place between nostrils; rump yellowish white (Hall, 1946).

Dentition. The dental formula is 0-0-3-3/3-1-3-3 (Ingles, 1965).

Sexual dimorphism. Large spiraled horns in males; slender and falcate horns in females (Ingles, 1965).

GEOGRAPHIC RANGE

The range of the bighorn sheep extends from northern Mexico and eastern Baja California northward to central British Columbia and Alberta (Hall and Kelson, 1959).

HABITAT

Life zones. Occurs from the Lower Sonoran Life Zone through the Arctic-Alpine Life Zone (Hall, 1946).

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