

BIRD USE OF RIPARIAN VEGETATION ALONG THE TRUCKEE RIVER, CALIFORNIA AND NEVADA

Suellen Lynn¹, Michael L. Morrison^{1,2}, Amy J. Kuenzi¹, Jennifer C.C. Neale³,
Benjamin N. Sacks³, Robin Hamlin⁴, and Linnea S. Hall^{1,2}

ABSTRACT.—The Truckee River in California and Nevada is subject to diverse water regimes and a corresponding variety of flow rates. Original riparian vegetation has been altered by these variable flow rates and by a variety of human uses resulting in loss of native riparian vegetation from its historic extent. We conducted bird surveys along the Truckee River during spring 1993 to (1) determine relationships between birds and the present vegetation; (2) determine the importance of different vegetation types to sensitive bird species that have declined recently in the western United States due to competition from exotic plant species, cowbird (*Molothrus ater*) parasitism, reduction in nesting habitat, or other unidentified reasons; and (3) establish a monitoring program and collect baseline data for future comparisons. The most frequently detected bird species throughout the study was the Brown-headed Cowbird. The greatest number of bird species (98 of 116) was found in the native mixed willow (*Salix* spp.) riparian scrub vegetation type. We recommend protecting the remaining native riparian vegetation types for bird habitat along the Truckee River.

Key words: bird abundance, bird species richness, riparian habitat, Truckee River, vegetation type.

Numbers of Neotropical migratory birds are declining throughout North America (Martin and Finch 1996). Explanations for this decline include reduction and fragmentation of breeding, wintering, and migratory stopover habitat (Stevens et al. 1977, Finch 1991a). Riparian corridors are well-known breeding and migratory stopover sites for many Neotropical migrants (Bottorff 1974, Stevens et al. 1977, Wauer 1977, Szaro and Jakle 1985). These corridors are important as cover and foraging habitat for birds migrating through sparsely vegetated desert areas (Sprunt 1975, Stevens et al. 1977). Historically, such corridors existed along the Truckee River and its tributaries in northeast California and northwest Nevada (Ridgway 1877, Klebenow and Oakleaf 1984).

At present the native riparian vegetation along the Truckee River is greatly reduced from its historical extent (Klebenow and Oakleaf 1984, USFWS 1993). A number of factors have contributed, and continue to contribute, to the reduction in riparian vegetation since the late 1800s, including varied flow rates from diversions of water for agricultural use, channelization of parts of the river in the early 1960s, log-

ging, gravel removal, and grazing (Klebenow and Oakleaf 1984). Consequently, the Truckee River riparian corridor is now a thin, discontinuous ribbon of cottonwoods (*Populus* spp.) and willows (*Salix* spp.; USFWS 1993) ranging up to 250 m wide, but averaging approximately 30–50 m wide where present.

Currently, there are no baseline data relating bird populations to vegetative communities along the Truckee River. Our study was designed in cooperation with the U.S. Fish and Wildlife Service (USFWS) to establish a systematic sampling scheme for monitoring bird numbers and species composition along the Truckee River, and to obtain quantitative baseline data on bird-vegetation relationships to satisfy the USFWS operating plan for the Truckee River. Our specific objectives were to determine (1) bird species composition and relative abundances of birds in the major vegetation types, (2) bird species most likely to be impacted by alterations of the native riparian plant communities, and (3) vegetative components (successional stage and species composition) that contribute most to bird abundance and species richness.

¹School of Renewable Natural Resources, Wildlife and Fisheries Sciences Program, University of Arizona, Tucson, AZ 85721.

²Present address: Department of Biological Sciences, California State University, Sacramento, CA 95819.

³Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720.

⁴U.S. Fish and Wildlife Service, 4600 Keitzke Lane, Building C-125, Reno, NV 89502.

STUDY AREAS

We conducted our study along the Truckee River, California and Nevada (approximately 80 km), and the Little Truckee River (16 km) and Independence Creek (3.5 km), California (Fig. 1). We divided the Truckee River into “lower” (Pyramid Lake to Sparks, Nevada) and “upper” (Floriston, Nevada, to Lake Tahoe)

sections based on the approximate elevational border where Fremont cottonwood (*Populus fremontii*) changes to higher-elevation black cottonwood (*P. trichocarpa*; USFWS 1993). Vegetation along the lower Truckee River is characterized by a narrow but extensive strip of willow (*Salix* spp.), intermixed with occasional clumps of variously aged Fremont cottonwoods. Agricultural development, wide-

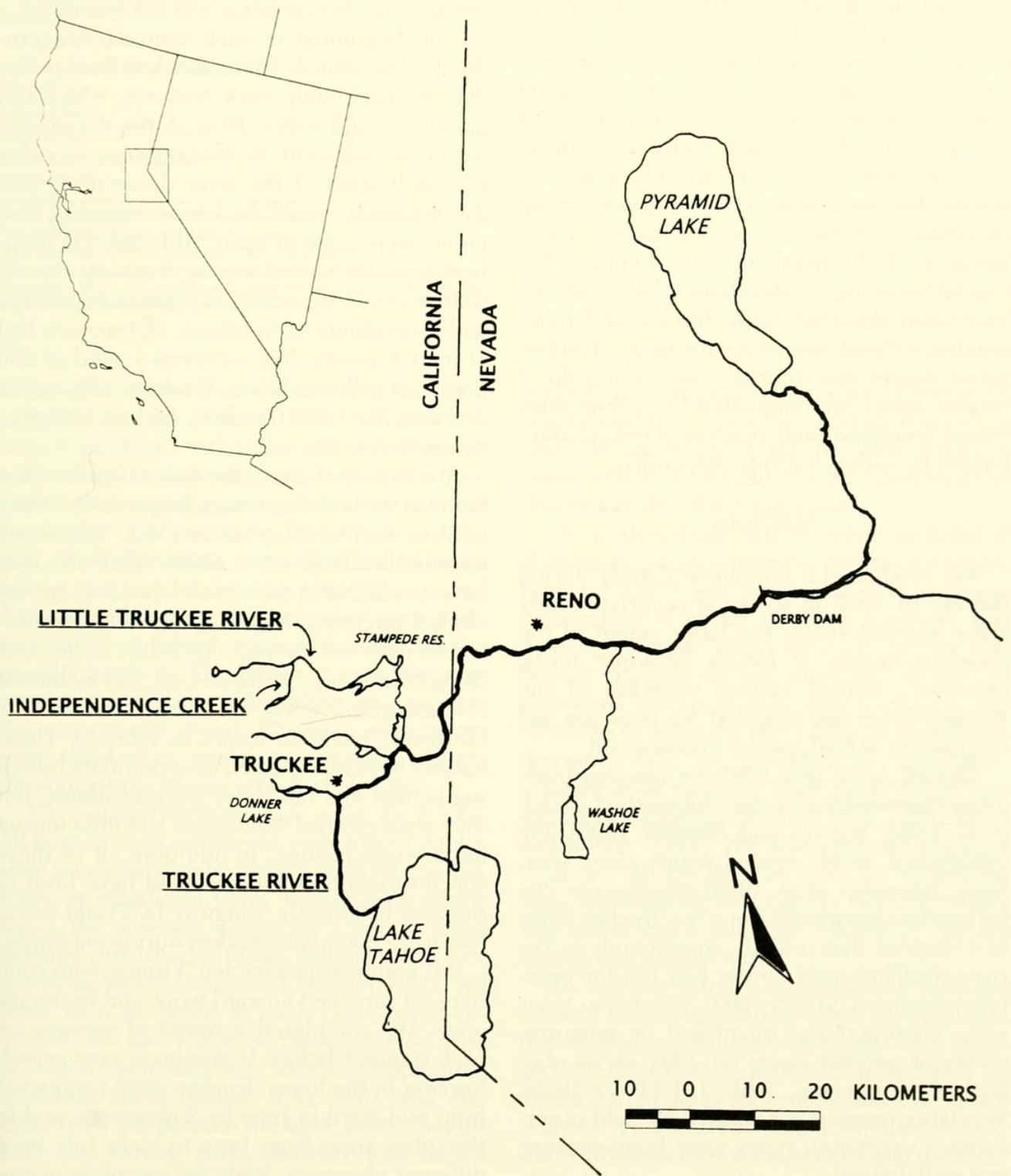


Fig. 1. Map of study site: Truckee River, California and Nevada; and Little Truckee River and Independence Creek, California.

spread along most sections of the lower Truckee, is especially prevalent near the confluence of the Truckee River with Pyramid Lake Reservoir; cattle grazing also is common near this confluence. Hillsides bordering the riparian corridor are dominated by upland shrubs (primarily shadscale [*Atriplex confertifolia*] and black greasewood [*Sarcobatus vermiculatus*]). Exotic whitetop (or peppergrass [*Cardaria draba*]) dominates open, disturbed sites.

Vegetation along the upper Truckee River is also characterized by a narrow strip of willow-cottonwood association. Black cottonwood replaces Fremont cottonwood between 1800 and 2150 m elevation. Uplands are dominated by big sagebrush (*Artemisia tridentata*). Riparian vegetation, and especially black cottonwoods, becomes less dense with increasing elevation. Extensive stands of mixed conifer forest reach the riverbanks and dominate the vegetation at higher elevations (1800–2750 m). Vegetation along the Little Truckee and Independence Creek resembles the upper Truckee River, except the riparian zones along the 2 smaller rivers are dominated by willow-alder (*Alnus tenuifolia*) and riparian scrub, characterized by willow thickets (Appendix).

METHODS

We conducted a preliminary study during the fall of 1992 to locate appropriate study areas and determine the latter extent of the breeding season of locally breeding birds. Observers walked various stretches of the Truckee River and recorded the presence and frequencies of bird species encountered.

During April–July 1993 we sampled birds using the variable circular-plot method (Ralph et al. 1993, Murray and Stauffer 1995). We established evenly spaced points along transects (Reynolds et al. 1980) which were distributed systematically along the Truckee River in a manner that roughly corresponds to the river stretches used by the USFWS for vegetation typing (USFWS 1993). Vegetation types were identified and quantified by measurements of percent cover on 1992 aerial photographs (Appendix, Table 1; USFWS 1993). Vegetation maps were verified by field observations; vegetation types were homogeneous and well defined.

Within each river stretch we placed transects in vegetation types roughly proportional

to their occurrence, ensuring adequate representation of the patchy, scattered willow and cottonwood vegetation types. Because the riparian vegetation is patchy and thin, most survey points sampled >1 vegetation type. Transects were also distributed along Little Truckee River and Independence Creek. Although transects on Little Truckee and Independence Creek were established to bisect riparian vegetation, aerial photos were not available for these streams and so vegetation was not quantified.

The beginning of each transect was randomly determined. We established fixed points 200 m apart along each transect, which ran parallel to, and within 10 m of, the stream and within or adjacent to the riparian corridor. Channelization of the river determined that the transects would be linear, ensuring that points were ≥ 200 m apart. Although the number of points varied among transects due to differences in the extent of riparian vegetation and accessibility of riverbank, all transects had at least 8 points. We surveyed a total of 250 points as follows: lower Truckee, 136; upper Truckee, 51; Little Truckee, 45; and Independence Creek, 18.

We surveyed along the lower Truckee first because the breeding season began earlier there relative to the other areas (M.L. Morrison, unpublished field notes, 1992). While this may have confounded our results because we included migrants, only 5 species that we detected were not common breeders in the area (Ring-billed Gull, California Gull, Black-chinned Hummingbird, Yellow-breasted Chat, and Blue Grosbeak; scientific names in Table 2). These species were all detected in appropriate breeding habitat and may have been residents, but they were rarely detected and had little impact on our conclusions. In addition, all of these species except Ring-billed Gull have bred in this area historically (Ridgway 1877) and therefore were potential breeders during our study.

All points were sampled 3 times, with each transect surveyed forward twice and backward once. We completed a round of surveys on each transect before beginning a new round. Surveys in the lower Truckee were conducted from mid-April to June by 2 observers, and in the other areas from June to early July by 2 different observers. With the exception of one 15-point transect counted by the same observer all 3 times, each transect was surveyed by 2

TABLE 1. Percent cover of major vegetation types along the lower, upper, and overall Truckee River, and number of birds observed, expected, and the difference (from χ^2 analysis), Truckee River, California and Nevada (USFWS 1993).

Vegetation type	Percent cover			Number of birds ^a		
	Lower	Upper	Overall	Observed	Expected	Difference
Open water						
Riverine	12	25	18	— ^b	—	—
Ponds	1	<1	<1	—	—	—
Forest						
Sierra mixed conifer ^c	0	3	2	636	391	−230
Black cottonwood ^d	0	7	4	219	521	−302
Fremont cottonwood–willow ^e	8	3	6	2018	782	+1236
Shrub						
Alder–willow	0	12	6	43	782	−739
Riparian scrub–mixed willow ^f	12	7	10	3011	1303	+1708
Marsh	3	3	3	161	391	−230
Gravel bars	10	3	7	56	912	−856
Sage steppe	16	6	10	1033	1303	−270
Whitetop (peppergrass)	14	6	10	381	1303	−922
Agriculture	23	14	18	—	—	—

^aBased on 7558 observations; does not include Little Truckee River or Independence Creek observations.
^bNot quantified for these vegetation types/areas.
^cIncludes lodgepole pine, Jeffrey pine, and mixed conifer forest.
^dIncludes seedling, pole-sapling, and mature stages of black cottonwood.
^eIncludes seedling, pole-sapling, and mature Fremont cottonwood, with and without whitetop.
^fIncludes riparian scrub with and without whitetop.

different observers over the season to standardize observer bias (Verner 1985). All observers were trained by 1 technician and tested against each other to minimize inter-observer bias. Before performing a count, each crew member was tested on a practice count where at least 90% of all detections were identical between trainer and trainee. Species identification and distance estimations were checked across observers by informal testing throughout the sampling season. The paces of each observer were measured by walking 50 m for 3 replications at normal speed. Distance estimations were checked by pacing to stationary objects throughout the season (Ralph et al. 1993).

We counted birds at each point for 5 min. All counts were conducted within the first 4 h after sunrise and only on days without precipitation or significant wind. Before beginning a count, the observer waited for 1 min to allow possibly disturbed birds to resume their normal behaviors (Murray and Stauffer 1995). All birds seen or heard at each point were recorded. We also recorded the vegetation type in which each bird was located (Appendix), detection mode (visual, song, call), and distance from the point to the bird. Before beginning any survey, each observer was shown examples of all vegetation types, which were distinct and easily identifiable. Therefore, we could locate the birds precisely and accurately

enough to confidently associate them with vegetation types when the vegetation could be seen. When it could not be seen during a count, observers sought out and identified the vegetation after the 5-min count.

We analyzed our data to obtain an index of abundance (mean number of birds/point/count; Raphael 1987) and frequency of occurrence (percentage of points at which a species was detected; Verner 1985) for each species discussed. Because we had small sample sizes of individual species in each vegetation type, and distances to birds are often difficult to estimate (Verner 1985), we included all detections, regardless of distance from observer, in our abundance analysis (Blondel et al. 1981, Sliwa and Sherry 1992). We also analyzed our data to obtain distribution of birds by vegetation type, highlighting bird species richness within vegetation types and distribution of species among vegetation types.

To test the validity of comparing bird detections among vegetation types, we examined the relationship among major vegetation types and the distribution of detections of birds by distance from the point center using chi-square analysis. This analysis tested whether detectability (measured by average detection distance) of bird species varied among vegetation types. Had they differed, comparisons of bird abundance between vegetation types would have

TABLE 2. Continued.

Species (Scientific name ^h)	Lower Truckee ^d			Upper Truckee ^e			Little Truckee ^f			Independence Creek ^g		
	\bar{x}	<i>s</i>	%	\bar{x}	<i>s</i>	%	\bar{x}	<i>s</i>	%	\bar{x}	<i>s</i>	%
Yellow-headed Blackbird (<i>Xanthocephalus xanthocephalus</i>)	1.1	1.6	6	—	—	—	—	—	—	—	—	—
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	1.1	0.9	14	1.4	1.3	13	1.0	0.8	10	—	—	—
Brown-headed Cowbird ^{EX} (<i>Molothrus ater</i>)	1.5	0.9	32	0.9	0.5	28	0.6	0.4	16	0.5	0.2	22
Unknown blackbird	0.7	0.6	12	—	—	—	—	—	—	—	—	—
Northern Oriole (<i>Icterus galbula</i>)	1.0	0.5	28	0.3	0.0	1	—	—	—	—	—	—
Purple Finch (<i>Carpodacus purpureus</i>)	—	—	—	—	—	—	0.7	0.7	3	—	—	—
Cassin's Finch (<i>Carpodacus cassinii</i>)	—	—	—	0.7	0.0	1	0.9	0.5	4	1.1	0.7	12
House Finch (<i>Carpodacus mexicanus</i>)	0.5	0.5	5	—	—	—	—	—	—	—	—	—
Pine Siskin (<i>Carduelis pinus</i>)	—	—	—	0.3	0.0	1	0.9	0.2	2	0.8	0.4	6
Lesser Goldfinch (<i>Carduelis psaltria</i>)	0.3	0.0	1	—	—	—	—	—	—	—	—	—
House Sparrow ^{EX} (<i>Passer domesticus</i>)	0.8	0.4	5	—	—	—	—	—	—	—	—	—

^aNumber of birds/point/count.
^bNumber of detections of this species/total # counts on this transect.
^cEX = exotic or opportunistic species, possibly having a negative impact on native species; NH = species with sensitive nesting habitat, impacted by alterations in riparian vegetation; CB = species adversely affected by exotic or opportunistic species; ? = species declining for unknown reason.
^d119 points, 357 total counts (points × 3)
^e68 points, 204 total counts (points × 3)
^f45 points, 135 total counts (points × 3)
^g18 points, 54 total counts (points × 3)
^hAOU 1983, 1995
ⁱNot present

been invalid. In a vegetation type where bird calls do not carry well (e.g., dense trees), the average distance of detection will be smaller than in vegetation types where bird calls carry long distances (e.g., open grassland). For 8 of 10 species examined, average detection distance did not vary between vegetation types ($P > 0.1$); the remaining 2 species had $0.05 < P < 0.1$. For these 2 species, average detection distance was shorter in riparian scrub than in other vegetation types. Some of our data, therefore, are slightly, but not usually significantly, biased toward fewer detections in the riparian scrub vegetation type; however, the number of detections in this vegetation type for these species exceeds detections in any other vegetation type. Also, our survey points often sampled multiple vegetation types; therefore, the distance from the point center to a given vegetation type varied. Riparian vegetation tended

to be most consistently nearer the point center, thus explaining some of the bias.

We also conducted chi-square analyses to determine if there is a difference between general bird use of vegetation types and availability of these vegetation types to the birds. Because our survey focused on nonagricultural vegetative relationships, for this analysis we excluded individual birds detected in agricultural areas and areas that were not quantified on vegetation maps (36% of all detections).

Throughout this paper we discuss general trends for all bird species, focusing on 21 avian species of special interest (Tables 2, 4). These species include those thought to be decreasing in abundance due to competition from opportunistic and exotic species or thought to be impacted by alterations of riparian vegetation. Other species of interest may be increasing opportunistic and exotic species (e.g., Brown-

headed Cowbird, European Starling, House Sparrow) that may adversely impact riparian birds. Identification of these species of special interest was designated by the USFWS based on review of previous works (Ridgway 1877, Klebenow and Oakleaf 1984) and communication with regional biologists (USFWS, California Parks Department).

RESULTS

Species Richness and Abundance of Birds

OVERALL.—We detected 116 species across the entire study area. The most abundant species overall was Cliff Swallow, followed by American White Pelican, Song Sparrow, Turkey Vulture, Northern Rough-winged Swallow, and House Wren (Table 2). Mean \pm s of bird species richness per point was 16 ± 4 among transects on the lower Truckee, 14 ± 4 on the upper Truckee, 13 ± 2 on the Little Truckee, and 13 ± 4 on the single Independence Creek transect. Total bird abundance on each transect ranged between 8.7 and 14.8 birds/point/count, with a mean of 11.2 ± 1.8 birds/point/count.

LOWER TRUCKEE RIVER.—The most frequently detected bird species along the lower Truckee was the Brown-headed Cowbird, followed by Northern Oriole, Black-billed Magpie, House Wren, Red-winged Blackbird, European Starling, Northern Rough-winged Swallow, and Mallard (Table 2). Eighteen species of special interest were detected along the lower Truckee, 4 at $>10\%$ of the counts and the remaining 14 at $\leq 9\%$ of the counts (Table 2).

UPPER TRUCKEE RIVER.—The most frequently detected species along the upper Truckee was the Song Sparrow, followed by Steller's Jay, American Robin, Brown-headed Cowbird, Warbling Vireo, Western Wood-Pewee, Mountain Chickadee, Yellow Warbler, and Spotted Sandpiper. Twelve species of special interest were detected along the upper Truckee, 4 at $>20\%$ of the counts and the remaining 8 at $\leq 6\%$ of the counts (Table 2).

LITTLE TRUCKEE RIVER.—Along the Little Truckee the most frequently observed bird species was the Western Wood-Pewee, followed by American Robin, Warbling Vireo, Steller's Jay, Mountain Chickadee, Song Sparrow, Spotted Sandpiper, and Yellow Warbler. Seven species of special interest were detected

along the little Truckee: 4 were detected at $>10\%$ of the counts and 3 at $\leq 6\%$ (Table 2).

INDEPENDENCE CREEK.—The most frequently detected bird species on Independence Creek was the Mountain Chickadee, followed by Warbling Vireo, Western Wood-Pewee, American Robin, Dusky Flycatcher, Dark-eyed Junco, unidentified *Empidonax* flycatchers, Yellow Warbler, Brown-headed Cowbird, Song Sparrow, Yellow-rumped Warbler, and Wilson's Warbler. Seven species of special interest were detected along Independence Creek: 4 were detected at $>20\%$ of the counts and 3 at $\leq 8\%$ (Table 2).

Over all sections of the river, ≤ 2 individuals of each of the most frequently detected species were observed during any single point count (Table 2).

Distribution of Birds by Vegetation Type

RICHNESS AND PERCENT OCCURRENCE OF BIRDS AMONG VEGETATION TYPES.—We did not sample each vegetation type equally throughout the Truckee River drainage; therefore, the following 3 results sections should be considered as baseline data to be compared with future avian sampling.

The highest bird species richness occurred in the riparian scrub vegetation type, with 17 species detected only in riparian scrub. Sagebrush steppe, riparian scrub with whitetop, mature Fremont cottonwood with and without whitetop, pole-sapling Fremont cottonwood with and without whitetop, whitetop alone, and Sierra mixed conifer also had high species richness (≥ 40 ; Table 3). Of 116 bird species observed during our study, only the Pine Siskin, White-breasted Nuthatch, White-faced Ibis, Blue-Gray Gnatcatcher, Brown Creeper, Black-throated Sparrow, Cedar Waxwing, and Hairy Woodpecker were never detected in native riparian vegetation.

Species richness was 30% less in riparian scrub that contained whitetop. However, bird richness in Fremont cottonwood was the same with and without whitetop (Table 3).

Riparian scrub vegetation had the highest percentage of detections of all species over all points in our study. Sagebrush steppe was the only other vegetation type with $>10\%$ of all birds detected. No single successional stage of cottonwood had $>8\%$ of all detections; however, 21.2% of all birds observed were across

TABLE 3. Species richness (number) and percentage of all birds detected (%) by vegetation type, Truckee River and vicinity, California and Nevada, spring 1993.^a

Vegetation type ^b	Number	%
Pole-sapling Fremont cottonwood–willow	49	3.3
Mature Fremont cottonwood–willow	53	6.6
Seedling Fremont cottonwood–willow with whitetop	9	0.1
Pole-sapling Fremont cottonwood–willow with whitetop	48	3.7
Mature Fremont cottonwood–willow with whitetop	57	7.5
Riparian scrub	93	28.7
Riparian scrub with whitetop	62	9.6
Whitetop	49	4.3
Sage steppe	77	14.0
Marsh	27	1.6
Gravel bar	17	0.5
Seedling black cottonwood	5	0.1
Pole-sapling black cottonwood	18	0.8
Mature black cottonwood	28	1.5
Jeffrey pine	39	4.1
Lodgepole pine	40	5.8
Sierra mixed conifer	42	5.7
Agriculture	34	2.1

^aBased on 11,812 observations.
^bSee Appendix for full description of vegetation types.

all stages of Fremont cottonwood. Pure white-top stands supplied 4.3% of all detections (Table 3).

The percentage of individual birds detected was low in all conifer vegetation types (<6%). Overall, the 3 conifer vegetation types—Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*Pinus contorta* var. *murrayana*), and mixed conifer—contained 15.6% of all birds detected. Black cottonwood, which occurs within the conifer zone, contained only 2.4% of bird occurrences (Table 3).

BIRD SPECIES DETECTIONS ACROSS VEGETATION TYPES.—Thirteen species were detected in ≥10 vegetation types, whereas 40 species were detected in ≤3 different types. Brown-headed Cowbirds (Table 4) and American Robins were detected in all vegetation types, and both were most commonly detected in riparian scrub vegetation.

FREQUENCY OF BIRD SPECIES OF SPECIAL INTEREST AMONG VEGETATION TYPES.—We considered a bird species to be rare if it was detected with a frequency of ≤2.5% (during <20 of the 750 total point counts).

EXOTIC OR OPPORTUNISTIC SPECIES.—Brown-headed Cowbirds were common and were detected in all vegetation types, though less frequently at higher elevations (Table 4). European Starlings were frequently detected at lower elevations where there were trees, and also in sagebrush steppe. Similarly, the introduced House Sparrow was most fre-

quently detected in Fremont cottonwood and riparian scrub at low elevations. Both starlings and House Sparrows were detected primarily near buildings and agricultural fields.

SPECIES POSSIBLY AFFECTED BY EXOTIC OR OPPORTUNISTIC SPECIES, UNKNOWN REASONS, OR ALTERATION IN RIPARIAN VEGETATION.—California Gulls, Common Yellowthroats, Spotted Towhees, Tree Swallows, Willow Flycatchers, Marsh Wrens, Chipping Sparrows, Savannah Sparrows, and Yellow-breasted Chats were rare but most often detected in riparian scrub (Table 4). Tree Swallows were also observed nesting in mature black cottonwood. Olive-sided Flycatchers, thought to be declining throughout the West (Robbins et al. 1986, DeSante and George 1994), were most often observed in Sierra mixed conifer and riparian scrub. Western Meadowlarks were fairly frequent across most vegetation types, and Violet-Green Swallows were only rarely detected; both species were detected only at lower elevations. Song Sparrows were common and Western Tanagers were rarely detected; both were seen across most vegetation types. Warbling Vireos were frequent in riparian scrub, lodgepole pine, and black cottonwood. Yellow Warblers were detected across all riparian types, most frequently in riparian scrub.

SPECIES POSSIBLY IMPACTED BY ALTERATION IN RIPARIAN VEGETATION.—Bank Swallows were most frequently detected in Fremont cottonwood and sagebrush steppe (Table 4). Hairy

TABLE 4. Percent detections of species of special interest among vegetation types^a along the Truckee River and vicinity, California and Nevada.

Species	cw	cw+w ^b	rs	rs+w	w	ss	m	g	bc	jp	lp	smc	a
Exotic/Opportunistic													
European Starling	19	31	22	13	4	12	<1	<1	0	0	0	0	0
Brown-headed Cowbird	13	12	26	13	8	17	2	1	2	1	1	4	<1
House Sparrow	39	10	49	3	0	0	0	0	0	0	0	0	0
Competition with exotics or unidentified reasons													
Olive-sided Flycatcher	0	0	31	8	0	0	0	0	0	8	8	46	0
Willow Flycatcher	0	0	100	0	0	0	0	0	0	0	0	0	0
Tree Swallow ^c	0	0	42	2	2	0	0	4	46	2	2	0	0
Violet-Green Swallow ^c	0	33	0	0	0	67	0	0	0	0	0	0	0
Marsh Wren ^c	0	0	0	67	0	33	0	0	0	0	0	0	0
Warbling Vireo	1	14	32	3	1	1	0	0	17	2	18	12	0
Yellow Warbler	8	17	43	10	2	4	1	0	9	0	3	4	1
Common Yellowthroat	9	18	0	36	9	18	0	0	0	0	0	9	0
Yellow-breasted Chat ^c	0	25	13	50	13	0	0	0	0	0	0	0	0
Western Tanager	15	20	10	15	0	0	5	5	5	5	0	20	0
Spotted Towhee	0	0	47	24	0	6	0	0	12	6	0	6	0
Chipping Sparrow	0	0	40	0	20	20	0	0	0	0	0	20	0
Savannah Sparrow	0	0	67	0	0	33	0	0	0	0	0	0	0
Song Sparrow	5	2	64	1	2	7	<1	0	5	2	2	12	0
Western Meadowlark	28	26	13	19	2	12	0	0	0	0	0	0	0
Impacted by loss of habitat or vegetation alteration													
California Gull	0	0	100	0	0	0	0	0	0	0	0	0	0
Hairy Woodpecker	0	0	0	0	0	0	0	0	0	0	0	100	0
Bank Swallow	48	0	24	8	8	32	0	0	0	0	0	0	0

^aVegetation types and codes found in Appendix.
^bb+w = vegetation type mixed with whitetop.
^cAlso affected by loss of habitat or alteration of vegetation.

Woodpeckers were detected only in Sierra mixed conifer. Both species were rare.

USE VERSUS AVAILABILITY OF VEGETATION TYPES.—Overall, birds did not use vegetation types in proportion to their availability ($\chi^2 = 7254$, $df = 8$, $P < 0.001$). The discrepancy between use and availability was highest in riparian scrub and Fremont cottonwood. Although totaling only 10% cover (Table 1), riparian scrub/mixed willow was used by birds almost 40% of the time during our observations. Bird use of monotypic whitetop was significantly less than expected given its percent cover. The number of bird species using these vegetation types supports our findings of bird preference: Fremont cottonwood, 70 species; riparian scrub/mixed willow, 80 species; and whitetop, 44 species.

DISCUSSION

Overall Distribution and Abundance of Birds

The lower Truckee River harbored the greatest richness of avifauna of any stream section we monitored. This was due primarily to the

section's extensive riparian scrub and Fremont cottonwood stands; these vegetation types decreased in area with increasing elevation (USFWS 1993) on the upper stretches of the river. Higher-elevation black cottonwood communities did not replace lower riparian scrub-cottonwood communities in terms of bird species richness. Elevational temperature gradients and arthropod abundances were not examined in this study but may have contributed to levels of species abundance we observed. Black and Fremont cottonwood each occupied similar absolute areas (Table 1); hence, differences in bird richness were unlikely due to an area effect.

Transects at higher elevations were composed of coniferous vegetation with a narrow strip of streamside riparian vegetation; a conifer overstory was often present at streamside. In contrast, transects at lower elevations were predominantly riparian, with a cottonwood overstory and scrub understory. Thus, by virtue of abundance of vegetation types alone, lower-elevation areas should be dominated by riparian-associated bird species, while upper-elevation areas should have fewer riparian-associated

bird species. Knopf (1985) and Finch (1991b) also reported different bird communities associated with different elevations.

Species-specific Considerations

The Brown-headed Cowbird was widely distributed but reached its highest numbers at lower elevations where agriculture was prominent (Table 1). These birds typically forage in agricultural areas while sometimes flying long distances to find forested nesting habitat. The Brown-headed Cowbird was the most frequently encountered bird along the lower Truckee and was also found in the greatest number of vegetation types. Yellow Warbler, Warbling Vireo, Common Yellowthroat, Yellow-breasted Chat, and Song Sparrow were also detected during our study and are known to be adversely impacted by cowbird nest parasitism (Friedmann et al. 1977).

European Starlings, common along the lower Truckee, were especially numerous near agricultural fields and buildings; their numbers decreased rapidly with increasing elevation. Therefore, their potential impact on cavity-nesting species may be of primary concern only at lower elevations (Stoner 1939, Jackson and Tate 1974). House Sparrows were rare and were detected primarily around buildings.

Willow Flycatchers, which are declining in the West (DeSante and George 1994, Rothstein and Robinson 1994), were detected at only 1 point on the upper Truckee River and nowhere else. Dates of the sightings (18 and 24 June) suggest the probability of breeding activity (Bent 1942, McCabe and Hovel 1991), but we were unable to confirm this.

Avifauna of Little Truckee River and Independence Creek were dominated by species typical of coniferous forests. However, Warbling Vireos, Song Sparrows, and Yellow Warblers, all riparian-associated species of concern, were also common in both areas throughout the study. In addition, the Wilson's Warbler, another riparian-associated species, was commonly observed on Independence Creek and, to a lesser extent, on the upper Truckee and Little Truckee. Even in these conifer-dominated areas, small patches of riparian vegetation apparently are enough to support these riparian-associated bird species.

Species Richness in Vegetation

Fremont cottonwood and riparian scrub willow were used by a wide variety of birds

and with a much greater frequency than their availability. Therefore, a drastic reduction in native riparian forest abundance may have more effect on birds than a reduction in any other plant species along the Truckee River. Habitat specialists (40 species found in ≤ 3 different habitat types) were observed most frequently in riparian scrub. Even the habitat generalists in our study (Brown-headed Cowbird and American Robin—the bird species found in the greatest number of different vegetation types) were most frequently observed in riparian scrub. Therefore, both dominant riparian vegetation plants—cottonwood and willow (the dominant plant species in riparian scrub)—should be considered in developing management plans for protecting the habitat of Truckee River bird species.

Because 98 of 116 bird species were detected in native riparian vegetation, 22 exclusively, the majority of bird species would be impacted in some way by altering native riparian plant communities. Although sagebrush steppe also had a high species richness, this is probably due to its proximity to riparian vegetation, creating an ecotone that attracts more species than the sagebrush-steppe vegetation type alone (Gates and Gysel 1978).

Impacts of Exotic Vegetation

The major exotic plant of interest in our study was whitetop, or peppergrass. Whitetop was used by bird species for foraging (S. Lynn personal observation), but nesting in this plant species was not documented. Whitetop was negatively associated with bird species richness in riparian scrub; however, bird richness in Fremont cottonwood did not differ with the presence of whitetop. Further research in this area is necessary to determine whether there is a cause-effect relationship between whitetop and bird species richness.

In summary, a varied flow regime, overgrazing, channelization, and other human activities have altered riparian vegetation along the Truckee River and its tributaries (Klebenow and Oakleaf 1984). Destruction and removal of native cottonwoods and willows from the riparian corridor has likely resulted in a decrease in numbers of riparian obligate bird species, a historical issue which will be presented in a future manuscript. Also, avian exotics and opportunistic species, such as the Brown-headed Cowbird, could potentially reduce sensitive

species richness and abundance. The effects of cowbird parasitism and exotic species on sensitive bird species in the Truckee River area warrant further investigation. Also warranting further investigation is the effect that the exotic plant species whitetop may have on bird distribution. Unfortunately, whitetop is an especially hardy species that is difficult to eradicate (Rosenfels and Headley 1944). Management plans may have to consider it as a permanent aspect of the riparian community and concentrate on keeping existing patches of the plant from spreading into native riparian habitats.

Managers who are interested in halting declines in bird populations and stimulating growth in these populations should consider protecting existing native Fremont cottonwoods and riparian scrub vegetation, as well as perhaps initiating restoration of these vegetation types in degraded areas. Data that we collected will be valuable as a baseline from which to compare future bird surveys along these rivers as land uses change or continue in degradation of native riparian forest. Future researchers will be able to use our data to discover and confirm trends among bird species and their vegetation requirements along the Truckee River and vicinity.

ACKNOWLEDGMENTS

We thank the U.S. Fish and Wildlife Service, especially David L. Harlow of the Reno Field Office, for consulting on logistical arrangements and financially supporting this project. We also thank Sagehen Creek Field Station, University of California, for providing housing; the landowners along the Truckee, Little Truckee, and Independence Creek for allowing access to their property; and several anonymous reviewers, as well as (and especially) Steve Knick, for critiques of this manuscript.

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Received 20 November 1995
Accepted 13 November 1997

APPENDIX. Major vegetation types along the Truckee River, California and Nevada (USFWS 1993).

Code	Vegetation type and characteristics
smc	<i>Sierra mixed conifer forest</i> : An open, parklike forest of coniferous evergreens with crowns often touching. Several predominant species: <i>Abies</i> , <i>Pseudotsuga</i> , and <i>Cornus</i> are most common on moist sites; <i>Pinus</i> spp. and <i>Ceanothus</i> spp. on dry sites. The understory typically is sparse, consisting of scattered chaparral shrubs and young trees. Elevation: 1500–2100 m.
jp	<i>Jeffrey pine</i> : A tall, open forest predominated by Jeffrey pine, with sparse understory of montane chaparral or sagebrush spp. Elevation: 2100–2750 m.
lp	<i>Lodgepole pine</i> : Typically a dense forest of slender trees up to 40 m tall, often in pure stands. Elevation: 2100–2750 m.
bc	<i>Black cottonwood</i> : A fairly dense, mixed riparian forest predominated by black cottonwood with Jeffrey pine and/or lodgepole pine. The shrub and herb layers are well developed. Elevation: usually >1800 m.
cw	<i>Great Basin cottonwood-willow forest</i> : Open-canopied forest predominated by Fremont cottonwood and <i>Salix laevigata</i> (primarily east of Vista). Elevation: usually <2100 m. This type was further delineated by the presence of whitetop (“/w” added to ending of type code) and by successional stage: cw2 = shrub seedling (<3 m tall); cw3 = pole-sapling; cw4 = mature.
rs	<i>Great Basin riparian scrub</i> : Open to dense riparian thickets usually composed of willow. Open stands may have a dense herbaceous understory. Elevation: all, but especially well developed along lower Truckee.



Lynn, Suellen et al. 1998. "BIRD USE OF RIPARIAN VEGETATION ALONG THE TRUCKEE RIVER, CALIFORNIA AND NEVADA." *The Great Basin naturalist* 58(4), 328–343.

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