

BIRD USE OF NATURAL AND RECENTLY REVEGETATED COTTONWOOD-WILLOW HABITATS ON THE KERN RIVER¹

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*Abstract: Birds were censused concomitant with revegetation efforts on the Kern River Nature Conservancy Preserve during spring and summer 1987. Three types of sites were surveyed: naturally occurring cottonwood (*Populus fremontii*)-willow (*Salix* spp.) habitats, one 10-ha revegetation site implemented in 1986, and two 10-ha revegetation sites implemented in 1987. Six natural-history criteria were used to compare bird species found in naturally occurring habitat with species found in recently revegetated habitat. These data are extremely useful in discerning species responses to revegetation across seral stages of vegetation development.*

Avian response to revegetated riparian habitats is poorly documented, with the exception of the long-term study conducted on the lower Colorado River (Anderson and others, 1989). The lower Colorado River represents an extremely degraded system with little native riparian habitat remaining (Ohmart and others 1977). Therefore, it is unclear whether legitimate comparisons can be made between these data and data collected on a system with relatively healthy riparian habitat such as that found along the South Fork of the Kern River.

Revegetation of cottonwoods (*Populus fremontii*) and willows (*Salix laevigata*, *S. lasiolepis*, *S. gooddingii*, and *S. exigua*) on the South Fork of the Kern River was undertaken to increase the habitat necessary for successful breeding of the California-endangered yellow-billed cuckoo (*Coccyzus americanus*; Anderson and Laymon, 1989). In addition, we were extremely interested in assessing response to revegetation by all riparian species on the Kern River. Many state threatened and endangered bird species and species of special concern, occurring in California's remaining riparian habitats, are all but extirpated outside of the Kern River Valley. These species include willow flycatcher (*Empidonax traillii extimus*; see Unitt 1987), yellow warbler (*Dendroica petechia brewsieri*), yellow-breasted chat (*Icteria virens*), and summer tanager (*Piranga rubra cooperi*). These species have healthier populations on the Kern River, which may result in a more rapid and permanent response to revegetation than has been found on the lower Colorado River (Anderson and others, 1989).

Fleshman and Kaufman (1984) presented background information and management recommendations for maintaining and improving the South Fork of the Kern River's riparian forest. We refer the reader to this paper for an in-depth description of the study area. They also included density estimates for riparian birds, however, an evaluation of their bird densities suggested that estimates for common species were unrealistically high, while uncommon species went unrecorded. Several frequent problems in sampling design contributing to these results include too few sample points, too few repetitions, and extrapolating densities from small (2 ha) to large (40 ha) scales of analysis (Anderson and others 1977; Engel-Wilson and others 1981; Wiens 1981).

In this paper, therefore, we present our data on initial responses by birds to Kern River revegetated habitats compared with their concurrent use of naturally occurring riparian habitats. Further we compare the initial response data on the Kern River to data collected on the lower Colorado River. Data collection on the Kern River is an ongoing project that will add significantly to the baseline established here.

Methods

All data were collected on the Kern River Preserve administered by the Nature Conservancy. Two seasons were recognized: spring from 15 March to 15 May and summer from 16 May to 30 July. Three habitats were defined and surveyed: five stands as naturally occurring riparian vegetation consisting of cottonwood-willow, one 10-ha stand revegetated in 1986, and two 10-ha stands revegetated in 1987 were surveyed.

Tree and shrub counts constitute the major measurements of vegetation pertinent to this study. Vegetation structure was not assessed in depth during this study as there was a clear distinction between the highly structured naturally occurring vegetation and the revegetation sites; as revegetation sites develop differentially through time, structure will become more important in assessing differences among habitats. Individual trees and shrubs were counted within a distance of 15 m from the transect line. Tree species were identified

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and divided into two broad size classes that were <3 m in height (this class included all revegetated and recently regenerated trees) and >3 m in height (Anderson and others 1977, Anderson and Ohmart 1986). Counts of mature riparian trees parasitized by mistletoe (*Phoradendron tomentosum*) were also taken as well as the number of snags present. Almost all shrubs were <3 m so no height distinction is made among these plant species. Number of sunflowers (*Helianthus* spp.), which were important to granivorous bird species, were also noted. Densities were expressed as plants per hectare.

During the spring season, daily anecdotal observations were made on bird use of the sites before and during preparation for revegetation. Preparation of revegetation sites involved clearing surface vegetation and creating earthen berms by bulldozer; changes in bird use during spring were interpreted with respect to these activities. Summer bird use of revegetation sites before preparation was ascertained from notes taken on other potential revegetation sites with similar vegetation on the Preserve. Following revegetation, transects were established to census birds using the variable-distance line technique (Emlen 1971; Anderson and others 1977).

Five transects were established along edges of riparian habitat and encompassed all noticeable variation of vegetation among stands within the Preserve (table 1). Although there may be problems in overestimating birds concentrating along edges (i.e., western bluebird [*Sialia mexicana*], house wren [*Troglodytes aedon*], song sparrow [*Melospiza melodia*], and both species of goldfinches [*Carduelis* spp.]), we were concerned primarily with interior-forest birds. One transect was established at each of the three revegetation sites and these were designed to cover as much of the sites as possible. Transects were censused 18 times during the entire study, with half in spring and half in summer.

Table 1 — Length and area covered by transects used in determining bird densities on the Kern River Preserve.

Habitats ¹	Transect	Sites censused	Transect length(m)	Area covered (ha)
NATRIP	DS-2	1	762	20
HQ-1		1	457	10
HQ-2		1	762	20
SH-2		1	457	10
KM-1		1	1,067	28
Total		1	3,505	88
REVEG86	DS-1		1,524	10
REVEG87	SH1	2	1,676	10
MF-1		2	1,524	10
Total		2	3,200	20

¹NATRIP = riparian vegetation; REVEG86 = revegetation site implemented in 1986; REVEG87 = revegetation site implemented in 1987.

Eighty-eight ha of the approximately 200 ha of riparian habitat on the Preserve (Hewett and Laymon, pers. comm.) were surveyed. Based on this, we estimated the total number of birds present in riparian habitat. In this paper, we compare our population estimates with known population sizes (Laymon and Harris, pers. comm.) during 1987 for yellow-billed cuckoo, willow flycatcher, and summer tanager, three interior-forest species of special interest.

Bird Group Classification

Bird species were grouped by six natural-history criteria. These were use of cavity nests, residency, breeding phenology, foraging guild, typical foraging height, and typical foraging technique. This general classification allowed us to directly compare changes in habitat use among seasons, among habitats, and among birds with different natural histories. Within each criterion, total numbers of individuals were determined for each habitat and compared among habitats. Categories are as defined by Anderson and others (these proceedings).

Results and Discussion

Habitats

All natural riparian transects were dominated by red willows (*Salix laevigata*) >3 m in height. Mature Fremont cottonwoods were much less common than red willows except on one transect (table 2). The total number of riparian trees, >3 m in height, varied substantially among transects. Riparian trees <3 m in height were absent except where there were stands of recently regenerated riparian trees and these were scarce on all transects. Mulefat (*Baccharis viminea*) was the dominant shrub on all but one transect; emergent vegetation replaced shrubs on that transect (HQ-1; table 2).

The site revegetated in 1986 was dominated by revegetated and regenerated Fremont cottonwoods. Other features in this habitat included a clumped distribution of four-winged salt bush (*Atriplex canescens*), widely distributed rabbit brush (*Chrysothamnus* sp.), and many patches of annual chenopods and grasses representing several species. All these plants contributed to a well-developed understory, especially during summer. Sunflowers, which were abundant in 1986, were almost nonexistent when this habitat was surveyed in 1987.

Table 2 - Trees and shrubs counted along each transect. Trees were grouped into those above and those below 3 m in height. RW=red willow, CW=Fremont cottonwood, GW=Goodding willow, SBW=sandbar willow (*Salix exigua*), /M=with mistletoe, sn=snag, MF=mulefat, RB=rabbit brush (*Chrysothamnus* spp.), FW salt= four-winged salt bush (*Atriplex canescens*), SF=sunflower.

		Plants per hectare															
Habitat	Transect													FW		SF	
		RW	CW	CW	RW	GW	GW	SBW									
		>3	>3	<3	<3	>3	<3	>3	CW/M	RW/M	CW sn	RW sn	MF	RB	salt		
NATRIP	DS-2	90	8	43		3	0	0	0	3	0	0	123	110	0	35	
	HQ-1	218	13	10		10	0	0	0	3	0	0	0	0	0	0	
	HQ-2	50	38	5		5	5	5	0	10	0	3	0	113	0	0	0
	SH-2	250	23	0		5	0	0	0	0	10	0	5	160	0	0	0
	KB-1	73	30	0		5	0	0	0	5	3	8	0	48	0	0	0
REVEG86	DS-1	0	3	240		50	0	0	0	0	0	0	25	80	8	0	
REVEG87	SH-1	5	0	153		48	0	0	5	0	0	0	8	20	25	55	
	MF-1	0	0	150		48	0	0	0	0	0	0	0	0	3	0	

The two sites revegetated in 1987 were also dominated by revegetated Fremont cottonwoods, but contained few regenerated trees reaching measurable heights. Both sites were at least 90% cleared of grasses and shrubs before revegetation. During summer, many annual chenopods germinated and formed a patchy understory. Other features associated with revegetation activities were the occurrence of sunflowers on one site and earthen berms on both sites.

Seral Changes Among Bird Species Within Revegetation Sites

Number of bird species using sites revegetated in 1987 increased progressively through the summer period. Eleven species were recorded on revegetation sites before clearing in spring 1987. All but one species (prairie falcon, *Falco mexicanus*) were found on the sites after clearing. During clearing, the number of species increased to 23. These included a number of species foraging on seeds and animals exposed by clearing the sites of grass and other plants. During spring, after clearing was completed but before planting, the number of species increased to 26.

Six species were found regularly during summer in fields similar to those revegetated in 1987, four of which

were found to breed. All of these species were also found on revegetation sites after planting, although only horned lark (*Eremophila alpestris*) and savannah sparrow (*Passerculus sandwichensis*) were found to breed (one pair each). Thirty-three species were recorded during summer after planting and after annuals and sunflowers germinated on the sites. Thus, there was an increase of 27 species during summer that may be attributed to just clearing and planting the sites.

At initial stages of clearing there were almost immediate responses from blackbirds, sparrows, bluebirds, American robins (*Turdus migratorius*), and European starlings (*Sturnus vulgaris*). Higher trophic level species, such as gulls (*Larus* spp.) and common raven (*Corvus corax*), were observed foraging along the recently formed berms. The large flocks of blackbirds and European starlings were replaced with arriving spring migrants, such as western kingbirds (*Tyrannus verticalis*) and savannah sparrows. Trees were planted in late April about the time the first Lazuli buntings (*Passerina amoena*) and blue grosbeaks (*Guiraca caerulea*) were found. Annuals and sunflowers were setting seed by late June and these attracted large numbers of mourning doves (*Zenaidura macroura*), red-winged blackbirds (*Agelaius phoeniceus*), both species of goldfinches, house finches (*Carpodacus*

menicanus), and lark sparrows. In addition, northern flickers (*Colaptes auratus*), western kingbirds, western bluebirds, western meadowlarks (*Sturnella neglecta*), and savannah sparrows continued to be found in small numbers on the revegetated sites through the end of July.

A slightly different set of species was found on the 1986 site one year after revegetation. White-crowned (*Zonotrichia leucophrys*), Lincoln's (*Melospiza lincolni*), and song sparrows were abundant in this habitat in dried up patches of sunflower and annual chenopods. Large numbers of California quail (*Callipepla californica*) were also found, mostly where four-winged salt bush and rabbit brush were most dense. As spring turned into summer, song sparrows remained while all other sparrows departed. California quail increased with the coming of summer. Lazuli bunting and blue grosbeak were the first spring migrants to be consistently observed perched in revegetated trees. House wrens and song sparrows were the most common understory and ground foragers present. By mid-July large flocks of tricolored (*Agelaius tricolor*) and Brewer's blackbirds (*Euphagus cyanocephalus*) were found in the more open areas of the site. Unlike sites revegetated in 1987, very few mourning Doves, savannah and lark sparrows, lesser (*Carduelis psaltria*) and Lawrence's (*C. lawrencei*) goldfinches, and house finches were found. Among insectivores, northern flickers, western kingbirds, western bluebirds, European starlings, and western meadowlarks were no longer found foraging on the revegetated parts of the habitat; however, most of these species still were occasionally seen perched in adjacent naturally occurring riparian trees.

Estimated Populations for Riparian Birds

Estimated population sizes for birds on the Kern River Preserve can be determined by multiplying bird densities by the number of hectares (200) of riparian habitats found on the Kern River Preserve. Three species of particular interest were yellow-billed cuckoo, willow flycatcher, and summer tanager. Observers in the field found 9, 38, and 36 individuals for these bird species, respectively (Laymon and Harris, pers. comm.). Our census estimates were 11, 36, and 35 individuals, respectively. Since population estimates were very close to known population size for these three rare interior-forest species, we were confident that our density estimates for most nonedge species are also nearly accurate.

Comparison of Natural-History Characteristics Between Natural Riparian and Revegetated Habitats

Birds in every natural-history category were clearly more abundant in natural riparian habitat than on all revegetation sites (fig. 1). The avifauna of natural riparian habitats was dominated by insectivores, noncavity nesters, ground and understory species, and early breeders with individual numbers evenly split between permanent residents and summer visitors and scratchers and gleaners. On the revegetation sites, granivores were proportionally well represented in contrast to natural riparian habitat. Absolute numbers of late breeders, cavity nesters, midstory and canopy users, and gleaners were very low on revegetation sites during one or both seasons, when compared to natural riparian habitats. Within revegetation sites, the proportion of noncavity users on all revegetated sites and the proportion of late breeding species (due almost solely to nonbreeding goldfinches (*Carduelis* sp.) and lark sparrows [*Chondestes grammacus*]) in 1987 sites during summer were substantially higher than found in natural riparian habitats.

Differences between sites revegetated in 1986 and 1987 were more in magnitude than in trend with most bird categories having higher individual numbers on the 1986 site than on 1987 sites. An exception, was the presence of proportionately, as well as numerically, more winter visitors in the site revegetated in 1986 than on 1987 revegetated sites. The very high proportion of winter visitors and granivores during spring on the 1986 site was reflective of the high number of seed-eating sparrows present in this habitat (Appendix I).

Birds using revegetation sites during early stages of habitat development tend to be quite different in a number of natural-history characteristics from birds using riparian forests. In fact, many of the species found during the early stages of revegetation are better described as open-country birds (Appendix I). Many of these species can be considered opportunists and are not expected to remain on the sites as the habitat develops. Many species during spring, after clearing but before planting, were found using berms. Berms remained important as perches, hiding places, and forage substrate to some species after trees were planted and annuals germinated.

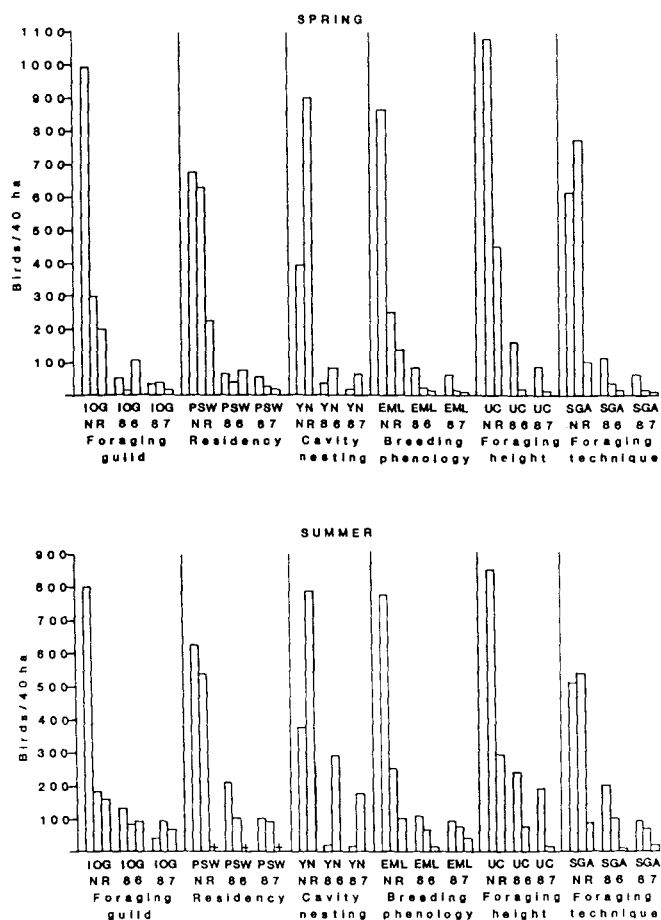


Figure 1– Bird use of natural riparian and revegetation sites as gauged by natural-history characteristics during spring and summer 1987. Foraging guild: I = insectivore, O = omnivore, G = granivore; Residency: P = permanent resident, S = summer visitor, W = winter visitor; Cavity nester: Y = yes, N = no; Breeding phenology: E = early, M = middle, L = late; Foraging height: GU = ground/understory, MC = midstory/canopy; Foraging technique: G = glean, S = scratch, A = aerial; NR = natural riparian; 86 = revegetation site 1986; 87 = revegetation site 1987.

Comparisons with the Lower Colorado River

An attempt to compare bird use of revegetated sites between the Kern River and the lower Colorado River is precarious as there is only one year of data on the former system. However, the occurrence of opportunistic granivores and other open-country species is consistent on both river systems. The occurrence of some species that require either large trees for cavity nesting or are otherwise most common in forest interiors (northern flicker, house wren, western bluebird, and song sparrow) may parallel the pattern observed on the lower Colorado River. Common permanent resident species became established on the lower Colorado River revegetated sites first for increased foraging opportunities and later for nesting (Anderson and others, 1989). Individual numbers increased for many common riparian species on the lower Colorado River revegetation sites 2-3 years after planting; if habitats develop at the same rate on the Kern River we may expect a similar response to revegetation, even with the more sensitive species.

Cavity-nesting, late-breeding, and canopy-foraging species are most closely associated with riparian forest but were poorly represented during the early stages of revegetation. It is these species, however, that we eventually hope to attract to revegetation sites. The work presented here is a first step in determining at what point in vegetative development we should expect these species to occur where relatively healthy populations exist in naturally occurring riparian habitats. We must stress that monitoring for bird occurrence, especially sensitive species, may require more than 3 years of intensive surveys to fully document the success of any revegetation effort. Therefore, we encourage the development of a strict and long-term survey whenever revegetation is proposed as mitigation for habitat losses (see also Anderson and others, 1989).

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References

- Anderson, Bertin W.; Engel-Wilson, Ronald W.; Wells, Douglas; Ohmart, Robert D. 1977. Ecological study of southwestern riparian habitat: techniques and data applicability. In: Johnson, R. Roy; Jones, Dale A., tech. coords. Importance, preservation and management of riparian habitat: a symposium; 1977 July 9; Tucson, Ariz. Gen. Tech. Rep. RM-43. Fort Collins, Colo.: Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 146-155.
- Anderson, Bertin, W.; Hunter, William C.; Ohmart, Robert D. 1989. Status changes of bird species using revegetated riparian habitats on the lower Colorado River from 1977 to 1984. [These proceedings].
- Anderson, Bertin W.; Laymon, Steve. 1989. Creating habitat for the yellow-billed cuckoo (*Coccyzus americanus*). [These proceedings].
- Anderson, Bertin W.; Ohmart, Robert D. 1986. Vegetation. In: Cooperrider, Allen Y.; Boyd, Raymond J.; Stuart, Hanson R., eds. Inventory and monitoring of wildlife habitat; U.S. Department of the Interior, Bureau of Land Management Service Center, Denver, Colo.; 639-660.
- Emlen, John T. 1971. Population densities of birds derived from transect counts. Auk 88:323-342.
- Engel-Wilson, Ronald W.; Webb, A. Kurt; Rosenberg, Kenneth V.; Ohmart, Robert D.; Anderson, Bertin W. 1981. Avian censusing with the strip method: a computer simulation. Studies in Avian Biology No. 6:445-449.
- Fleshman, Carolyn; Kaufman, Darrell S. 1984. The South Fork (Kern River) Wildlife Area: will the commitment be forgotten? In: Warner, Richard E. and Hendrix, Kathleen E., eds. California riparian systems: Ecology, preservation, and productive management. Berkeley: Univ. Calif. Press; 482-494.
- Ohmart, Robert D.; Deason, Wayne O.; Burke, Constance. 1977. A riparian case history: the Colorado River. In: Johnson, R. Roy; Jones, Dale A., tech. coords. Importance, preservation and management of riparian habitat: a symposium; 1977 July 9; Tucson, Ariz. Gen. Tech. Rep. RM-43. Fort Collins, Colo.: Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 35-47.
- Unitt, Philip. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137-162.
- Wiens, John. 1981. Scale problems in avian censusing. In: Ralph, C. J. and Scott, J. M., eds., Estimating numbers of terrestrial birds. Studies in Avian Biology No. 6; 513-521.

Appendix I. — Densities and natural-history characteristics of birds found on the Kern River Preserve among habitats for spring (15 March-15 May) and summer (16 May-31 July) 1987.

Group*	Species	Densities (birds/40 ha)						Natural- history** characteristics
		Spring			Summe			
		Reveg 1986	Reveg 1987	NatRip	Reveg 1986	Reveg 1987	NatRip	
PROC								
California quail	(<i>Callipepla californica</i>)	33	0	10	79	1	61	N,P,E,GV,Gr,Sc
Killdeer	(<i>Charadrius vociferas</i>)	0	2	0	0	2	0	N,P,E,I,Gr,Gl
Horned lark	(<i>Eremophila alpestris</i>)	0	+	0	0	3	0	N,P,E,O,Gr,Gl
Red-winged blackbird	(<i>Agelaius phoeniceus</i>)	1	27	183	26	25	59	N,P,E,O,Gr,Gc
Western meadowlark	(<i>Sturnella neglecta</i>)	0	3	0	0	11	+	N,P,E,O,Gr,Sc
Brewer's blackbird	(<i>Euphagus cyanocephalus</i>)	0	1	0	6	4	4	N,P,E,O,Gr,Gc
Lesser goldfinch	(<i>Carduelis psaltria</i>)	0	0	68	9	29	31	N,P,M,GV,U,Gl
House finch	(<i>Carpodacus mexicanus</i>)	0	0	1	0	0	0	N,P,E,GV,U,G1
SVOC								
Mourning dove	(<i>Zenaida macroura</i>)	3	3	46	2	28	64	N,SV,M,GV,Gr,Sc
Western kingbird	(<i>Tyrannus verticalis</i>)	2	6	6	0	3	2	N,SV,M,I,Gr,Ae
Savannah sparrow	(<i>Passerculus sandwichensis</i>)	1	7	+	1	10	1	N,SV,E,O,U,Sc
Lark sparrow	(<i>Chondestes grammacus</i>)	0	0	0	1	28	40	N,SV,L,O,Gr,Sc
Yellow-headed blackbird	(<i>Xanthocephalus</i>)	0	15	0	0	0	0	N,SV,M,O,Gr,Sc
Tricolored blackbird	(<i>Agelaius tricolor</i>)	0	+	21	51	10	11	N,SV,M,O,Gr,Sc
Brown-headed cowbird	(<i>Molothrus ater</i>)	0	1	102	0	0	65	N,SV,M,O,Gr,Sc
Lawrence's goldfinch	(<i>Carduelis lawrencei</i>)	2	+	46	0	10	11	N,SV,L,GV,U,G1
WVOC								
Dark-eyed junco	(<i>Junco hyemalis</i>)	0	2	7	—	—	—	-,WV,-,GV,Gr,Sc
White-crowned sparrow	(<i>Zonotrichia leucophrys</i>)	55	6	12	—	—	—	-,WV,-,GV,Gr,Sc
Golden-crowned sparrow	(<i>Zonotrichia atricapilla</i>)	2	0	+	—	—	—	-,WV,-,GV,Gr,Sc
Lincoln's sparrow	(<i>Melospiza lincolni</i>)	16	1	12	—	—	—	-,WV,-,GV,Gr,Sc

Appendix I. – Continued.

Group*	Species	Densities (birds/40 ha)						Natural-history** characteristics
		Spring			Summer			
		Reveg 1986	Reveg 1987	NatRip	Reveg 1986	Reveg 1987	NatRip	
PRFI								
Northern flicker	(Colaptes auratus)	1	2	10	1	4	16	Y,P,E,I,Gr,Gl
Downy woodpecker	(Picoides pubescens)	0	0	5	0	0	12	Y,P,E,I,C,Gl
Hairy woodpecker	(Picoides villosus)	3	0	5	0	0	6	Y,P,E,I,C,G1
Nuttall's woodpecker	(Picoides nuttallii)	1	0	12	0	0	14	Y,P,E,I,C,G1
Black phoebe	(Sayornis nigricans)	3	1	14	2	2	20	N,P,E,I,U,Ae
Scrub Jay	(Aphelocoma coerulescens)	0	0	3	1	0	3	N,P,E,I,M,GI
Plain titmouse	(Parus inornatus)	5	0	18	0	0	32	Y,P,E,I,C,Gl
Bushtit	(Psaltriparus minimus)	2	0	55	51	0	86	N,P,E,I,M,Gl
White-breasted nuthatch	(Sitta carolinensis)	0	0	2	0	0	10	Y,P,E,I,C,G1
Bewick's wren	(Thyomanes bewickii)	1	0	9	1	0	15	Y,P,E,I,U,Gl
Western bluebird	(Sialia mexicana)	3	4	15	0	8	13	Y,P,E,I,Gr,Ae
American robin	(Turdus migratorius)	0	5	10	0	1	8	N,P,E,I,Gr,Sc
California thrasher	(Torostoma redivivum)	0	0	0	0	0	1	N,P,E,I,Gr,Sc
European starling	(Sturnus vulgaris)	5	9	39	0	8	30	Y,P,E,I,Gr,Gl
Rufous-sided towhee	(Pipilo erythrophthalmus)	0	0	4	0	0	4	N,P,E,I,Gr,Sc
Brown towhee	(Pipilo fuscus)	8	0	4	4	+	7	N,P,E,I,Gr,Sc
Song sparrow	(Melospiza melodia)	4	3	199	28	5	187	W,P,E,I,Gr,Sc
SVFI								
Yellow-billed cuckoo	(Coccyzus americanus)	–	–	–	0	0	2	N,SV,L,I,C,A1
Ash-throated flycatcher	(Myiarchus cinerascens)	0	+	18	+	1	21	Y,SV,MR,I,Ms,Ae
Western wood-pewee	(Contopus sordidulus)	0	1	15	0	0	13	N,SV,L,I,C,Ae
Willow flycatcher	(Empidonax traillii)	0	0	4	0	0	7	N,SV,L,I,C,Ae
Tree swallow	(Tachycineta bicolor)	0	1	26	+	1	4	Y,SV,E,I,C,Ae
House wren	(Troglodytes aedon)	9	1	237	22	0	206	Y,SV,E,I,U,Gl
Yellow warbler	(Dendroica petechia)	0	0	18***	0	0	2	N,SV,MR,I,U,Gl
Common yellowthroat	(Geothlypis triches)	0	0	13	1	0	10	N,SV,MB,I,U,Gl
Yellow-breasted chat	(Icteria virens)	0	0	2	0	0	3	N,SV,L,I,U,Gl
Blue grosbeak	(Guiraca caerulea)	2	1	15	8	4	18	N,SV,MB,I,Ms,Gl
Lazuli bunting	(Passerine amoena)	2	+	4	13	+	15	N,SV,MB,I,Ms,Gl
Northern oriole	(Icterus galbula)	0	1	42	1	1	29	N,SV,MB,I,Ms,Gl
Summer tanager	(Piranga rubra)	1	0	3	0	1	7	N,SV,L,I,C,A1
WVFI								
Hermit thrush	(Catharus guttatus)	0	0	7	–	–	–	–,WV,–,I,Gr,Sc
Ruby-crowned kinglet	(Regulus calendula)	0	0	8	–	–	–	–,WV,–,I,C,Gl
Orange-crowned warbler	(Vermivora celata)	1	0	6	–	–	–	–,WV,–,I,C,Gl
Yellow-rumped warbler	(Dendroica coronata)	1	1	156	–	–	–	–,WV,–,I,C,Gl
NECTIVORE								
Black-chinned hummingbird	(Archilochus alexandri)	0	+	8	1	1	7	NA
Anna's hummingbird	(Calypte anna)	0	0	7	0	0	3	NA
WVF								
Cedar waxwing	(Bombycilla cedrorum)	0	0	11	–	–	–	NA
Phainopepla	(Phainopepla nitens)	0	0	1	–	–	–	NA
RAPTORS								
Turkey vulture	(Cathartes aura)	0	0	1	0	0	0	NA
Black-shouldered kite	(Elanus caeruleus)	0	0	+	+	0	0	NA
Cooper's hawk	(Accipiter cooperii)	0	0	+	0	0	0	NA
Red-shouldered hawk	(Buteo lineatus)	0	0	+	0	0	+	NA
Red-tailed hawk	(Buteo jamaicensis)	0	0	+	0	0	1	NA
American kestrel	(Falco sparverius)	0	0	+	0	+	1	NA
Great horned owl	(Bubo virginianus)	0	0	1	0	0	1	NA
Common raven	(Corvus coral.)	0	0	+	0	+	1	NA

*PROC = permanent resident, open-country; SVOC = summer visiting, open-country; WVOC = winter visiting, open-country; PRFI = permanent resident, forest insectivore; SVFI = summer visiting, forest insectivore; WVFI = winter visiting, forest insectivore; WVF = winter visiting frugivore.

**Y = cavity nester; N = noncavity nester; P = permanent resident; SV = summer visitor; WV = winter visitor; E = early (April) breeding; MB = middle (May) breeding; L = late (June) breeding; I = insectivore; O = omnivore; GV = granivore; Gr = ground foraging; U = understory foraging; Ms = midstory foraging; C = canopy foraging; Gl = gleaning; Sc = scratching; Ae = aerial pursuit; NA = not applicable; and + species not included in fig. 1.

***Density includes northbound migrants.