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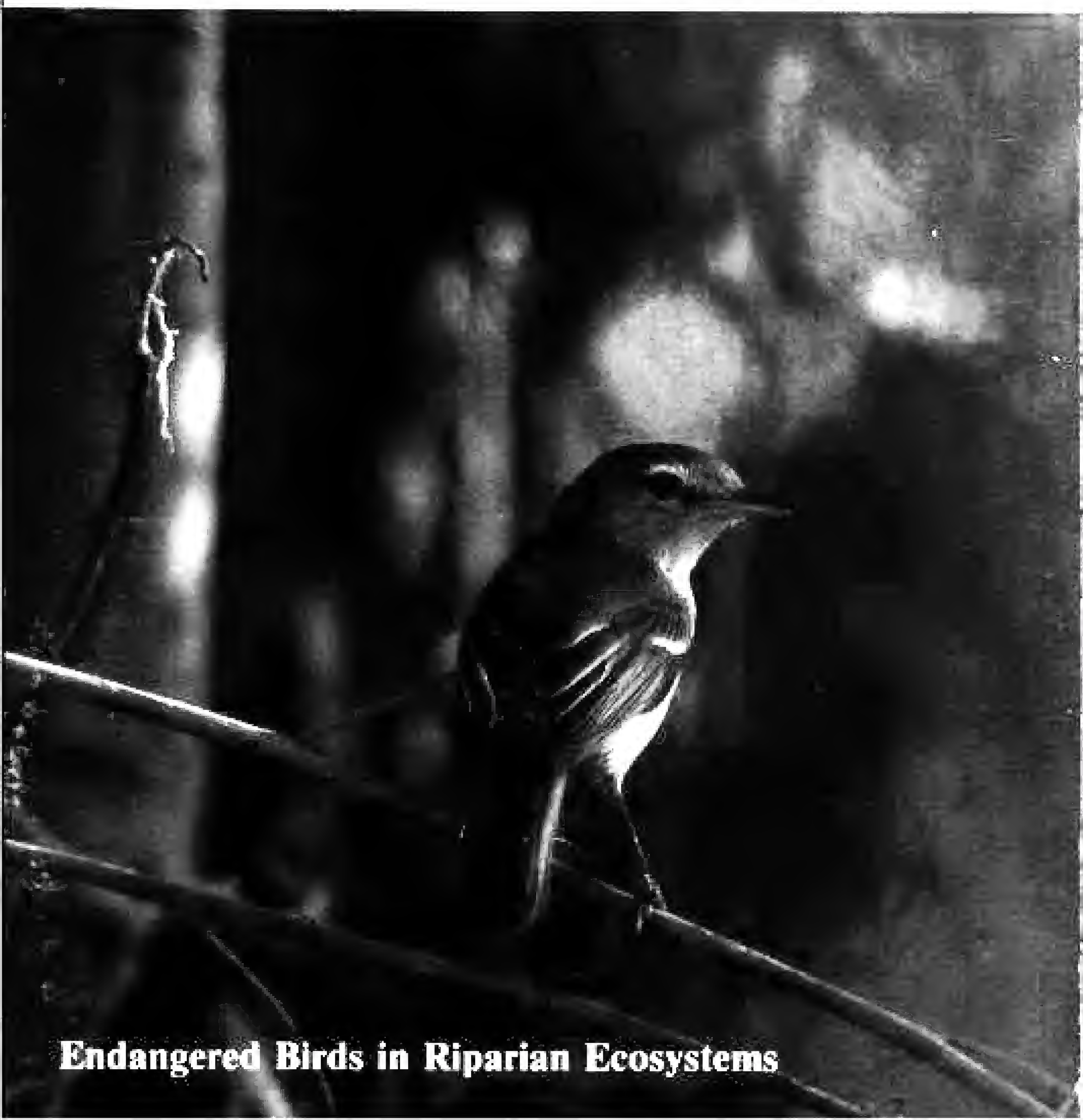

WESTERN BIRDS

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WESTERN BIRDS

Volume 18, Number 1, 1987

MANAGEMENT AND PRESERVATION OF ENDANGERED BIRDS IN RIPARIAN ECOSYSTEMS:

A SYMPOSIUM PRESENTED IN CONJUNCTION WITH THE COOPER ORNITHOLOGICAL SOCIETY ANNUAL MEETING, 10 SEPTEMBER 1986

STEPHEN A. LAYMON, Department of Forestry and Resource Management, 145 Mulford Hall, University of California, Berkeley, California 94720

When the Cooper Ornithological Society announced its annual meeting to be held in Davis, California, in the fall of 1986, the organizers requested topics for mini-symposia. Because one of the major management issues and conservation problems concerning birds in California and the arid West is the preservation and management of riparian ecosystems and their accompanying bird communities, I organized a steering committee to explore the possibility of conducting a symposium on this topic. This steering committee consisted of Edward Beedy of Jones and Stokes Associates, Kathleen Franzreb of the U.S. Fish and Wildlife Service Endangered Species Office, and John Gustafson of California Department of Fish and Game Nongame Bird and Mammal Section. The format we chose emphasized the management and preservation of endangered birds in riparian habitats.

The call for papers met with enthusiasm and the final program consisted of 17 papers ranging from reports of original scientific research to papers reviewing issues of management importance. The symposium concluded with a panel discussion involving members of the academic, land management, and environmental communities. This was an opportunity to explore the views, concerns, and management plans of the participating organizations. Special thanks go to Felix Smith of the U.S. Fish and Wildlife Service, who acted as the moderator, and to the panel members, David Busch of the Bureau of Reclamation, Earle Cummings of the California Department of Fish and Game, Steven Johnson of The Nature Conservancy, William Laudenslayer of the U.S. Forest Service, Robert Ohmart of Arizona State University, Richard Spotts of Defenders of Wildlife, and Daniel Taylor of the National Audubon Society, for making it a success.

The steering committee is grateful to the Cooper Ornithological Society and Daniel Anderson, chairman of the local arrangements committee, for providing logistical support during the symposium. Special recognition must be extended to the Western Field Ornithologists for publishing the proceedings. Many organizations and individuals have provided funding for these proceedings, including Biosystems Analysis, Davis Audubon Society, EIP Associates, Environmental Science Associates, Harvey and Stanley Associates, Inc., Jones and Stokes Associates, Inc., Kern Audubon Society, Kerncrest Audubon Society, Richard Kust, Marin Audubon Society, Mt. Diablo Audubon Society, Morro Coast Audubon Society, Riparian Systems, Mr. and Mrs. David Rorick, Sacramento Audubon Society, Sea and Sage Audubon Society, David D. Smith & Associates, and Westec Services, Inc.

It is our hope that this volume will contribute to the management of endangered species inhabiting riparian ecosystems. We trust that the following papers will not be viewed as containing the ultimate answers, but rather, that they will provide grains of knowledge that will stimulate a new round of research and management activites and promote the reestablishment of viable riparian ecosystems throughout the West.

PERSPECTIVES ON MANAGING RIPARIAN ECOSYSTEMS FOR ENDANGERED BIRD SPECIES

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The emphasis of this symposium is the management of endangered, threatened, and other sensitive bird species in western riparian habitats. Riparian areas are limited in their extent, yet are extremely productive and have well documented wildlife values (Gaines 1977, Johnson and Jones 1977, Stevens et al. 1977, Warner and Hendrix 1984). This paper examines the nature of riparian systems from historical and current perspectives, describes the importance of riparian habitats to sensitive bird species, and briefly explores the laws, policies, and regulations designed to protect these habitats.

DEFINITION OF RIPARIAN HABITATS

Located primarily along major rivers and tributaries, riparian forests are usually associated with abundant water supplies, have coarse textured and well-drained soils, and contain high levels of nutrients (Roberts et al. 1977). Riparian habitats may be defined as streamside, riverside, or lakeside communities, extending from high forest to low desert (Pase and Layser 1977). Soil moisture is seldom limiting although surface water may be lacking at times (Pase and Layser 1977).

GENERAL DESCRIPTION

Within riparian forests the density and diversity of vegetation tend to be greater than in adjacent upland habitats because of edge effects. Western riparian forests are complex and structually diverse ecosytems, often having dense understories of shrubs or young trees with canopy layers of more mature trees.

In many western riparian systems early successional stages are pure cottonwood-willow (*Populus* spp.-*Salix* spp.), whereas mid- and late successional stages frequently have cottonwood-willow overstory with an occasional oak (*Quercus* spp.) or sycamore (*Platanus* spp.). Box elder (*Acer negundo* subsp. *californicum*), black walnut (*Juglans hindsii*), and ash (*Fraxinus* spp.) often constitute the second canopy layer in these older stands (Strahan 1984). Should flood-induced scouring of the forest be absent for many years, cottonwood-willow habitats may be replaced by these second canopy (as defined above) species (Strahan 1984). Reproduction is usually by seed, but willows such as sandbar willow (*Salix hindsiana*) also use vegetative means. For a more complete description of riparian habitats, please refer to Johnson and Jones (1977), Johnson and McCormack (1978), and Warner and Hendrix (1984).

HISTORICAL PERSPECTIVE

Historical accounts suggest that along both sides of large, lowland rivers, belts of riparian trees averaged from 3.2 to 6.4 km (2-4 mi.) in width (Thompson 1961). Such conditions prevailed especially in the Central Valley in California, which provides a typical example of modifications that have occurred in riparian areas.

Farmers, noting that the soil in riparian areas was very fertile, cleared riparian vegetation so they could grow crops. The expansion of farming and concurrent increase in the demand for water and flood control prompted large-scale water development and reclamation projects that had far-reaching, adverse effects on riparian systems. Much of the water diverted for crop irrigation was no longer available to support riparian habitats.

Towns developed in conjunction with the rapidly expanding agricultural industry. Seasonal flooding became a major concern because many of these valley towns were built in floodplains. As levees were built higher and higher, water levels rose and water that would have previously overflowed into the natural floodplain basins was now confined within the levees.

Extensive, controversial water projects have been constructed throughout the Central Valley. The once vast riparian forests have been decimated by dam building, river channelization (riprapping, concrete lining, etc.), groundwater pumping, land clearing (for urban and agricultural development), artificial levees, water diversion (irrigation canals), bank protection systems, grazing, road construction, and pooling of water (to water stock and for water diversion) (Carothers 1977, Johnson 1978, Katibah 1984, Katibah et al. 1984).

DECLINE IN DISTRIBUTION AND QUANTITY OF RIPARIAN HABITAT

Bottomland riparian forests are the most highly modified of natural landscapes in California. Most of the riparian forest along the water courses of the Central Valley was rapidly eliminated or greatly reduced in size. Using a map by J. Greg Howe, Katibah (1984) conservatively estimated the presettlement riparian vegetation for the entire Central Valley at more than 373,000 ha (924,000 ac). In 1979 it was estimated that about 41,300 ha (102,000 ac) of riparian forest remained in the Central Valley and 85% of it was in a disturbed or degraded condition (Katiban et al. 1984) (Table 1). Similar losses are evident throughout much of the U.S. (Korte and Fredrickson 1977).

BIRD USE OF RIPARIAN HABITATS

According to Miller (1951), the ". . . number of species of birds associated with riparian woodlands is larger than that of any other formation." Several factors contribute to the avian diversity of riparian habitats, including ecotone and edge effects, as the aquatic stream ecosystem interfaces with the adjacent terrestrial habitat (Odum 1978).

Table 1 Current Sample Site[a] Condition of Riparian Systems in the Central Valley[b]

Condition	Amount (ha)	Percentage
Apparently unaltered	1,239	3
Good	4,956	12
Disturbed	10,325	25
Degraded	12,803	31
Severely degraded	11,977	29
Total	41,300	100

[a]For definition of sample site, see Katibah et al. (1984), pp. 316-317.
[b]From Katibah (1984) and Katibah et al. (1984).

Avian use of riparian systems is well documented (Table 2). Although most of the studies concentrated on breeding birds, similar trends are evident with migrants; both Rappole and Warner (1976) and Stevens et al. (1977) reported that migrants preferred riparian habitat over adjacent upland areas. This is particularly significant because the loss of riparian habitat affects not only nesting birds, but may adversely affect migrating individuals by influencing migration routes, reducing cover, eliminating resting areas, and reducing food supplies (Rappole and Warner 1976, Stevens et al. 1977, Johnson 1978). Riparian habitat also serves as an essential link for long-distance migrants and as wintering grounds (Laymon 1984).

Table 2 Examples of Avian Use of Riparian Areas

Habitat	State	Estimated no. per 40 ha	Source
Mixed broadleaf	AZ	332 pairs	Carothers et al. (1974)
Cottonwood	AZ	847 pairs	Carothers et al. (1974)
Cottonwood-willow	TX	475 birds	Engel-Wilson and Ohmart (1978)
Cottonwood-willow	AZ/CA	84-298[b] birds	Anderson et al. (1983)
Desert riparian	AZ	336[a] birds	Szaro and Jakle (1985)
Willow-tamarisk	AZ	445[a] birds	Szaro and Jakle (1985)
Honey mesquite	AZ	178-200[b] birds	Anderson et al. (1983)
Salt Cedar	AZ	23-146[b] birds	Anderson et al. (1983)
Arrowweed	AZ	111[b] birds	Anderson et al. (1983)
Screwbean mesquite	AZ	92-202[b] birds	Anderson et al. (1983)
Mesquite bosque	AZ	476 pairs	Gavin and Sowls (1975)

[a]Densities varied depending on year and interior/edge area of riparian.
[b]Densities values for spring season; all plots along the Colorado River.

Avian densities and species richness in riparian systems demonstrate the importance of these habitats to birds. For example, riparian forests support more species of breeding birds in California than any other habitat type and at least 100 species use it for food and cover (Gaines 1977).

In analyzing data from *American Birds* for various habitat types, Laymon (1984) noted that riparian areas had the highest density (birds/km^2) and greatest species richness of all habitats studied in both the breeding and winter seasons. During the last 100 years, 83 species are known to have nested in riparian habitats in the Sacramento Valley, and 20 of the regularly occurring species are believed to have their highest densities in riparian systems (Laymon 1984). Several species, such as the Willow Flycatcher (*Empidonax traillii*) and Least Bell's Vireo (*Vireo bellii pusillus*), are no longer known to nest anywhere in the interior lowland areas of California.

Riparian avifaunas also increase the avian diversity of nearby and adjacent communities. For example, it was found that the avian community in a riparian area increased the nearby desert bird community in both species composition and density (Szaro and Jakle 1985). In this south-central Arizona study, contributions from the riparian avifauna ranged from 23 to 33% of the birds along the adjacent desert washes and 7 to 15% within the desert uplands (Szaro and Jakle 1985). This contrasts with a contribution of only 1 to 1.5% from the desert areas to the riparian community (Szaro and Jakle 1985). Likewise, riparian birds exert a stong influence over the bird communities in adjacent agricultural and second-growth fields and pastures (Carothers et al. 1974, Conine et al. 1978). Along the Sacramento River, agricultural land devoid of adjacent riparian areas supported 95% fewer individuals and 32% fewer species than similar agricultural lands bordering riparian habitat (Henke and Stone 1978).

MANAGEMENT CONCERNS AND ADVERSE IMPACTS

A number of activities either modify or have the potential to adversely affect riparian habitats and their avian populations. These include water storage projects that inundate riparian areas, erosion, excessive groundwater pumping (and declining water tables), human recreation (camping, hunting, trapping, etc.), pesticide buildup resulting from drainage and erosion from nearby agricultural fields, flood control projects, and bank protection projects (Johnson 1978, Katibah 1984, Katibah et al. 1984).

Invasions by exotic plants such as salt cedar (*Tamarix* spp.) and giant reed (*Arundo donax*) present insidious threats because the exotics gradually replace cottonwood-willow and other native riparian species. Floodplain management is designed to protect against loss of human life and property, but frequently moves the potential problem downstream by channelizing the water from one locale to another (Johnson 1978). These conditions all serve to reduce native riparian vegetation and portend either the elimination or reduction in avian populations and other wildlife.

Management of riparian areas requires that the natural periodicity of the river flow be sustained to allow the functioning of riparian systems. Depending on its frequency, duration, and intensity, flooding can be beneficial or stressful to a riparian system (Odum 1978). Projects that reduce or eliminate normal seasonal flooding retard riparian productivity (Odum 1978). Too frequent flooding knocks down vegetation and may prevent it from becoming reestablished. If flooding (and attendant scouring of vegetation) is too infrequent, succession will proceed to climax, to the detriment of species that rely on early successional stages, such as the Least Bell's Vireo. If the flood is too intense or long in duration, extensive scouring and erosion may result, adversely modifying the stream bed. As a conservation policy, any structures that alter river flow so as to cause a substantial negative effect on the riparian ecosystem should be discouraged.

A balance must be maintained between riparian and fluvial systems. We must recognize that flooding is a natural process and should consider channel and floodplain as complementary if we are to maintain the integrity of riverine systems. In some areas natural flooding is no longer feasible and artificial means of duplicating the effects of natural flooding should be considered.

The public must be involved in the management of riparian systems; such involvement could include education, legislation, preservation, and restoration.

A number of laws and regulations are available to manage and protect riparian habitat. These include the Clean Water Act, National Environmental Policy Act of 1969, Endangered Species Act of 1973, Fish and Wildlife Coordination Act, National Wild and Scenic Rivers Act of 1968, and others. In California, several state laws apply, such as the California Environmental Quality Act of 1970, State Wild and Scenic Rivers Act of 1972, and Surface Mining and Reclamation Act of 1975.

A prime example of how laws can be used to manage sensitive species is provided by the Endangered Species Act of 1973, as amended. Federally listed species and the ecosystems on which they depend are protected under the Endangered Species Act through implementation of two of its provisions. Section 9 prohibits "take" (defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) and states the penalties for violations. Section 7 requires that all federal agencies insure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species or result in destruction or adverse modification of any designated critical habitat.

According to the Endangered Species Act, for federally listed species the term "endangered" means "any species (this includes subspecies of vertebrate fish or wildlife or plants and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature) which is in danger of extinction throughout all or a significant portion of its range." The reference to a population segment is pertinent because it enables a distinct portion of a vertebrate species to be listed even though the entire species may not warrant protected status. A federally "threatened" species is one which is likely to become endangered should factors currently reducing the population persist throughout all or a significant portion of its range. The Secretary of the Interior bases the decision to list a species as endangered or threatened on whether it meets at least one of the following criteria: (a) the present or threatened destruction, modification, or curtailment of its habitat or range; (b) overutilization for commercial, recreational, scientific, or educational purposes; (c) disease or predation; (d) the inadequacy of existing regulatory mechanisms; and (e) other natural or man-made factors affecting its continued existence. Various states maintain lists of endangered, threatened, or rare species with their own standards that a species must meet to qualify for state listing.

To protect riparian habitat all applicable laws and regulations must be aggressively implemented and stringently enforced. A far-reaching monitoring program to assess and evaluate the status of riparian systems should be established by a consortium of federal, state, and local agencies. Only through dynamic, diligent, and innovative actions to manage riparian areas appropriately will this sensitive, valuable, and irreplaceable habitat persist.

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STATUS OF BREEDING RIPARIAN-OBLIGATE BIRDS IN SOUTHWESTERN RIVERINE SYSTEMS

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Ecological values of riparian habitats have received much attention over the past decade. One issue confronting management agencies is the effect of intensive water management on riparian vegetation in the Southwest (e.g., the decline of native vegetation and the increase of exotic Salt Cedar [*Tamarix chinensis*]; Table 1).

Many bird species have declined in number or suffered extirpation along these riparian systems as habitat changes have occurred (Table 2). We examine breeding birds obligated to riparian habitats and draw qualitative conclusions on their status throughout their range below 1524 m elevation (Phillips et al. 1964, Ohmart 1982, Ohmart and Anderson 1982). Trends are also described for species that are breeding riparian obligates in one or more riparian systems but use nonriparian habitats elsewhere. Species are reviewed with respect to historical status and present status, as well as to riparian habitat use within and among riparian systems. We compare Salt Cedar as breeding habitat with native habitats, both within and among riparian systems, present possible explanations for existing patterns, and review management implications.

METHODS

Data on breeding birds in riparian habitats are from our studies and from other published information. Sites of studies include the upper Verde River (1969-1972, Carothers et al. 1974), the lower Colorado River (1972-1984, Anderson and Ohmart 1984), the Rio Grande near Presidio, Texas (1977-1978, Engel-Wilson and Ohmart 1978), the lower Verde River (1980, Higgins and Ohmart 1981), the middle Pecos River (1979-1981, Hildebrandt and Ohmart 1982), the middle Rio Grande (1981-1983, Hink and Ohmart 1984), the lower Virgin River (1982-1983, Kasprzyk 1984), the upper Gila River (1978-1979 in mixed broadleaf habitats only, Clark 1984), the lower and upper Gila River (1985-1986, Hunter 1987), the lower San Pedro River (1985-1986, Hunter 1987), and the upper San Pedro River (1986, Krueper and Corman unpubl.), the lower Salt, lower Santa Cruz, and middle Gila rivers (Rea 1983), the Colorado River through the Grand Canyon (Brown et al. 1981), and the upper Santa Cruz River (Arnold 1940). Climatic differences among riparian systems may have an important effect on a species' use of riparian habitat. We divided study sites into low-elevation (below 427 m) and high-elevation (427 m-1524 m) groups to investigate climatic effects on habitat use.

Bird species were grouped by four criteria: (1) dependence on broadleaf habitats (obligate, partial obligate, generalist); (2) type of nest (open, covered, cavity); (3) residency (permanent resident or summer visitor); and (4) period of peak egg laying (spring-early summer or midsummer).

Dependence on broadleaf riparian was determined from field studies. Nest type and residency status are drawn from the literature or personal observations. Peak egg-laying periods are primarily from Bent (1963-1968).

RESULTS

Broadleaf Obligates

Seventeen of the 32 riparian-dependent species are broadleaf obligates (Table 3). Two major groups within the 17 species are large raptors (seven species) and cavity nesters (seven species).

Broadfleaf-obligate raptors require tall, large trees for nest placement. Mature broadleaf trees constitute the most important raptor nest sites in riparian systems. Honey Mesquite (*Prosopis glandulosa*) and Salt Cedar are rarely used for nest platforms. The Mississippi Kite (*Ictinia mississippiensis*) requires

Table 1 Area Encompassed by Riparian Habitats along Each River Reach[a]

Elevation/river reach	Hectares/habitat type[b]						Total ha
	CW	SM	HM	SC	SH	MB	
Low (<427 m)							
Colorado	3,417	9,799	5,652	15,638	3,826		38,382
Gila	330		4,985	22,493	2,162		29,970
Salt	228			49			277
Santa Cruz	18		1,665	46			1,729
Subtotal	3,993	9,799	12,302	38,276	5,988		70,358
Percentage	5.7	13.9	17.5	54.4	8.5		
High (427-1524 m)							
Virgin	70			3,211			3,281
Grand Canyon	109		600	901			1,610
Gila	442		5,771	7,281	462		13,956
Salt	388		1,278	542	123	54	2,385
Santa Cruz	270		4,033				4,303
Lower San Pedro	490		2,976	715			4,181
Upper San Pedro	804		4,728	307			5,839
Lower Verde	2,309		2,426				4,735
Upper Verde	1,244		1,105			505	1,610
Lower Rio Grande	60	25	3,029	5,600			8,714
Middle Pecos	834		215	11,295			12,344
Subtotal	6,950	25	26,161	26,641	585	559	62,958
Percentage	10.9	0.0	40.7	46.5	0.9	0.9	

[a]From Ohmart (1982) except for the Pecos River (Hildebrandt and Ohmart 1982) and the lower Rio Grande (Engel-Wilson and Ohmart 1978).
[b]CW, cottonwood-willow; SM, Screwbean Mesquite; HM, Honey Mesquite; SC, Salt Cedar; SH, Salt Cedar-Honey Mesquite; MB, mixed broadleaf.

Table 2 Riparian Birds That Have Declined or Been Extirpated in the Southwest since 1900[a]

	River system and reach																	
	Colorado			Gila		Santa Cruz		Salt		San Pedro		Verde		Rio Grande		Middle	Total	Total
Species	L	GC	Virgin	L	U	L	U	L	U	L	U	L	U	L	M	Pecos	D and E	P
Cooper's Hawk	E			E	P	E	P		P	P	P	P	P		P		3	8
Zone-tailed Hawk	E				P		P		P	P	P	P	P				1	7
Common Black-Hawk			P		P		E	E	P	P	E	P	P		P		3	7
Harris' Hawk	E			E		E	P	E	P	P	P	P		P	P	P	4	8
Yellow-billed Cuckoo	D	P[b]	P	D	P	D	P	D	P	P	P	P	P	P	P	P	4	12
Elf Owl	D			D	P	D	P	D	P	P	P	P	P				4	7
Ferruginous Pygmy-Owl				E	E	E	P	E	E	P		E					6	2
Gila Woodpecker	D		P	P	P	P	P	P	P	P	P	P	P				1	11
Northern (Gilded) Flicker	D		P	P	P	P	P	P	P	P	P	P	P				1	11
Brown-crested Flycatcher	P	P[b]	P	E	P	E	P	E	P	P	P	P	P				3	10
Vermilion Flycatcher	D		P	E	P	E	P	E	P	P	P	P	P	P		P	4	10
Willow Flycatcher	E	P	E		P		E	E	E	P	D	E	E	E	D		10	3
Bell's Vireo	D	P	P	D	P	E	P	D-E	P	P	P	P	P	P			4	10
Yellow Warbler	E	P	P	E	P	E	P	E	P	P	P	P	P	E	P		5	10
Summer Tanager	D	P	P	E	P	E	P	E	P	P	P	P	P	P	P	P	4	12
Hooded Oriole	P	P	P	E	P	E	P	E	P	P	P	P	P	P			3	11
Yellow-breasted Chat	P	P	P	D	P	E	P	D	P	P	P	P	P	P	P	P	3	13
Total D and E	12	0	1	12	1	12	2	13	2	0	2	2	1	2	0	0		
Total P	3	8	11	2	15	2	15	2	15	17	14	15	14	7	8	5		

[a]D, declining; E, extirpated; P, still present in stable numbers; L, lower reach; M, middle reach; U, upper reach; GC, Grand Canyon.
[b]Status unclear.

an understory of Salt Cedar to provide one of its primary foods, the cicada (*Diceroprocta apache*; Glinski and Ohmart 1983). Besides this special case, no raptor extensively uses Salt Cedar anywhere in the Southwest. Breeding Cooper's Hawks (*Accipiter cooperii*) and Harris' Hawks (*Parabuteo unicinctus*) have been extirpated from the lower Colorado River and adjacent tributaries, while the Common Black-Hawk (*Buteogallus anthracinus*) has disappeared from the upper Santa Cruz and upper San Pedro rivers (Table 2).

Cavity-nesting species are locally obligated to riparian vegetation, and when so, are also obligated to broadleaf trees. In areas where Saguaro cacti (*Carnegiea gigantea*) do not occur, the Elf Owl (*Micrathene whitneyi*), Gila Woodpecker (*Melanerpes uropygialis*), Northern (Gilded) Flicker (*Colaptes auratus*), and Brown-crested Flycatcher (*Myiarchus tyrannulus*) are broadleaf obligates. The Elf Owl has declined to very low population levels along the lower Colorado River (Cardiff 1978); declines have also been noted on the lower Gila, lower Salt, and lower Santa Cruz rivers (Rea 1983). The status of the Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) remains an enigma as this species has declined significantly since the late 1800s (Rea 1983). Cavity-nesting species are not known to occur in or regularly use Salt Cedar anywhere in the Southwest.

Remaining broadleaf obligates are the Rose-throated Becard (*Pachyramphus aglaiae*), Thick-billed Kingbird (*Tyrannus crassirostris*), and Northern Beardless Tyrannulet (*Camptostoma imberbe*). All are primarily tropical in distribution and occur locally along riparian systems in southeastern Arizona at the northern edge of their range.

In summary, all but two broadleaf obligate species (Thick-billed Kingbird and Northern Beardless Tyrannulet), require tall and mature broadleaf trees for nest sites whether for huge basket, large platform, or cavity nests. Honey Mesquite and Salt Cedar rarely grow tall enough to become suitable nest sites for these species.

Partial Broadleaf Obligates

Nine of the 32 species are broadleaf obligates in some areas but not in others (Table 3). All are broadleaf obligates in low-elevation river systems but nest in Salt Cedar and/or Honey Mesquite along high-elevation riparian systems.

The seven summer-visiting, midsummer-breeding builders of open nests were all found to nest in Salt Cedar in higher-elevation riparian systems but not at lower elevations. Four species—Yellow-billed Cuckoo (*Coccyzus americanus*), Bell's Vireo (*Vireo bellii*), Yellow-breasted Chat (*Icteria virens*), and Summer Tanager (*Piranga rubra*)—also use Honey Mesquite habitats along high-elevation river systems. Willow Flycatcher (*Empidonax traillii*) and Yellow Warbler (*Dendroica petechia*) have been extirpated from all low-elevation sites and some high-elevation sites.

Broadleaf habitats are required for the existence of all these species in low-elevation river systems. In high-elevation river systems, all of these species use Salt Cedar and/or Honey Mesquite as well as broadleaf habitats. All species in this category have declined at lower elevations but retain healthier populations at high elevations.

Riparian Generalists

Six of the 32 riparian-obligate species are riparian generalists throughout the Southwest (Table 3). These species use most, if not all, riparian habitats in all river systems. The Northern Cardinal (*Cardinalis cardinalis*) is very rare on the lower Colorado River but occurs in all riparian habitats from Gila Bend, Arizona, eastward. Blue Grosbeak (*Guiraca caerulea*) is the only midsummer-breeding riparian-obligate species to occur in Salt Cedar throughout the Southwest. Broadleaf habitats are not required for the occurrence of any of these species in the Southwest, nor are any declining within their range.

Characteristics of Broadleaf Obligates and Salt Cedar Users

All riparian-obligated raptors and cavity nesters at both low and high elevations are broadleaf obligates. However, more raptor and cavity-nesting species are found on high-elevation river systems. Differences in species composition of the broadlead riparian obligates between low and high elevations are in the number of raptor and cavity-nesting species vs. the number of partial broadleaf obligates (Table 4). The number of species using Salt Cedar at low vs. high elevations differs only in the number of midsummer-breeding summer visitors that build open nests. Six of the eight species in this category use Salt Cedar at high elevations but are broadleaf obligates at low elevations.

DISCUSSION

The Importance of Broadleaf Riparian Vegetation

Broadleaf trees within riparian systems provide secure, suitable nest platforms for raptors. Woodpeckers excavate the large dead, softwood limbs, and these cavities are subsequently used by other species. Where Saguaro cacti are absent, broadleaf trees are apparently vital to these species.

Dependence of midsummer breeders on broadleaf riparian is more difficult to explain. Some species may be adversely affected by the extremely high summer temperatures at low elevations outside the structurally complex mature broadleaf forests. Temperature stress may affect survival of eggs during midsummer. The upper physiological limit for embryo life is 43°C (Walsberg and Voss-Roberts 1983). This limit is exceeded on over 25% of all days at elevations below 427 m (Hunter 1987). This stress rarely exists above 427 m elevation, where all midsummer breeders expand into habitats other than broadleaf riparian. Thus, nest-site selection appears to be a very important determinant in the breadth of habitat use among these species in southwestern riparian systems.

Management of Riparian Obligate Species

Management of southwestern riparian birds has often centered on the few Federally and state listed endangered and threatened species. The only terrestrial bird in the Southwest that is Federally listed as an endangered species is the Bald Eagle (*Haliaeetus leucocephalus*). The Arizona race of the Bell's Vireo (*V.b. arizonae*) is no longer being considered for listing while the western population of the Yellow-billed Cuckoo (*C.a. occidentalis*) is presently being considered. California considers 16 of the riparian obligates as endangered,

Table 3 Riparian-Obligate Species and Their Life-History Characteristics

Broadleaf dependency/species	Nest type	Residency status[a]	Peak egg laying[b]	Locations of Salt Cedar use[c] LE	HE	Habitats other than broadleaf used[d]
Obligate						
Bald Eagle	Open	PR	Sp-early Su	No	No	None
Mississippi Kite	Open	SV	Mid-Su	No	No	None
Cooper's Hawk[e]	Open	PR	Sp-early Su	No	No	None
Gray Hawk	Open	SV	Sp-early Su	No	No	None
Zone-tailed Hawk[e]	Open	SV	Sp-early Su	No	No	None
Common Black-Hawk	Open	SV	Sp-early Su	No	No	None
Harris' Hawk[e]	Open	PR	Sp-early Su	No	No	None
Elf Owl[e,f]	Cavity	SV	Sp-early Su	No	No	None
Ferruginous Pygmy-Owl[e,f]	Cavity	PR	Sp-early Su	No	No	None
Gila Woodpecker[e,f]	Cavity	PR	Sp-early Su	No	No	None
Northern (Gilded) Flicker[e,f]	Cavity	PR	Sp-early Su	No	No	None
Thick-billed Kingbird	Open	SV	Mid-Su	No	No	None
Brown-crested Flycatcher[e,f]	Cavity	SV	Mid-Su	No	No	None
Rose-throated Becard	Covered	SV	Mid-Su	No	No	None
Northern Beardless Tyrannulet	Covered	PR	Mid-Su	No	No	None
Bridled Titmouse[e]	Cavity	PR	Sp-early Su	No	No	None
White-breasted Nuthatch[e]	Cavity	PR	Sp-early Su	No	No	None
Partial Obligate						
Yellow-billed Cuckoo	Open	SV	Mid-Su	No	Yes	SC, HM
Tropical Kingbird	Open	SV	Mid-Su	No	Yes	SC
Vermilion Flycatcher[e]	Open	PR	Sp-early Su	No	No	HM
Willow Flycatcher	Open	SV	Mid-Su	No	Yes	SC
Bell's Vireo	Open	SV	Mid-Su	No	Yes	SC, HM
Yellow Warbler	Open	SV	Mid-Su	No	Yes	SC
Yellow-breasted Chat	Open	SV	Mid-Su	No	Yes	SC, HM
Hooded Oriole	Covered	SV	Mid-Su	No	No	HM
Summer Tanager	Open	SV	Mid-Su	No	Yes	SC, HM
Generalists						
Crissal Thrasher[e]	Open	PR	Sp-early Su	Yes	Yes	SM,SC,HM
Lucy's Warbler	Covered	SV	Sp-early Su	Yes	Yes	SM,SC,HM
Northern Cardinal	Open	PR	Mid-Su	Yes	Yes	HM,SC
Blue Grosbeak	Open	SV	Mid-Su	Yes	Yes	SM,SC,HM
Abert's Towhee	Open	PR	Sp-early Su	Yes	Yes	SM,SC,HM
Northern Oriole	Covered	SV	Sp-early Su	Yes	Yes	SM,SC,HM

[a]PR, permanent resident; SV, summer visitor.
[b]Sp, spring; Su, summer.
[c]LE, low elevation (<427 m); HE, high elevation (427-1524 m).
[d]Vegetation abbreviations as in Table 1.
[e]Locally obligated to riparian.
[f]These species may construct or use cavities in very large mesquites, but primarily use soft-wood riparian trees.

Table 4 Numbers of Broadleaf Obligates and Salt-Cedar-Using Species Compared by Life-History Characteristics between Low (L) and High (H) Elevations

	Permanent resident Sp-early Su		Summer visitor Sp-early Su		Permanent resident Mid-Su		Summer visitor Mid-Su		Total	
Nest type	L	H	L	H	L	H	L	H	L	H
Broadleaf obligates										
Open	4(3)[a]	3(3)	0	3(3)			6	2(1)	10(3)	8(7)
Cavity	2	5	1	0			1	1	4	6
Covered					0	1	1	1	1	2
Total	6(3)	8(3)	1	3(3)	0	1	8	4(1)	15(3)	16(7)
Salt-Cedar users										
Open	2	2			1	1	1	8	4	11
Cavity										
Covered			2	2					2	2
Total	2	2	2	2	1	1	1	8	6	13

[a]Numbers within parentheses represent numbers of raptor species included in the totals.

threatened, or species of special concern. New Mexico lists four species of special concern along the upper Gila River. Arizona lists seven species as threatened native wildlife. An additional seven species have declined from at least half of their historical range in Arizona. Finally, the Ferruginous Pygmy-Owl and Willow Flycatcher are not listed, though they have disappeared from most of their historical range in Arizona.

Despite the Federal listing of the Bald Eagle, this species does not greatly influence riparian habitat management where many bird species have declined or been extirpated. The greatest problem afflicting effective riparian management throughout the Southwest, especially at lower elevations, is the attention given to single species at the expense of an entire community of species that is in trouble.

The change in status of any single species is insufficient to indicate the loss of native riparian habitat regionwide. The Arizona Bell's Vireo has declined tremendously at lower elevations but remains common and has even spread at higher elevations (Brown et al. 1983). Listing throughout its range is therefore inappropriate, while listing of declining populations at lower elevations is needed. The same problem may apply to western populations of the Yellow-billed Cuckoo. The listing of Yellow-billed Cuckoo populations at low elevations, where they are declining, will not protect populations of cuckoos or other riparian birds at high elevations. Listing of any one species will not protect all other declining species of riparian birds in the Southwest. A radical change in orientation is needed, from the piecemeal approach of protecting single species (which is still essential) to protecting habitats. Native riparian systems must be protected for what they are—endangered ecosystems. Only by river system management can we effectively stem the decline of our riparian avifauna. The priority should be the return of healthy stands of broadleaf trees.

To maximize the growth of broadleaf trees, natural regeneration should be encouraged, large-scale revegetation efforts should be initiated, and Salt Cedar should be controlled. The need for mature broadleaf trees as nesting platforms and for cavity excavation is unequivocal; in addition, mature and structurally complex stands of broadleaf trees may also provide the thermal cover necessary for successful nesting of midsummer breeders at low elevations. The most effective management for riparian-obligate breeding species is to return the breeding habitat they require.

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CAN THE WESTERN SUBSPECIES OF THE YELLOW-BILLED CUCKOO BE SAVED FROM EXTINCTION?

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Historically, the California Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) was considered common in river bottoms throughout western United States and southern British Columbia (Gaines and Laymon 1984). It began a drastic decline in numbers as the riparian forests on which it depended were removed for fuel and to make way for agriculture and grazing. Along with local declines, there was an overall range contraction; the last known breeding birds were in British Columbia in the 1920s, in Washington in the 1930s, in Oregon in the 1940s, and in California north of the Sacramento Valley in the 1950s (Roberson 1980, Gaines and Laymon 1984, Figure 1).

Clearing for agriculture, flood control, and urbanization has resulted in the loss of hundreds of thousands of hectares of riparian habitat throughout the West. Examples of this massive habitat destruction include (1) the Los Angeles basin, which supported hundreds of cuckoos prior to 1900, no longer supports any riparian habitat (Gaines and Laymon 1984); (2) the Buena Vista Lake area of Kern County, where ornithologists collected 17 cuckoos in three weeks in 1921, has been converted to a seemingly endless sea of cotton fields (Gaines and Laymon 1984); and (3) the Sacramento Valley, where the species was once common, now has less than 1% of the original habitat and supports fewer than 50 pairs of breeding cuckoos (Gaines and Laymon 1984).

Remnant fragments of riparian habitat throughout the West are still endangered by degradation, clearing, and inundation. For these reasons the future of the California Yellow-billed Cuckoos appears uncertain. In this paper we present the results of field surveys from California that further document this species' decline. We also discuss causes for these recent declines and prospects for the future.

METHODS

Our conclusions are based on research done on the Sacramento River, Butte and Tehama counties, during 1978 and 1979; along the South Fork Kern River, Kern County, during 1985 and 1986; and throughout southern California in 1986. Methods included field surveys, nest monitoring, foraging observations, radiotelemetry, and measuring eggshell thickness. Our standard survey method involved stopping every 200 m in suitable habitat and playing a tape-recorded Yellow-billed Cuckoos call 10 times, or until a response was elicited. The tape recording could be heard to approximately 300 m under field conditions. Unmated cuckoos were distinguished from paired ones by their cooing or cawing vocalizations and their high level of interest in the tape-recorded calls. While surveying and locating nests, we recorded data, including tree species and foraging height, on the cuckoos' foraging activity. Radio-telemetry data were gathered on two female cuckoos at the Kern River site and included both constant monitoring of foraging behavior and delineation of home range.

RESULTS

Gaines (1974) defined Yellow-billed Cuckoo habitat as willow (*Salix* spp.)-cottonwood (*Populus fremontii*) forests below 1300 m elevation, >10 ha in extent, and wider than 100 m. Using radio-telemetry and intensive observation we refined this definition of the species' habitat. We determined that cuckoos used larger areas, averaging 17 ha, and foraged predominantly in cottonwoods rather than willows, as expected from previous observations. Nests were placed almost entirely in willows, making a mix of cottonwoods and willows essential (for more data see Laymon and Halterman 1985). We defined a tract of riparian woodland as suitable for cuckoos if it was larger than 15 ha and included a minimum of 3 ha of closed-canopy, broad-leafed forest. We defined as unsuitable tracts smaller than 4 ha and all tracts containing no closed-canopy, broad-leafed forest, regardless of their extent.

In 1986 we surveyed all habitat meeting this definition of suitability in southern California from Inyo and Kern counties south to the Mexican border and in Arizona along the Colorado River. The only population (defined as more than 5 pairs) found in California was 9 pairs on the South Fork of the Kern River. In the Prado Flood Control Basin on the Santa Ana River, Riverside County, we found one breeding pair and two additional adults; a third adult was found by R.L. Zembal (pers. comm.). The single birds may also represent mated birds, giving a total of 4 pairs for the Prado area. The only other pair away from the Colorado River was on the Amargosa River near Tecopa, Inyo County. Single unmated birds were found in the Owens Valley and on the Mojave River. Seemingly suitable habitat for several pairs is present on the Mojave, Santa Clara, and Owens rivers, but no cuckoos were found there. We located 2 pairs of cuckoos on the California side of the Colorado River, 3 pairs on the Arizona side, and an additional 3 unmated birds, 2 in California and one in Arizona. We estimate the total population for the Colorado River from Davis Dam to the Mexican border to be 5-10 pairs, representing a 92-96% decline from the 122 pairs estimated in 1977 (Gaines and Laymon 1984).

The only area where we found a substantial population of cuckoos was on the Bill Williams River between Lake Havasu and Planet Ranch, Mohave and La Paz counties, Arizona. At this site we found paired cuckoos at 17 locations and an additional 4 unmated birds. We estimated that 25-30 pairs were breeding there in 1986, a decline from an estimated 57 pairs in 1977 (Gaines and Laymon 1984).

In 1979 we collected two eggs and analyzed them for pesticides. The eggs contained an average of only 0.1 parts per million of DDE, suggesting that chlorinated hydrocarbons are present in low concentrations (Laymon 1980). However, in 1985 we collected from three nests on the South Fork of the Kern River eggshell fragments that averaged 0.115 mm thick, an average of

19% and range of 17 to 24% thinner than eggshells (average thickness 0.143 mm) collected before the DDT era.

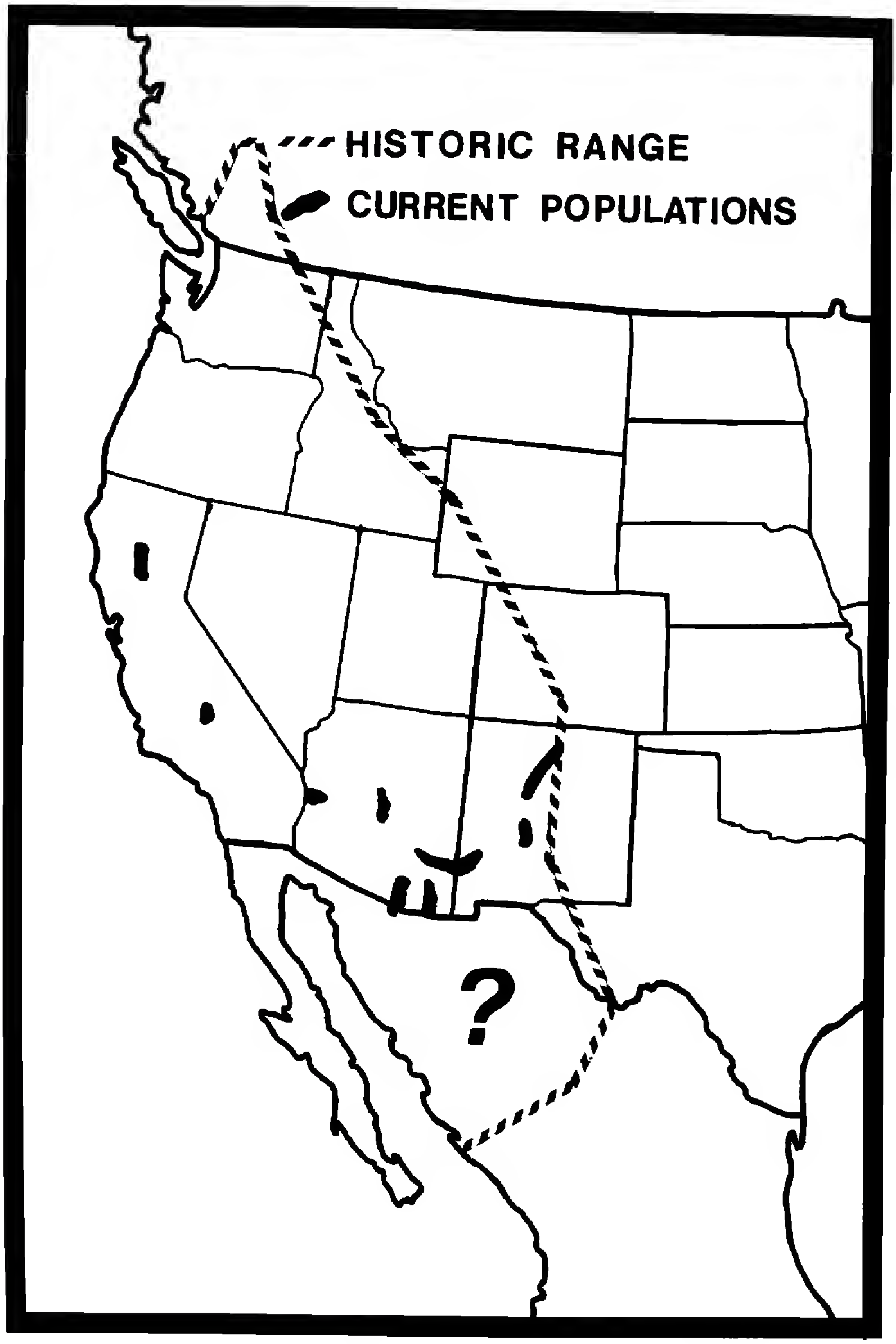

Figure 1. Historic and current range of the California Yellow-billed Cuckoo.

DISCUSSION

What relationship do drastic population declines, restrictive habitat requirements, and possible pesticide contamination have on the western subspecies of the Yellow-billed Cuckoos? There has, of course, been massive riparian loss throughout the West. Since cuckoos need large expanses of closed-canopy cottonwood-willow riparian forest, their numbers have dropped as habitat has been removed and degraded. The recent decline of 92-96% along the Colorado River between 1977 and 1986 is cause for great concern; this area was the stronghold of the species in the northwestern 70% of its original range (Figure 1).

Although there has been some clearing for agriculture along the Colorado River since 1977, most of the habitat loss since that time was due to unusually high water flows from May 1983 to the present. Heavy precipitation and the filling of Glen Canyon Dam have resulted in extensive floods that immersed the roots of willows and cottonwoods for prolonged periods of time, drowning as much as 99% of the existing habitat (B.W. Anderson pers. comm.).

Areas occupied by several pairs of cuckoos in 1977 are now monotypic stands of salt cedar (*Tamarix pentandra*) and uninhabited by cuckoos. For example, above Laguna Dam in 1977 at least 3 pairs of cuckoos occupied a 12-ha site that was approximately 40% willow (Gaines and Laymon 1984). The dominant vegetation is now salt cedar and less than 1% willow cover remains; our 1986 survey revealed no cuckoos at this site. Another example is the vicinity of Picacho State Recreation Area, where in 1977 21 pairs of cuckoos were breeding in 120 ha of 70-m wide willow forest (Gaines and Laymon 1984). Salt cedar and aquatic vegetation now dominate this site and in 1986 we found no cuckoos in the 5 ha of scattered willow-cottonwood habitat that remains. The sites on the Colorado River where we did locate cuckoos cannot be considered suitable habitat for the species. They are marginal locations at best, lacking sufficient extent, breadth, and structural diversity.

Habitat for several pairs on the Amargosa River at Tecopa was eradicated by flash floods in 1983 that scoured out the river bed (J. Tarble pers. comm.). Only one pair remains at this site where four were found in 1977.

We also noted declines in areas where habitat has remained constant or improved. Gaines and Laymon (1984) found 3 pairs in the Owens Valley where we found only a single unmated female. The habitat was unchanged at this site. Unoccupied habitat was also found on the Santa Clara, Mojave, Amargosa, and Sants Ana rivers. The Amargosa site is especially interesting since it has been surveyed yearly since 1977 (J. Tarble pers. comm.). Since 1977, when 4 pairs were found at the site, cuckoos have nested only in 1979 (1 pair), 1982 (2 pairs), and 1986 (1 pair), illustrating a very unstable population. A possible explanation is that with the population decline along the Colorado River, fewer recruits are available to colonize and sustain outlying areas. With small populations, under 25 pairs, stochastic events could cause chance extinctions (Soule and Wilcox 1980). At this time we do not know if any population in California is safe from these effects.

Comparison with early ornithological records shows that the western subspecies of the Yellow-billed Cuckoo now uses a narrower range of habitats than it did historically. Yellow-billed Cuckoos once bred in spruce bogs in Washington, along city streets in Sacramento, and in prune orchards in Marysville, all non-riparian habitats (Gaines and Laymon 1984). Two hypotheses that might explain these differences include (1) cuckoos were forced into marginal areas by saturation of suitable habitat and (2) cuckoos actually had a wider range of suitable habitats then they do today. If the latter is correct, this narrowing of habitat preference could have come from a physical inability to reproduce in the more open, arid habitats because of moisture loss caused by eggshell thinning induced by pesticides. Water loss in eggs is caused by a relationship between the thickness and porosity of the eggshell and environmental factors such as temperature and humidity. Higher temperature, lower humidity, and thinner eggs all could cause excess water loss and reduced hatchability (Rahn and Ar 1974). Arizona cuckoos breed in dry, open salt cedar habitats at elevations above 500 m, but are confined to moist willow-cottonwood habitats below 500 m (Hunter et al. 1987). Summer rains in eastern Arizona and lower temperatures at the higher elevations could mitigate the effects of eggshell thinning.

Since DDT was banned in the United States in the mid-1970s, birds are exposed to persistent pesticides primarily on their wintering grounds and in migration. The wintering grounds of the western subspecies are unknown but suspected to be in South America, where the eastern subspecies winters.

Exposure to other pesticides and agricultural chemicals can be either direct or indirect. We observed direct exposure in the Sacramento Valley when active nests in walnut orchards were sprayed with Zolone, causing sub-lethal poisoning of the young (Laymon 1980). Cuckoos could be exposed indirectly when a favored food, such as the Pacific tree frog (*Hyla regilla*), occurs in pesticide-laden runoff from adjoining agricultural lands. Sphinx moth larvae (Sphingidae), another favored prey, could be poisoned by pesticides, thus reducing the prey population. This reduction of prey would be another indirect effect on cuckoos.

The western Yellow-billed Cuckoo has declined dramatically in geographic range as well as number. Eastern Arizona, New Mexico, western Texas, and Sonora and Chihuahua in Mexico are currently the only areas where cuckoos are believed still to have populations of which extinction is not an immediate concern. Even in these areas, much riparian habitat has been removed for agriculture or river channelization, displaced by salt cedar, and degraded by grazing. No surveys of cuckoos have been done in these areas so the current populations there are unknown. However, on the basis of estimates of current habitat (Hunter et al. 1987), the numbers of the subspecies must be very low. In California, 50-75 pairs of cuckoos probably still breed (Gaines and Laymon 1984). It is likely that fewer than 200 pairs breed in Arizona, 100-200 pairs breed in New Mexico, and 100-200 pairs breed in western Texas. Numbers in Mexico are unknown, but are believed to be low because of habitat degradation in at least the northern two-thirds of Sonora (S. Howell pers. comm.). These estimates yield a total of 475-675 pairs in North America north of Mexico; the Mexican population is unknown, but probably does not exceed this figure. The U.S. Fish and Wildlife Service lists as endangered species and subspecies of birds that have larger populations than that of the California Yellow-billed Cuckoo (e.g., Red-cockaded Woodpecker *Picoides borealis*).

The California Yellow-billed Cuckoo's range is approximately 30% of its historical extent. Wilcove and Terborgh (1984) categorized the patterns by which birds decline; the Yellow-billed Cuckoo most closely fits a pattern of retraction from the peripheral parts of its range combined with retraction from marginal habitats. This pattern characterizes the northwestern 70% of the historic range. Wilcove and Terborgh (1984) cited no examples of this pattern and listed it only as a theoretical possibility.

MANAGEMENT CONSIDERATIONS

What can be done to ensure the future of the California Yellow-billed Cuckoo? The first priority is a survey to determine numbers and locations of cuckoos, especially in the center of the remaining population's range. Such information would permit management agencies to direct efforts at habitat preservation and restoration to the areas where they would best benefit the cuckoos. Acquisition and improvement of both actual and potential cuckoo habitat should be the primary aim of efforts to save the western subspecies. One step to improve areas for cuckoos is removal of grazing to allow natural regeneration and encourage increased density of willows and cottonwoods. In treeless areas that have been severely overgrazed for a long time, or where natural flooding does not occur, other steps need to be taken. The most effective way to reforest an area is through sapling plantings. This has been done, with varying degrees of success, on the Colorado River over the past 15 years (B.W. Anderson pers. comm.). The Nature Conservancy at the Kern River Preserve has initiated reforestation at suitable sites by using California Department of Fish and Game tax check-off funds. In 1986 11 ha of willow and cottonwood forest were replanted to replace the original forest that had been removed in the late 1800s to fuel a local flour mill. The success on this site is phenomenal, with some trees reaching a height of 3 m during the first growing season (B.W. Anderson pers. comm.). This area will be a valuable addition to the existing 120 ha of forest currently on the preserve. In 1987 two additional sites totaling 27 ha are scheduled to be replanted.

Captive propagation and reintroduction into areas, such as the Willamette Valley of Oregon, where much seemingly suitable habitat persists but cuckoos have been extirpated, is also a management tool that merits investigation. Studies should be initiated to determine the habitat and food resource base of potential reintroduction sites and the feasibility of captive breeding of cuckoos.

Further research is needed to determine effective population size and site tenacity in the cuckoo. In addition, almost all life-history variables such as mortality and longevity are still poorly known. The location of the wintering grounds has not yet been located; this needs to be determined before threats to wintering cuckoos can be addressed.

We feel that the western subspecies of the Yellow-billed Cuckoos can be saved from extinction, but not without the concerted efforts of researchers, resource management agencies, and conservation organizations.

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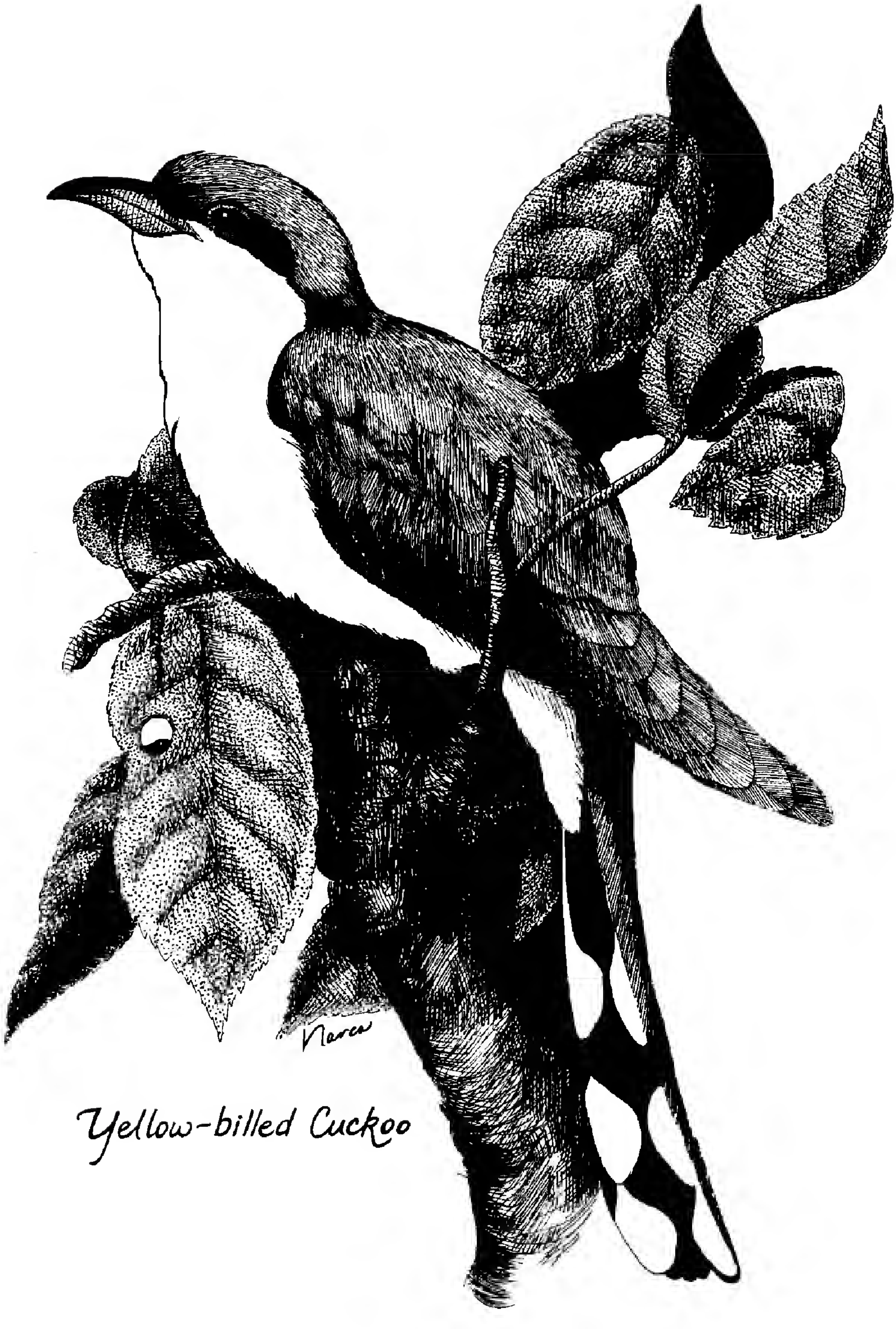

Yellow-billed Cuckoo *Sketch by Narca Moore-Craig*

WILLOW FLYCATCHER SURVEYS IN THE SIERRA NEVADA

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The Willow Flycatcher (*Empidonax traillii*) was formerly a common summer resident in California, breeding in riparian willow thickets. It has been extirpated from most of its California range, and is currently under consideration for state Threatened or Endangered status (R. Schlorff pers. comm.). Most of the remaining populations occur in isolated mountain meadows of the Sierra Nevada and along the Kern, Santa Margarita, and San Luis Rey rivers (Remsen 1978, Serena 1982, Unitt 1987). The California Department of Fish and Game conducted a survey for Willow Flycatchers in six Sierra Nevada national forests and Yosemite National Park in 1982 (Serena 1982). This paper describes the results of the 1986 Willow Flycatcher survey in the Sierra Nevada and summarizes information about the species' status in California. The purposes of our study were to survey sites at which Willow Flycatchers had been previously seen, search for new sites, and attempt to refine our knowledge of the species' habitat requirements.

METHODS

We conducted our surveys between 23 June and 31 July 1986 in order to minimize the likelihood of counting migrant birds. Studies at Dinkey, Poison, and Long meadows in the Sierra National Forest (Stafford and Valentine 1985) suggest that Willow Flycatchers frequently arrive at their breeding location as late as mid-June, occasionally as late as early July. In the same area, Willow Flycatchers depart at any time from the end of July to late August, with a peak in mid-August. During the 1982 survey some sites were visited in the first week of June. Birds observed at this time could have been migrants.

We conducted our surveys early in the morning, generally from sunrise until 1000. Spontaneous singing declines after 1000 (King 1955, Flett and Sanders 1987), although individuals can be heard at any time of day. A second, less intense, period of singing generally occurs before dusk. At each site, we walked along the perimeter of all willow habitat, listening and playing taped songs and calls of Willow Flycatchers. We recorded the number of singing male Willow Flycatchers at each site and mapped the locations of all Willow Flycatchers on sketched maps of the sites. A significant fraction of the singing males may remain unpaired through the breeding season, as current studies on the Little Truckee River and Shaver Lake area indicate (Flett and Sanders 1987, Stafford and Valentine 1985). The assumption that singing males represent pairs may thus lead to an overestimate of the number of breeding birds. On the other hand, song frequency declines after pairing (Stafford and Valentine 1985); thus successfully paired males may be missed in a song survey.

During 1982 the Inyo, Sierra, Stanislaus, Tahoe, Plumas, and Lassen national forests were surveyed (Serena 1982). Other areas surveyed included The Nature Conservancy's Kern River Preserve and Yosemite National Park. We visited most of the sites of the 1982 survey, including all locations which had Willow Flycatchers in 1982 or subsequent years. New areas of coverage included portions of the El Dorado, Toiyabe, and Sequoia national forests, Sequoia National Park, and Kings Canyon National Park. We also visited new sites in the Lassen, Plumas, Inyo, Sierra, and Tahoe national forests.

RESULTS

We visited 125 sites during the 1986 survey, recording 110 singing male Willow Flycatchers at 30 sites. In addition, we have received reports of an additional 6 birds in the Sierra/Cascades region, for a total thus far of 116 singing males. Fifty-six of the sites visited were not surveyed in 1982. These sites were added to the survey on the basis of suggestions by biologists and sightings of Willow Flycatchers between 1982 and 1986. Visits to these new sites resulted in sighting of 11 singing males at 6 of the sites. Areas with more than 2 singing males are shown in Table 1. The Nature Conservancy's Kern River Preserve had the largest number of singing males (39). The preserve contains several miles of riparian cottonwood-willow forest (*Populus fremontii*, *Salix laevigata*, and *S. gooddingii*). The Little Truckee River drainage, which had the largest number of singing males in 1982, had 25 in 1986. This area

Table 1 Willow Flycatcher Concentrations in the Sierra Nevada 1982-1986[a]

Location	1982	1983	1984	1985	1986
Perazzo Meadow (Tahoe N.F.)	11	17	12	8	11
Lacey Valley (Tahoe N.F.)	13	14	10	12	7
Little Truckee R. Total (Tahoe N.F.)	39	—	—	—	25
Kern River Preserve (Nat. Conserv.)	26	—	23	29	39
Shaver Lake Area (Sierra N.F.)	10	—	15	8	9
Beasore Meadow (Sierra N.F.)	2	—	—	—	4
Hodgdon Meadow (Yosemite N.P.)	2	—	—	3	1
Ackerson Meadow (Stanislaus N.F.)	5	—	—	—	2[b]
Westwood Meadow (Lassen N.F.)	4	—	—	—	6
Gurnsey Meadow (Lassen N.F.)	0	—	—	—	3
Faith, Charity Valleys (Toiyabe N.F.)	—	—	—	—	5
Klamath River (Siskiyou Co.)	—	—	—	3[c]	—

[a]For each site the number of singing male Willow Flycatchers is indicated for years in which surveys have been conducted. The table includes all sites that had more than 2 singing male Willow Flycatchers at some time during the study period. Only sites in the Sierra Nevada and Cascade ranges are included. A total is given for the Little Truckee River drainage, which includes Perazzo Meadow and Lacey Valley.

[b]Reports indicate that there may have been 3 singing males (J. Winter pers. comm.).

[c]Reported by M. Robbins.

includes extensive meadows near Webber Lake, Perazzo Meadow, and additional meadows along the Little Truckee River west of Highway 89. The Shaver Lake area, Sierra National Forest, had 9 singing males. This area includes Dinkey, Long, and Poison meadows. Dinkey Meadow had 6 singing males in 1982 and 3 singing males in 1986. The Little Truckee River, Kern River, and Shaver Lake areas together account for 67% of the Willow Flycatcher sightings in the Sierra during 1986. These three areas accounted for 73% of the Sierra Nevada sightings during 1982.

Roughly the same number of birds was seen at the sites surveyed in both 1986 and 1982 (99 in 1986, 103 in 1982). Seven sites that had Willow Flycatchers in 1982 had none in 1986. Six of these sites had only one bird in 1982. Six additional sites decreased in number. Most important among this group were Lacey Valley (declined from 13 to 7), Little Truckee River (one site declined from 8 to 2), and Dinkey Meadow (declined from 6 to 3). Three sites that had no Willow Flycatchers in 1982 had birds in 1986. In two cases three birds were present in 1986, in the other case two birds were present. Seven additional sites increased in numbers of Willow Flycatchers. Most important among these were Westwood (increased from 4 to 6), Beasore Meadow (increased from 2 to 4), Long Meadow (increased from 1 to 3), and the South Fork of the Kern River (increased from 26 to 39).

The three most numerous Sierran populations have been surveyed during at least 4 of the last 5 years. Perazzo Meadow and Lacey Valley are two Little Truckee River sites that have been consistently surveyed over the last five years. The Perazzo Meadow population has fluctuated, but there were the same number of singing males in 1986 and 1982. The Lacey Valley population appears to be declining, and accounts in part for the overall decline along the Little Truckee River. The Shaver Lake area (9 sites) has been studied intensively since 1983. The population during 1985 and 1986 was smaller than that in 1982. Dinkey Meadow had 6 singing males in 1982 (this may have been an overestimate, B. Valentine pers. comm.), but has had 3 in all subsequent years except 1985, when there were only 2 singing males. Long Meadow, which had only 1 singing male in 1982, has had 3 in every year since 1984. The Kern River population apears to have increased steadily since 1984. The increase is distributed fairly evenly over the area. Grazing has been eliminated in several of the areas of concentration within the preserve since 1981 or 1982. Prince Pond, which has had as many as 13 birds, was acquired by the Nature Conservancy in 1982 and has been ungrazed since 1983. Mariposa Marsh, ungrazed since 1981, has increased from 7 to 12 birds in the last three years. Prince Pond had fewer birds (7) in 1986 than in the last two years, but the birds may have moved to adjoining flooded habitat. Flooded areas west of Prince Pond had at least 6 singing males where none had been sighted previously. These areas are not flooded every year. Willow Flycatcher distribution on the Kern River floodplain may be related to the distribution of flooded areas in a given year. Grazed areas adjoining the preserve, such as Onyx and Bloomfield Ranches, had no birds this year.

Among the new sites visited, 6 sites had Willow Flycatchers. A site on the Feather River near Clio had 1 Willow Flycatcher. Other new sites included one on the Little Truckee River (3 birds), Summit Meadow 2 (Shaver Lake area, 1 bird), Faith Valley and Charity Valley (Toiyabe National Forest, 3 and 2 birds, respectively), and Troy Meadow (Sequoia N.F., 1 bird; 1 has been seen in previous years). The Faith Valley and Charity Valley sites are only a few miles apart, and there is some apparently suitable habitat nearby in Hope Valley, although we did not locate singing males there during the 1986 survey.

DISCUSSION

The Willow Flycatcher was formerly considered common and widely distributed in the state wherever suitable habitat existed (Grinnell and Miller 1944). Areas where it was most common included the Central Valley, the southern coastal region, and central California in general. Specific areas mentioned in which Willow Flycatchers were common or abundant include the Kings River (Goldman 1908), the vicinity of Buena Vista Lake (Linton 1908), the south coast (Willet 1912, 1933), swampy thickets near Los Angeles and the valley rivers of central California (Belding 1890), the San Francisco Bay region (Barlow 1900), and Yosemite Valley (Grinnell and Storer 1924). Ridgway considered it to be the most abundant and generally distributed *Empidonax* species (cited in Belding 1890). In the Sierra Nevada, Willow Flycatchers were felt to be common along willow-lined streams, especially in broad river bottomlands (Grinnell and Storer 1924, Grinnell et al. 1930, Sumner and Dixon 1953). Nesting sites were found from sea level to about 2500 m (8000 ft) (Grinnell and Miller 1944).

As a breeding species, the Willow Flycatcher has been extirpated from most of its former range, surviving only in mountain meadows of the Serra Nevada, and along the south fork of the Kern River, the Santa Margarita River, and the San Luis Rey River (Remsen 1978, Garrett and Dunn 1981, Serena 1982, Unitt 1987). As a spring and fall transient, the Willow Flycatcher is still fairly common in riparian willow habitat throughout the state (McCaskie et al. 1979, Garrett and Dunn 1981). Willow Flycatchers no longer breed in the Central Valley (McCaskie et al. 1979), and records from the southern coast and central coast have been sporadic (Stallcup and Greenberg 1974, Garrett and Dunn 1981, Roberson 1985, Unitt 1984). Extensive searches in the Sacramento River Valley (Gaines 1974) have revealed no breeding Willow Flycatchers. Careful search of riparian habitat in southern California in the summer of 1978 revealed only two singing males (Garrett and Dunn 1981), although subsequent surveys have revealed populations on the Santa Margarita and San Luis Rey rivers in San Diego County (L. Salata pers. comm., Unitt 1987). Even in the Sierra Nevada, the species has apparently declined (Gaines 1977, Serena 1982), having become alarmingly scarce in the Yosemite region.

Our survey results indicate that the majority of Sierra Nevada Willow Flycatchers are located in three general areas. Between the Little Truckee River (Tahoe National Forest) and Westwood Meadow (Lassen National Forest), we found 43 singing males, most of which were along the Little Truckee River (Table 1). Nineteen singing males were found in the central Sierra, from Ackerson Meadow (Stanislaus National Forest) to the Shaver Lake area (Sierra National Forest). The south fork of the Kern River had the largest population, with 39 singing males. In addition to these major areas, small numbers of singing males were located on the east side of the Sierra, near Mono Lake

(3 singing males) and in the vicinity of Carson Pass (5 singing males). There is a large gap in the distribution of sightings between the central Sierra and the Kern River. There have been a few reports in recent years of Willow Flycatchers in the Sequoia and Kings Canyon National Parks (L. Norris pers. comm. to R. Schlorff) but no birds were found during this year's survey, and there seems to be insufficient habitat to support large populations.

Portions of northern California, particularly the area north of Lassen National Forest, from the Nevada border to the coast, should be surveyed in the future. During our survey, a singing male was located along the Feather River, near Clio. This site was visited briefly, and there appears to be more suitable habitat that should be surveyed in the future. Singing males have been reported in recent years from the forks of the Salmon (1), the vicinity of Mt. Shasta (1), and Lower Klamath Lake (3 nests) (M. Robbins pers. comm.). Singing males have been reported from Humboldt County in the vicinity of Garberville (R. LeValley pers. comm.) and from Willow Creek (Serena 1982). These sightings may have been of migrants (R. LeValley pers. comm.). Recent Breeding Bird Surveys have produced a few sightings in the northern tier of counties (S. Droge pers. comm.). There are 29 survey routes in Humboldt, Trinity, Del Norte, Siskiyou, Shasta, and Modoc counties. Seven of these routes have recorded Willow Flycatchers during the period from 1982 to 1985 (4, 3, 3, and 6 birds in the four years). A single male was observed at the Modoc National Wildlife Refuge for the first time in 1985, and a pair fledged a single young there in 1986 (W. Radke pers. comm.). This successful nesting may have resulted from protection of riparian habitat over the last 6 years. Further surveys in northern California will likely produce more sightings, but there is no indication that large populations occur in this region.

The subspecific identity of California Willow Flycatcher populations provides further reason for concern about the species status in the state. Three subspecies occur in California (Unitt 1987). *Empidonax traillii brewsteri* breeds from Fresno County north, from the coast to the Sierra Nevada crest. *Empidonas traillii adastus* breeds east of the Sierra/Cascade axis. The type locality for this taxon is in southern Oregon, and it is known to range into Modoc County (Phillips 1948) and perhaps south to northern Inyo county (Unitt 1987). Willow Flycatchers in northern California may represent a zone of intergradation between *E.t. brewsteri* and *E.t. adastus* (Phillips 1948). Southern California populations of Willow Flycatchers have recently been shown (Unitt 1987) to belong to the subspecies *E.t. extimus* Phillips (1948). The northern limits of breeding for this taxon are Independence in the Owens Valley, the south fork of the Kern River, and the Los Angeles basin. It has also suffered serious declines in the portions of its range outside of California (Unitt 1987). Thus the small number of breeding Willow Flycatchers in California is further divided among three subspecies, each of which has declined to very low numbers within the state.

Remsen (1978) listed the Willow Flycatcher as a species of highest priority, facing extirpation if current trends continue. In 1980, reports from the Pacific coast and southwest regions led to the species being added to the Audubon Blue List (Arbib 1979). The Blue List for 1981 included Utah, Arizona, and New Mexico as areas of concern (Tate 1981). In 1983, the Kings River Conservation District began studies of Willow Flycatchers at Dinkey Meadow and other nearby meadows in the vicinity of Shaver Lake (Stafford and Valentine 1985). Dinkey Meadow, known to harbor breeding Willow Flycatchers, is due to be inundated by the Dinkey Creek Hydroelectric Project. In 1984, the Willow Flycatcher was added to the U.S. Forest Service Region 5 Sensitive Species list. The U.S. Fish and Wildlife Service has also designated the Willow Flycatcher as a Sensitive Species for Region 1 (Washington, Idaho, Oregon, California, and Nevada) on the basis of significant declines in this region (Sharp 1986). The Willow Flycatcher is currently under review for possible listing as a state Threatened or Endangered Species (R. Schlorff pers. comm.).

Many authors agree that alteration and loss of riparian habitat, especially in the Central Valley, had a role in the decline of Willow Flycatchers (Remsen 1978, Garrett and Dunn 1981). However, the absence of Willow Flycatchers in apparently suitable habitat suggests that other factors are also at work. Brown-headed Cowbird (*Molothrus ater*) nest parasitism has been suggested as a cause of the Willow Flycatcher's decline (Gaines 1974). Studies at low elevations in southern California suggested that the Willow Flycatcher is susceptible to cowbird parasitism (Hanna 1928, Rowley 1930). Friedmann (1963) reported 150 instances of Brown-headed Cowbird parasitism of Willow Flycatchers, 41 of which were reports from southern California. Gaines (1974) concluded that 9 of 12 species (including the Willow Flycatcher) known to have declined along the Sacramento River are highly susceptible to cowbird parasitism. Decline of Willow Flycatchers in central and coastal California coincides with the spread of cowbirds in the 1920s and 1930s (Gaines 1974, Garrett and Dunn 1981). The lack of overlap in breeding seasons between Brown-headed Cowbirds and Willow Flycatchers in the Shaver Lake area and the lack of observed parasitism (Stafford and Valentine 1985) suggest that cowbird parasitism may be less important in the Sierra Nevada than at lower elevations (but see Flett and Sanders 1987).

Grazing in riparian habitats has been suggested as a possible factor in decline of the Willow Flycatcher in the Sierra Nevada and elsewhere (Serena 1982, Stafford and Valentine 1985, Taylor 1986, Flett and Sanders 1987). Cattle can adversely affect Willow Flycatchers by disturbing nests (Stafford and Valentine 1985, Flett and Sanders 1987) and by changing the structural features of riparian habitat such as meadow wetness (drying of meadows by soil compaction and gullying), willow foliage height, and willow foliage volume (Serena 1982, Taylor 1986). At the Malheur Wildlife Refuge in Oregon, ungrazed transects had higher willow foliage density and volume and had more Willow Flycatchers than grazed transects (Taylor and Littlefield 1986). These authors also present data indicating a correlation between increases in Willow Flycatcher numbers and decreases in grazing. Other factors that might be involved in the decline of Willow Flycatchers in the Sierra Nevada include loss of meadow habitat due to reservoir and hydroelectric development, fires set by grazers, Lodgepole Pine (*Pinus contorta*) encroachment on meadows, and events on the wintering grounds (Serena 1982).

The habitat relationships of Willow Flycatchers in the Sierra Nevada were studied by Serena (1982). Complete analysis of our habitat data will be reported elsewhere (Harris et al. 1987), but we present here a few brief comments on the habitat preferences of Willow Flycatchers. In agreement with Serena (1982), we found that most birds (104 of 110) were in meadows larger than 8 ha. Broad, flat areas seem to be preferred, as suggested by Grinnell and Storer (1924) and Gaines (1977). Serena reported no association between occurrence of Willow Flycatchers and the wetness of meadows. During our survey, Willow Flycatchers appeared to prefer wet meadows (see also Flett and Sanders 1987; Stafford and Valentine pers. comm.). Virtually all of the sites with more than one singing male had standing water. Willow Flycatchers were only found where the willow cover was at least 2 m high. The total amount of willow cover, obviously correlated with meadow size and percent cover of willow, is also important, though the percentage cover of willow alone may show no association with Willow Flycatcher presence or absence (Serena 1982). Most of the sites with Willow Flycatchers had high foliage density. Meadows in which the willows were very arborescent, or in which willows had been severely "high-lined" by cattle, generally did not support Willow Flycatchers. Meadows with clumps of willow separated by openings were preferred over solid masses of willow, as suggested by Serena (1982), although Willow Flycatchers were sometimes found at the edge of such masses of willow.

SUMMARY AND MANAGEMENT RECOMMENDATIONS

The 1982 survey resulted in the observation of 103 singing males in the Sierra Nevada. Nineteen sightings were reported in addition, giving a statewide total of 122 singing males for 1982. Our surveys resulted in sightings of 110 singing males. We have also received reports of an additional 6 birds in the Sierra/Cascades region, for a total thus far of 116 singing males. Unitt (1987) and L. Salata (pers. comm.) suggest breeding populations of about 15 pairs on the Santa Margarita River and about 12 pairs on the San Luis Rey River (both in San Diego County). This gives a statewide total for 1986 of about 143 singing males. It appears that in California the species has been reduced to a small number of marginal populations. These belong to three subspecies, one of which (*E.t. extimus*) has declined dramatically in most of its range. Three relatively small areas account for about two thirds of the known Sierra Nevada population. With the two San Diego County populations, these account for 70 percent of the known statewide population of Willow Flycatchers.

We believe that our results and the results of past surveys justify the following management recommendations:

1. The Willow Flycatcher should receive Threatened or Endangered status because of its small population size, evidence of severe decline in numbers, and the concentration of the majority of the state's breeding Willow Flycatchers in five areas. This situation is critical because the Little Truckee River population appears to be declining, the Shaver Lake population is threatened by hydroelectric development, and two dams, which would flood much of the existing riparian habitat, have been proposed for the Santa Margarita River. Management planning should recognize the plight of all three of the recognized subspecies of Willow Flycatcher occurring in California and should address the preservation of genetic variation in this species.

2. Future surveys should attempt to clarify the status of the species in areas not previously surveyed, including north coastal California, the Klamath Mountains and Cascades, and northeastern California in general. Areas of concentration should continue to be surveyed.

3. Existing meadow sites should be protected from habitat loss (as from hydroelectric projects or housing developments). Acquisition of private parcels or purchase of conservation easements by public agencies or conservation organizations may be appropriate in some situations.

4. Planning for the species should recognize that a site that is unoccupied during a given year should not be considered to be unsuitable, as it may be reoccupied. This is likely to be important especially for small sites.

5. Riparian vegetation should be protected from grazing wherever possible, particularly where grazing is reducing foliage density or drying meadow sites by soil compaction and gullying. Furthermore, grazing in riparian zones should be curtailed during June and July, when Willow Flycatchers are breeding. More studies are needed to clarify the effects of grazing on riparian birds.

6. Further studies are needed on the responses of Willow Flycatchers to Brown-headed Cowbird nest parasitism, particularly at lower elevations. Experiments in cowbird removal would provide useful data and might enhance Willow Flycatcher populations.

7. Response of Willow Flycatchers to revegetation and meadow restoration should studied, as a possible means of increasing the amount of available habitat and of attracting Willow Flycatchers to otherwise suitable meadows. Restoration of Willow Creek, Modoc County, provides an encouraging model for meadow restoration (Clay 1984).

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Willow Flycatcher *Sketch by Keith Hansen*

ECOLOGY OF A SIERRA NEVADA POPULATION OF WILLOW FLYCATCHERS

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Willow Flycatchers (*Empidonax traillii*) have declined in California, and much of the state's population is now restricted to meadows in the Sierra Nevada (Harris et al. 1987, Serena 1982). To understand the factors contributing to their decline and to develop recommendations to protect and enhance the flycatchers' habitat, we studied a Sierra Nevada population of Willow Flycatchers in the late spring and summer of 1986. In this paper, we present preliminary information on Willow Flycatcher nesting success, territory and habitat characteristics, and effects of livestock grazing. We conclude with some management recommendations based on this study and the results of a distributional survey also conducted in the summer of 1986 (see Harris et al. 1987).

STUDY SITES

Perazzo Meadows and Lacey Valley are in the Little Truckee River drainage approximately 32 km northwest of the town of Truckee, Sierra County, California. These meadows are at an elevation of 2010 m on the east slope of the Sierra Nevada in Tahoe National Forest. Both are wet meadows with perennial streams running through them and are surrounded by lodgepole pine (*Pinus murrayana*) forest. Willow clumps (*Salix* sp.) are scattered in patches throughout the meadows.

Perazzo Meadows is over 350 ha in size. We confined our study to the eastern 60 ha of this extensive meadow system. Lacey Valley, approximately 3 km east of Perazzo Meadows, extends over 90 ha. These two meadows support the largest population of breeding Willow Flycatchers in northern California (Serena 1982).

METHODS

Our field work extended from early June to late August 1986. We observed 13 pairs of Willow Flycatchers and 6 additional singing males, at least 2 of which were unpaired. Birds were observed from dawn to mid-morning, and the location and behavior of Willow Flycatcher individuals, pairs, or families were recorded. These observations were the basis for determining the breeding status of individuals, nest locations, habitat use, and territorial boundaries. We spent 186 hours observing the birds. To facilitate observations and identify individuals, we captured 16 Willow Flycatchers in mist nets and banded them with unique color combinations.

We regularly checked nests to follow the fate of eggs and nestlings. Recorded characteristics of nests included height, location in willow clumps, and foliage density at the nest. We assessed foliage density by placing a 1 m square board behind the nest, pacing back about 5 m, and estimating the percentage of the board obscured by willow twigs and leaves. Because nests were placed near the outer edge of willow clumps and the clumps were impenetrable, we made foliage density measurements at the nests from the outside of the clumps.

To determine the boundaries of the territories of paired males, we recorded the locations of perches from which males repeatedly sang and measured the distances between those perches. We considered the area enclosed by the outermost singing perches to be the male's territory. Since territories shifted during the different phases of the breeding season, we mapped and measured territorial boundaries only when a nest containing eggs or nestlings was within the territory. We measured 8 territories in the two study sites.

To assess habitat characteristics of Willow Flycatcher territories, we estimated the percentage of each territory covered by willows, standing or running water, and trees. Using the technique described above, we measured willow foliage density at 0-1 m and 1-2 m above the ground at 10 sites throughout the territory. Since foliage on shrubby willows normally extends to the ground, measurements taken at 0-1 m were intended to document the effects of livestock browsing on the lower portions of the willows. Because Willow Flycatchers at our study sites place their nests approximately 1.5 m from the ground, measurements at 1-2 m were taken to assess the vigor and amount of foliage at heights appropriate for nesting. These measurements were taken every 5 m for 50 m along the outer edge of the longest willow clump in the territory. Circumference of the willow clumps generally did not exceed 50 m.

On 31 separate days we observed the cattle in Perazzo Meadows by walking through the study area and recording the number of cows in the open and in willows. We made similar observations of sheep at Lacey Valley, but because of the late arrival of the flock and its habit of traveling as a unit, we were able to observe it on only 4 of 13 days spent searching for it. We noted associations of Brown-headed Cowbirds (*Molothrus ater*) with the livestock.

RESULTS AND DISCUSSION

Breeding Chronology

Willow Flycatchers arrived by early to mid-June and established territories by late June. The first eggs were laid by mid-June and the young hatched by 30 June. The first young fledged on 15 July. Clutches were still being laid in mid- to late July, and the last young fledged on 13 August. Territories began breaking down the week of 28 July, and the last breeding Willow Flycatchers departed by the end of August.

Nest and Egg Success

Table 1 summarizes data from 11 Willow Flycatcher nests at Perazzo Meadows and Lacey Valley. The average number of fledglings per nest was 1.3 (n = 11, s.d. = 1.3). The total number of young fledged was 14 or 15 (we are uncertain whether 3 or 4 young fledged from nest number 5). For 5 of the 11 nests, we had complete egg-to-fledgling data. The total egg-to-fledgling success rate for these 5 nests was 29%. There was little difference in success rates between Perazzo Meadows and Lacey Valley. Willow Flycatchers at Perazzo Meadows produced an average of 1.6 fledglings per nest

Table 1 Numbers of Willow Flycatcher Eggs, Nestlings, and Fledglings Produced from 11 Nests at Perazzo Meadows and Lacey Valley, 1986

Nest	Location	No. eggs	No. nestlings	No. fledglings
1	Lacey	3	0	0
1A	Lacey	?	1	0
2	Perazzo	3	3	0
3	Lacey	?	4	3
5	Perazzo	?	4	3-4
6	Perazzo	?	2	1
8	Perazzo	3	1	1
9	Perazzo	2	1	1
10	Lacey	?	3	0
11	Lacey	3	2	2
13	Perazzo	?	3	3
Total		31?	24	14-15

Mean no. of fledglings per nest: 1.35
Egg-to-fledgling success: 29%
Perazzo Meadows: 25%
Lacey Valley: 33%

(n = 6, s.d. = 1.4) and had an egg-to-fledgling success rate of 25%. At Lacey Valley the flycatchers produced an average of 1.0 fledglings per nest (n = 5, s.d. = 1.4), resulting in an egg-to-fledgling success rate of 33%. Stafford and Valentine (1985) followed 8 Willow Flycatcher nests over 2 years in the southern Sierra Nevada and found a range of egg-to-fledgling success rates between 25% and 38%. Stafford and Valentine's estimated success rates and ours are low compared to Nice's (1957) estimate of 45% for open-cup nesters.

The cause of nest failure is known for 4 of the 11 nests. Nest 1 at Lacey Valley was precariously placed at the outermost edge of a willow clump. We found it tipped over and the eggs in fragments on the ground below it. The nest was destroyed either by heavy gusts of wind or by a predator; there were no livestock present then to account for the nest upset. Nestlings in nests 1A and 10 were found dead after a severe hailstorm on 25 July. Nest 2 was parasitized by a Brown-headed Cowbird. The only other published observation of parasitism of a Willow Flycatcher nest by the cowbird in the Sierra Nevada occurred in 1960 (Gaines 1977). The single cowbird in nest 2 fledged successfully, but its 3 Willow Flycatcher nestmates died within several days of hatching. These 3 Willow Flycatchers represented more than 10% of the total number of nestlings produced in the two sites in 1986. If all three nestlings had fledged, the egg-to-fledgling success rate in the two sites would have been 50% instead of 29%.

Nest Characteristics

All Willow Flycatcher nests were in willows, even though lodgepole pines were present in some territories. The birds placed their open-cup nests at a mean of 1.3 m above the ground (n = 11, range = 0.90-1.75 m, s.d. = 0.28 m) and at a mean of 1.0 m from the top of the willow shrub (n = 11, range = 0.50-1.50 m, s.d. = 0.27 m). Willow foliage density in the vicinity of the nest averaged 63% (n = 11, range = 10-90%, s.d. = 29%).

Nine of the 11 nests were placed at a mean distance of 1.68 m from the edge of a willow clump (n = 9, range = 0.60-2.40 m, s.d. = 0.57 m). Two of the 11 nests were deeper within a willow clump, but even these nests were close to livestock trails that tunneled through the willows. The distances of these nests from the outer edge of the willow clumps were 6.75 and 7.0 m, but the distances to the nearest livestock trails were only 1.5 and 2.5 m.

Territory Size and Characteristics

The average territory size for a paired Willow Flycatcher male was about 3000 m^2 (n = 8, range = 800-7000 m^2, s.d. = 2000 m^2). Males spent most of their time singing or foraging from a few high perches on their territories. The average number of singing perches per territory was 6 (n = 8, range = 5-9, s.d. = 2.5). If tall lodgepole pines or snags were available within the territories, males used them more often than willows for singing and foraging perches. Males and females did most of their flycatching from perches within the territory, although they occasionally foraged beyond territorial boundaries. The average percentage of the territory covered by willow clumps was 46% (n = 8, range = 16-80%, s.d. = 23%). Foilage density was 64% at 0-1 m (range = 44-78%, s.d. = 13%) and 80% at 1-2 m (n = 8, range = 74-96%, s.d. = 7%). These measurments and those taken at the nests show that foliage was fairly dense where Willow Flycatchers bred in these study sites. Standing and/or running water was present on all territories early in the season and remained on some through the end of the summer. Other studies (Harris et al. 1987, Stafford and Valentine 1985) confirm that the presence of free water is an important aspect of Willow Flycatcher habitat.

Effects of Livestock

Approximately 150 cattle arrived at Perazzo Meadows in late June. Cattle foraged mainly in the open meadow, but a small percentage were usually observed in or near willow clumps. An average of 3.8% (n = 31, range = 0-6%, s.d. = 4.4%) of the cattle were typically found in willow clumps, creating trails within the clumps in their search for shade and forage. Stafford and Valentine (1985) report that 3 out of 8 Willow Flycatcher nests in their study sites were probably destroyed by cattle. We have no data suggesting nest upsets by livestock, but the placement of nests in willow clumps made them all potentially vulnerable to disturbance because they were built near the edge of willow clumps and low enough to be knocked over by cattle.

One thousand sheep arrived at Lacey Valley in mid-July, after most Willow Flycatchers had finished nesting. During 4 observations of the flock, we noted that sheep were always accompanied by flocks of 5-50 Brown-headed

Cowbirds that foraged in the immediate vicinity of the flock and even perched on the backs of the sheep. These data suggest that the arrival of sheep and their cowbird associates could cause an increase in Willow Flycatcher nest parasitism if the flock's presence coincided with the peak of egg-laying.

MANAGEMENT RECOMMENDATIONS

Designate the Willow Flycatcher as a Threatened or Endangered Species in California

Willow Flycatchers need the legal protection that state Threatened or Endangered status would provide. In California, the range and numbers have been dramatically reduced and the population shows no sign of recovery (Harris et al. 1987).

Acquire and Manage Existing Willow Flycatcher Habitat

Most Sierra Nevada meadows that support breeding Willow Flycatchers are managed for livestock grazing rather than for wildlife resources. Sierra Nevada meadows are vulnerable to inundation by hydroelectric projects, to housing or recreational development, and to livestock grazing. Montane meadows that support Willow Flycatchers should be protected by conservation easements with landowners or by land purchases or exchanges. In particular, efforts should be made to acquire and protect the meadow system along the Little Truckee River. These meadows support the second largest population of Willow Flycatchers in the state, and the population in them is declining.

Reduce or Eliminate Grazing in Willow Flycatcher Habitat

Livestock grazing can adversely affect willows and other shrubs (Taylor 1986). Duff (1979) found that exclusion of grazers yielded an increase in the middle story of willows, the favored nesting height of Willow Flycatchers. Streambank trampling and soil compaction associated with overgrazed riparian areas could affect the water table and reduce free water, an important aspect of Willow Flycatcher habitat in California. Definitive guidelines that would establish the appropriate level, timing, and duration of livestock grazing on meadows or riparian areas supporting Willow Flycatchers do not exist. A single set of specific guidelines would not be applicable to all meadow and riparian habitat because of differences in elevation, vegetation, soils, slopes, and hydrology. Further studies are needed to determine grazing levels and to create monitoring and management plans suitable for protection and enhancement of Willow Flycatcher habitat. Until such plans are available, land managers should implement a general policy of reducing grazing on meadows and riparian areas that support Willow Flycatchers, especially during the nesting season in June and July. Effective enforcement of this policy will require implementation of the first two recommendations made above.

Reduce or Eliminate Brown-headed Cowbirds in Willow Flycatcher Habitat

Because Willow Flycatchers in California are so few, single incidents of nest parasitism can have significant impacts on Willow Flycatcher populations.

Because of the close association of Brown-headed Cowbirds with livestock, eliminating grazing in Willow Flycatcher habitat could alleviate nest parasitism by cowbirds. Studies to document further the effects of cowbird nest parasitism on Willow Flycatchers are necessary.

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ENDANGERED STATUS AND STRATEGIES FOR CONSERVATION OF THE LEAST BELL'S VIREO (*VIREO BELLII PUSILLUS*) IN CALIFORNIA

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The Least Bell's Vireo (*Vireo bellii pusillus*) is a small, gray, migratory passerine that feeds mainly on insects. The normal clutch of four eggs is incubated about 14 days. The young remain in the nest approximately 10-12 days. The Least Bell's Vireo arrives in its breeding habitat from mid-March to early April, and departs in late August or September for its wintering range in Baja California, Mexico.

The Least Bell's Vireo usually constructs its nest low to the ground, primarily in willow-dominated riparian habitats, but also uses a variety of shrubs, trees, and vines. Nesting is now largely restricted to small, remnant segments of willow-dominated habitats. Its precarious status prompted the U.S. Fish and Wildlife Service (FWS) (1986a) to designate it officially as an endangered species on May 2, 1986. The state of California classified the vireo as an endangered species in 1980.

HISTORICAL AND PRESENT DISTRIBUTION, POPULATION SIZE, AND DENSITY

Once widespread and abundant throughout the Central Valley and other low-elevation riverine valleys, the Least Bell's Vireo maintained an historical breeding range that extended from interior northern California (near Red Bluff, Tehama County) to northwestern Baja California, Mexico. In the last several decades, the subspecies apparently has been extirpated from the Sacramento and San Joaquin valleys, which once were the center of its breeding range. Several intensive surveys of virtually all potential breeding habitat in California have been conducted (Gaines 1977, Goldwasser 1978, Goldwasser et al. 1980, unpublished FWS data). In total, Least Bell's Vireos have been reported from only 47 of over 150 former localities (some locatities cover several miles of a water course) surveyed in the U.S. from 1977 through 1985 (Table 1). The data indicate the presence of approximately 300 territorial males. This is considered a maximum estimate because roughly 20% of territorial male vireos are believed to be unpaired.

Results from a comprehensive survey in 1986 indicate there are approximately 395 territorial males (319 pairs) in the United States (RECON 1986). Preliminary field examinations in Baja California, Mexico, resulted in the locating of a number of small populations, but suitable habitat is declining and limited (Wilbur 1980a, P. Fromer, pers. comm. 1986, Franzreb, pers. obs.). There are probably several hundred pairs in Baja California (Wilbur 1980b).

Relative density data (Table 2) indicate that from 1 to a maximum of 20 males per kilometer of habitat were located during recent surveys. This compares to the historical figure of 11-29 males/km estimated by Grinnell and Storer (1924).

Table 1 Location and Number of Territorial Male Least Bell's Vireos in 1985

County	Sites[a]	Males[b]
San Benito	1	1
Monterey[c]	0	0
Inyo[c]	0	0
San Bernardino[c]	0	0
Santa Barbara	3	26
Ventura	1	5
Los Angeles	3	7
Orange	1	1
Riverside	8	29
San Diego	30	223
Total	47	292

[a]Number of different known breeding localities.
[b]Number of known territorial males.
[c]No known breeding in 1985.

The average number of fledglings produced per nesting pair has varied from a low of 0.17 in 1984 along the San Diego River (Jones 1985) to a high of 2.85 in 1983 along the Santa Margarita River (Salata 1983b). Fledging rates have been substantially higher in the least degraded habitats such as the Santa Margarita River on Camp Pendleton (40-59%) and Gilbraltar Reservoir (35-36%) (Table 3).

Table 2 Population Densities of the Least Bell's Vireo

Region	Estimated males/km	Source
Historical		
Sierra Nevada foothills	11-29[a]	Grinnell and Storer (1924)
Current		
Santa Margarita River (Camp Pendleton)	3-7	Salata (1981)
	1-8	Salata (1983a)
	1-13	Salata (1983b)
	1-19	Salata (1984)
8 sites in southern California	3-5	Goldwasser et al. (1980)
Northwestern Baja California	8-20	Wilbur (1980a)

[a]Historical density data are based on extrapolation and are not direct counts.

Table 3 Fledging Rate and Reproductive Success of the Least Bell's Vireo

Location	Fledging rate[a] (%)	Avg. no. fledglings per nesting pair[b] and per successful pair[b]	Year	Source
Santa Margarita River (Camp Pendleton)	40	2.08/2.78	1982	Salata (1983a)
Santa Margarita River (Camp Pendleton)	57	2.85/3.21	1983	Salata (1983b)
Santa Margarita River (Camp Pendleton)	59	1.60/2.24	1984	Salata (1984)
Gibraltar Reservoir	36	1.98/3.27	1980	Gray and Greaves (1984)
Gibraltar Reservoir	35	1.90/2.84	1981	Gray and Greaves (1984)
San Luis Rey River	6	0.25/1.0	1984	Jones (1985)
San Diego River	5	0.17/3.0	1984	Jones (1985)
Sweetwater River	16	0.50/2.25	1984	Jones (1985)

[a]Number of eggs that produced fledglings.
[b]Number of fledglings per nesting pair; number of fledglings per successful nesting pair.

REASONS FOR DECLINE

Habitat Loss or Modification

Over 95% of historical riparian habitat has been lost throughout the vireo's former breeding range in the Central Valley of California, which may have accounted for 60-80% of the original population (U.S. Fish and Wildlife Service 1986a). Similar habitat losses have also occurred throughout its remaining stronghold in southern California, and habitats are currently declining in Baja California as well (Wilbur 1980a, Fromer pers. comm. 1986, Franzreb pers. obs. 1986). These widespread losses are attributable mainly to flood control and water development projects, agricultural development, livestock grazing, invasive exotic plants, off-road vehicles, and urban development resulting from rapidly expanding human populations. Despite growing concern for declining riparian vegetation, substantial amounts of such habitat continue to be lost each year.

The widespread habitat losses described above have fragmented remaining breeding populations into small, disjunct, widely dispersed subpopulations. Of the 47 localities known to have supported breeding populations from 1977 to 1985, 35 localities support 4 or fewer territorial males and only seven sites support more than 10 territorial males.

Predation

As with other passerines, the Least Bell's Vireo has always been subject to nest predation. Unlike many other passerines, however, Least Bell's Vireos typically build nests within about 1 m of the ground, where they are accessible to a variety of terrestrial predators that prey on eggs or young (Wilbur 1980b; Salata 1981, 1983a). Male vireos often sing while on the nest, thereby potentially increasing predation rates by attracting predators. Recent studies have quantified predation rates of 25-40% of all nesting attempts (J. Greaves and M. Gray, unpubl. data; Salata 1981, 1983a; Jones 1985).

Nest Parasitism

The effect of nest parasitism by the Brown-headed Cowbird (*Molothrus ater*) has been greatly enhanced by anthropogenic factors, resulting in increased cowbird habitat and range and decreased vireo habitat. The Brown-headed Cowbird was rare in California prior to 1900, but expanded tremendously in both range and numbers (Garrett and Dunn 1981) as irrigated agriculture and animal husbandry increased (Wilbur 1980b). The first record of nest parasitism on the Least Bell's Vireo was in 1907, after which reported incidences increased rapidly (Linton 1908, Wilbur 1980b).

Recent studies have documented parasitism rates of between 20 and 47% from 1980 to 1982 (Greaves and Gray, unpubl. data; Salata 1981, 1983a) and 80% in 1984 (Jones 1985). S.A. Laymon (unpubl.) suggests rates above 20% are probably detrimental to the vireo population's recruitment; at levels above 40% the local population may be expected to decline. Although the results of these studies do not indicate inordinately high parasitism rates compared to those of other common host species of Brown-headed Cowbirds, they do support the hypothesis that cowbird parasitism is significantly reducing Least Bell's Vireo reproductive success. Considering the present widespread abundance of cowbirds throughout the historic range of the vireo, it appears that cowbird parasitism may greatly increase the probabilities of localized extinction to many of the small, vulnerable breeding subpopulations of Least Bell's Vireos.

ONGOING AND PLANNED CONSERVATION EFFORTS

Section 7(a) of the Endangered Species Act, as amended, requires federal agencies to consult with the FWS to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. Through this consultation process, the FWS may require compensation for any possible adverse impacts or recommend against the action if no appropriate compensation is possible.

A recovery plan specific for the Least Bell's Vireo has been prepared (FWS 1986b) that draws together the state, federal, and local agencies having responsibility for conservation of the vireo and provides a framework for agencies to use to coordinate conservation efforts. The plan describes recovery tasks, sets priorities, estimates the cost of each task, and assigns an agency lead responsibility for implementing each task.

A limited amount of cowbird control and monitoring of vireo breeding success has been funded by the FWS, California Department of Fish and Game, California Department of Transportation, San Diego Association of Governments (SANDAG), and the U.S. Marine Corps Base, Camp Pendleton. Cowbird trapping in a portion of Anza-Borrego Desert State Park is also underway.

Section 9 of the Endangered Species Act prohibits the "taking" of endangered and threatened species. Within the broad legal definition of "take" is to ". . . harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

Section 10(a) of the Endangered Species Act covers the development of a habitat conservation plan (HCP) and issuance of a permit to take an endangered species incidentally. To obtain such a permit, an applicant must submit a conservation plan that specifies the possible impacts of such taking and the actions the applicant will undertake to minimize and mitigate such impact. The FWS may issue a Section 10(a) incidental-take permit provided that, among other things, the permit application is supported by an HCP whose implementation will ensure the long-term conservation of the species and the taking of the species will not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Issuance of such a permit is subject to the requirements of Section 7(a)(2) of the Act as well as Section 102(2)(C) of the National Environmental Policy Act (NEPA) [42 U.S.C. 4332(2)(C)].

SANDAG is spearheading the effort by local governments, state and federal agencies, private entities, and conservation organizations to prepare a comprehensive species management plan (CSMP) that will consist of one or more separate habitat conservation plans (each HCP will cover one or more proposed critical habitat areas, of which there are 10). Funding for this effort originated with the state legislature, which appropriated $150,000 for this project with both private and public entities providing matching funds for a total of $300,000. With these initial funds, SANDAG issued a contract to Regional Environmental Consultants (RECON) to prepare the CSMP. RECON's program includes collection of biological and land-use data, censusing vireos, monitoring nest parasitism in selected areas, and conducting hydrological analyses. In addition, the effects of aggregate mining and of both existing and proposed land uses will be assessed. With this information, RECON will develop HCP's for the San Luis Rey River and San Diego River and a prototype HCP to serve as a model for other organizations to follow in development of additional HCP's. A HCP for the Sweetwater River is being prepared by a private landowner.

Membership in the CSMP Task Force encompasses agencies, county and city government, project proponents, conservation organizations, and various other local entities. Initiated in November 1985, the task force has met regularly since then. Other government and local entities are being encouraged to develop HCP's for additional areas.

Preservation of the Least Bell's Vireo will rely on a long-range, well-funded conservation program as outlined in the recovery plan, compensation packages, and HCP's. Success is contingent on a successful monitoring program to assess progress, strict enforcement of laws and regulations designed to protect endangered species and ecosystems, and a dedicated effort on the part of all concerned parties.

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NEST-SITE TENACITY OF LEAST BELL'S VIREOS

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In 1978, the total population of Least Bell's Vireo (*Vireo bellii pusillus*) was estimated at 90 pairs (Goldwasser et al. 1980). With the expected listing of the subspecies as endangered by the California Fish and Game Commission, and interest in listing it at the Federal level, information on the vireo's breeding biology and population dynamics was needed. No such data were available, and studies of the nominate subspecies (*V. b. bellii*) addressed only reproductive rates and nesting substrate with data gathered from small samples over many years (Overmire 1962) or reported sample sizes too small (Mumford 1952; Nolan 1960; Barlow 1962) to be useful for analysis of population dynamics. For five breeding seasons, 1979-1983, I conducted a banding study of a Least Bell's Vireo population at Gibraltar Reservoir, Santa Barbara County, California, in order to assess the population's dynamics. My investigation reveals new information about the vireo's mating system and territoriality that raises serious questions that managers of its breeding habitats must understand and adequately address.

METHODS

I used unique combinations of U.S. Fish and Wildlife Service aluminum bands and colored plastic bands to mark the vireos. Beginning in 1979, I began banding nestlings, and in 1980 I began mist-netting adults. I continued the banding through the 1983 season.

I surveyed the adult population at least once a week in 1979, by walking through the study area and marking the locations of singing adult males, pairs, and nests on aerial photographs and maps. Counts were made by listening for males and searching all habitats in and adjacent to the riparian willow-cottonwood forests in the study area. Habitat descriptions of the study area can be found in Gray and Greaves (1984). Eighty percent of the contiguously occupied habitats constituted the study area.

Data on breeding success by males and females were compared by means of chi-square contingency tables. I compared data by sex and whether the birds were monogamous or polygamous within a season. Successful nests were those that fledged at least one young vireo. Territories were areas with readily discernible and defended boundaries (either stream courses or particular trees or shrubs) that were generally reused from year to year. Nest sites were smaller locations within a territory, usually a single shrub or a clump of weeds or shrubs.

RESULTS

I banded 40 adult males, 42 adult females, and 312 nestlings or fledglings. Forty-eight of the young returned during subsequent years as 25 males and 23 females. From 1980 through 1983, a cumulative total of 185 males and 161 females (yearly mean, 46 and 40, respectively) was found in the study population. Of these, 114 males and 105 females (yearly mean, 29 and 26, respectively) were banded, and represented 65 individual males and 65 individual females, of which 57 males and 65 females attempted to breed at least once. Actual annual sex ratios from 1980 to 1983, including unbanded birds, were 50.5:49.5 (n = 91), 53.9:46.1 (n = 89), 53.3:46.7 (n = 90), and 56.7:43.3 (n = 76), respectively.

Males and females act differently in regard to nest site fidelity. Of 48 returns by 26 banded males, 63% were to the same territory and 85% were to the same or adjacent territory. Of 29 returns by 19 banded females, only 31% were to the same territory and 59% were to the same or adjacent territory. Forty-one of 50 banded males (82%) and 19 of 44 banded females (43%) remained faithful for the duration of the study to the territory in which I first detected them.

Twenty-two females were sequentially polyandrous, and 12 males were sequentially polygynous. Polyandry consisted of females moving from one territory to another, with polygyny the result of a new female joining a territorially tenacious male after its prior mate(s) had moved elsewhere. In addition, I suspected several instances of simutaneous polyandry and one of simultaneous polygyny.

Forty-two of 57 banded males (74%) and 43 of 65 banded females (66%) successfully raised at least one nestling to fledging. Of birds breeding for a second year (SY), 37 of 51 males (73%) and 41 of 57 females (72%) bred successfully at least once. Of all birds, banded and unbanded, 62 of 98 males (63%) and 65 of 98 females (66%) were successful. At least 57 of 86 monogamous males (66%) and 51 of 78 monogamous females (65%) were successful. The only significant difference was between monogamous and polygamous males at the 90% confidence level, with monogamy the more successful form. None of the other comparisons was significant at that level, and none approached the 70% confidence level.

Most territories remained centered on the same clump of shrubs or small trees throughout the study, but in some the centers shifted while remaining within the boundaries of previous territories. From 1980 through 1982, however, some larger areas containing a few territories became more crowded. One section contained four territories in 1980 and 1981 but had seven territories in 1982. In 1983, only two territories were found in the same area.

From one year to the next, nest sites were generally in the same clump of shrubs, even when different males and females were found on the territory. A few nests were found in the same shrub within a few feet of the nest of the previous season. Only three nests (n = 403) were on the exact fork or immediately above the previous season's fork. Only one nest was used more than once, by a male that was successful in raising two broods, one with each of two different females, both of which were themselves polyandrous.

Females switched mates following either the success or failure of a nest. No switching was observed during the actual care of a clutch or brood. In 1983, a first-year banded female successfully raised a brood of four with one male, then immediately moved to an adjacent, unpaired male who had previously failed with an unbanded female. Another, older banded female raised a brood of four with one male and then moved to an unmated male who had been constructing a nest several territories away prior to the fledging of his prospective mate's first brood. He was then seen feeding at least one of the two accompanying banded fledglings, while his new mate proceeded to lay eggs in his nest. Such moves as these discounted the interpretation that handling by humans may have affected the behavior of the birds, causing them to move to avoid disturbance.

DISCUSSION

Within-season mate switching by females was sufficiently frequent to suggest that males and females use different strategies to maximize reproductive success. Most passerine species have been presumed to be strictly monogamous (Möller 1986), though some exhibit varying degrees of polygamy (Fitch and Shugart 1984). There have been no other reports of polygamous behavior among the Vireoninae. While an increasing number of articles have described and attempted to explain advantages and causes of polygamy (Orians 1969; Leisler 1985), few examples of polyandry have been documented among passerines. Most examples of polygamy address polygyny in several small passerines (Möller 1986). Graul et al. (1977) attempted to explain possible factors influencing polygyny and polyandry. Verner and Willson (1966) discussed the influences that habitats might have on mating systems, and predicted that polyandry should be a rare occurrence among passerines.

Gowaty (1981), in describing mating strategies other than polygyny, defined sequential polygamy as "mating and parenting which occurs without significant overlap between successive mates," meaning that a female would contribute substantially to the raising of a first brood before attempting another brood with a new mate. This strategy describes the sequence of events that I found at Gibraltar Reservoir.

The apparent availability of unmated males in the study population might be sufficient enticement to nearby females to encourage mate switching, whether the females were successful or not with their first mates. Indeed, Smith et al. (1982) suggested that polygyny was a result of a similar, though opposite, sex bias in Song Sparrows. Most such examples of polygyny, however, are of primary and secondary females simultaneously mating with one male and brooding clutches presumably both fathered by the single male. I found no such simultaneity in the population I studied. In fact, polygamous behavior appeared to be only one of several means that females used to maximize their reproductive success. Many females dwelt in large territories containing an abundant supply of nest sites, allowing the pair to build numerous nests, even though all failed. The avilability of nearby, unpaired males did not seem to distract many repeatedly unsuccessful females from monogamy while, simultaneously, other successful females switched mates immediately after completion of nesting duties in their first territories, often traveling more than a mile to a new territory containing a previously unpaired male.

The data on mate switching and between-year site fidelity together show that males and females have developed different strategies regarding nest site selection and fidelity. Males establish and maintain fixed territories, while females search for one mate among many who possesses a suitable nesting location. Females view the entire area of habitat as one large potential territory from which they may select one or more mates during their lifetimes.

Indeed, only 3 of 26 males retained the same mate from one season to the next.

The strategy of the female, viewing the habitat area as one large potential territory, could result in greater genetic mixing. The male becomes more familiar with his territory and its resources, so he is better able to provide the young with the necessary food while they are in the nest and to lead them to good foraging areas once they have fledged. The female is free either to remain with her young or to move to another male with whom she can start a new brood. Even though many successful broods were followed almost immediately by another attempt with the same mate, the ability to move to another male, whether or not the necessity arises, presents the female with a greater array of opportunities for success than she might have had if she remained strictly monogamous.

A clear understanding of the vireo's relationship with its breeding habitats is important for management of this species. The primary implication for proper management of its breeding habitats is as follows: the males and females obtain a territory differently, with the males being tied much more closely to a certain plot of habitat. Managers should be aware that actions that disturb or alter the vireo's habitats might not affect the more tenacious male but could be sufficient to drive females from the disturbed area. The male Least Bell's Vireos that are scattered on isolated territories throughout southern California may be defending territories that are inadequate to meet a female's needs. The presence of a singing male does not establish the presence of a female or that the habitat is suitable for a breeding pair.

Mistakes of past management of other endangered passerines should be used as lessons in methods to be avoided or altered by managers of the Least Bell's Vireo. Understanding of these errors should be combined with factual data and the proper understanding of these data. With such a synthesis, we can better ensure that the Least Bell's Vireo and its breeding habitats will recover their place as viable members of our natural heritage.

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LEAST BELL'S VIREO MANAGEMENT BY COWBIRD TRAPPING

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To promote the survival of the Least Bell's Vireo (*Vireo bellii pusillus*), the California Department of Transportation (Caltrans) began a program of trapping Brown-headed Cowbirds (*Molothrus ater*) on the Sweetwater River of San Diego County in 1986. The trapping was part of the mitigation required for a U.S. Army Corps of Engineers 404 permit to compensate for removal of 1 acre of vireo habitat for construction of a bridge. The U.S. Fish and Wildlife Service (USFWS) provided details of the trapping scheme through an interagency cooperation agreement.

This paper addresses the present USFWS management method for reducing brood parasitism of vireos through trapping of cowbirds. Such trapping should manage both the Least Bell's Vireo and Brown-headed Cowbird effectively, but we contend that the present program does not fully address the behavior or ecology of the latter species.

METHODS

In 1986, Caltrans placed 20 cowbird traps along a 3-mile stretch of the Sweetwater River, in accordance with USFWS conditions of the 404 permit; 15 traps were in the riparian/nesting area and 5 traps were in an adjacent horse stable where cowbirds feed. As in other trapping programs in southern California (B. Jones, unpubl. data), modified Australian crow traps with dimensions 6' × 6' × 8' were baited with one live male cowbird, wild birdseed, and water. Traps were in operation by 15 March and were attended once daily through 31 July, for a total of 108 days. Trapped female cowbirds were killed and kept for analysis. Trapped males were used to replace escaped decoy birds.

We divided the 108 days into two-week intervals and compared trap results from the riparian area to those from the vicinity of the horse stables. We excluded from comparison traps that were vandalized frequently or were not baited for at least 67% of the time.

Differences in the decline of numbers of males versus females trapped were compared by a t test of the regression lines (Zar 1983). A chi-square test for goodness of fit was used to compare the sex ratio of birds from San Diego County to ratios reported by others. A two-way G test of independence (Sokal and Rohlf 1981) was used to determine whether the sex ratio of birds trapped would be influenced by the location of the trap. A Mann-Whitney U test was used to compare total birds trapped per day in the riparian and horse-stable traps because these data were not normally distributed.

We investigated the relationship between cowbird breeding activity and trapping success by comparing the timing of ovarian development to the timing of trap yields. Exact correlation of these two activities is not possible since trapping data are from the Sweetwater River in 1986 while ovary data are from Camp Pendleton in 1983 and 1984.

Seventy-six female cowbirds trapped in 1983 and 71 females trapped in 1984 at Camp Pendleton were donated to the San Diego Natural History Museum (SDNHM). The donated birds from 1984 represent an unspecified subsample of the total birds trapped during that year. The museum's staff measured the maximum length and width of each bird's ovary, noted whether the follicles were developing or burst, and checked for the presence of an egg in the oviduct.

RESULTS

The number of cowbirds trapped per two-week period is plotted in Figure 1. Cowbirds were first trapped on 27 March, and the numbers trapped peaked by 14 April; few were seen in the project area after the end of June. The decline in the trap rate of the female birds appeared to be greater than that of the males (Figure 1), but slopes of the regression lines (regression coefficients −0.380 for males and 0.016 for females) do not differ significantly (t_{crit} = 2.306>0.080, p>0.05).

The sex ratio of Brown-headed Cowbirds trapped in this study (Figure 1) does not appear to be representative of other wild populations. The plumage of 4316 first-year birds in west-central Kansas indicated a sex ratio of 1:1 (Hill 1976). Darley (1971) observed a ratio of 1.5 adult males to 1.0 adult females in western Ontario. Rothstein et al. (1986) reported the same ratio for parts of the U.S. In contrast, along the Sweetwater River 163 males and 46 females

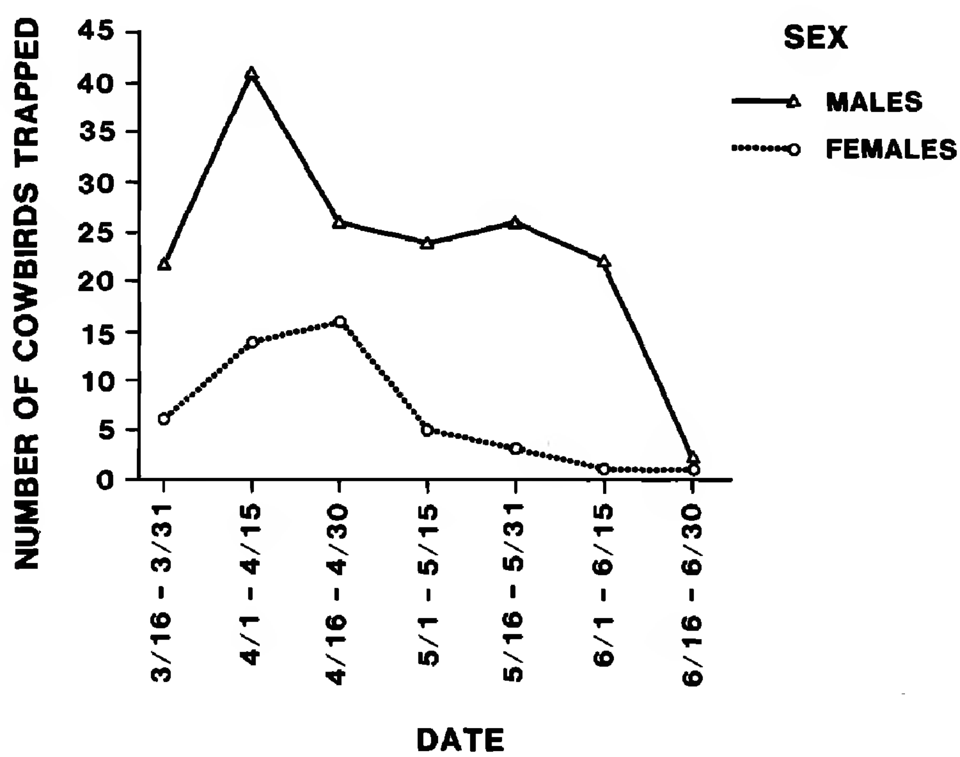

Figure 1. Total number of cowbirds trapped on the Sweetwater River, San Diego Co., 1986.

were trapped, a ratio of 3.5 to 1.0. This ratio of males to females deviates significantly from the 1.5:1.0 ratio ($\chi^2 = 28.2$, $p < 0.001$). The sex ratio of all the 562 cowbirds trapped in San Diego County 1984-1986, 2.3:1.0, also differs significantly from the 1.5:1.0 ratio ($\chi^2 = 20.7$, $p < 0.001$) (Table 1).

A two-way G test of independence indicates that the sex of the cowbirds trapped was independent of the type of area in which the trapping was done ($\chi^2 = 3.00 < 3.841$, $p > 0.05$). Along the Sweetwater River more males than females were trapped per trap day both in riparian woodland and around stables (Table 2). Significantly more birds per trap day were trapped in the foraging area than in the riparian area ($U = 60.5 > 57$, $p < 0.05$).

In this study trapping yield of female Brown-headed Cowbirds was highest in April. The cowbirds donated to the San Diego Natural History Museum from Camp Pendleton in 1983 and 1984 showed a similar trend, but the subsample that was donated may not be representative of the trapped population.

A plot of ovary size versus time indicates that ovary recrudescence begins by April (Figure 2). The first burst follicles appear in late April, indicating that egg laying has begun by that time. The decline in numbers of cowbirds trapped appears to coincide with the onset of breeding.

DISCUSSION

Lower-than-expected numbers of females trapped in both areas suggest trap bias—the probability of trapping a female being lower than the fraction of females in the population—or that the local populations have a larger percentage of males than those reported by Darley (1971) and others. Roth-

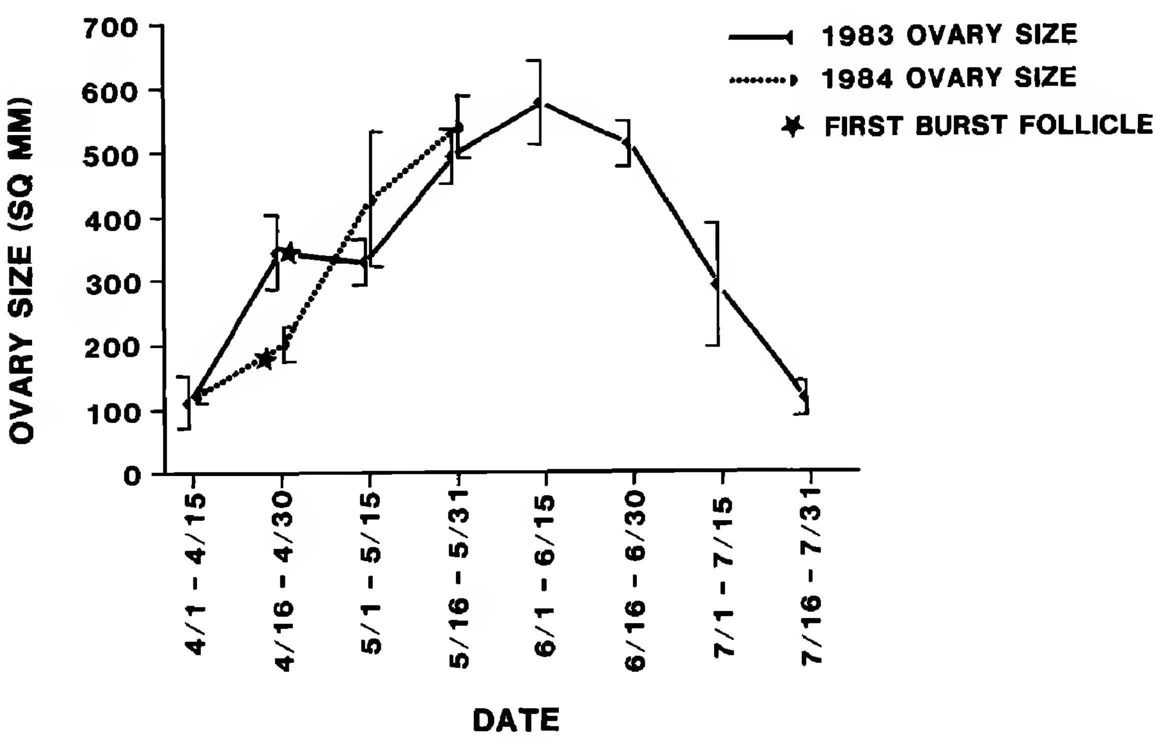

Figure 2. Cowbird ovarian development at Camp Pendleton, San Diego Co., 1983 and 1984. Error bars represent the standard error of the mean.

Table 1 Ratios of Male to Female Brown-headed Cowbirds Trapped in San Diego County.

Year	Trapping area	Total cowbirds	Males	Females	Ratio M:F	Source
1986	Sweetwater River	209	163	46	3.5:1	This study
1984	San Diego River	49	33	16	2.1:1	B. Jones, unpubl.
1985	San Diego River	151	93	58	1.6:1	B. Jones, unpubl.
1985	Sweetwater River	87	57	30	1.9:1	B. Jones, unpubl.
1985	San Luis Rey River	66	44	22	2.0:1	B. Jones, unpubl.

Table 2 Cowbirds Trapped in Riparian and Foraging areas, Sweetwater River, San Diego County, 1986

Trap Location	Total trap days	Total males trapped	Total females trapped	Females per trap day	Males per trap day	Total cowbirds per trap day
Riparian	973	50	24	0.025	0.051	0.076
Foraging	321	113	22	0.069	0.352	0.421
Total	1294	163	46			

stein et al. (1980) reported higher ratios of males to females (3:1 to 6:1) in the Sierra Nevada. Sex ratios in San Diego County cowbird populations have not been determined so bias cannot be demonstrated conclusively. Traps that rely on decoys, however, have been shown to catch a biased ratio of icterines in Quebec (Weatherhead and Greenwood 1981).

The sex of trapped cowbirds has important implications for the effectiveness of trapping as a management tool. Females are the brood parasites, so their removal would reduce the rate of parasitism more than the removal of males. A reduction in numbers of males is essentially unimportant as long as sufficient numbers remain to fertilize the available females. Cowbirds in central California appear to have a monogamous mating system with the dominant males guarding their mates from other males (Rothstein et al. 1986), but this system does not preclude a female's remating in the event of the loss of her mate.

Bias may be related to cowbird behavior in the breeding range, or it may be inherent in the trapping scheme.

Cowbirds typically maintain two ranges. The roosting area is separate from the foraging area, requiring that the birds commute daily. Cowbirds roost in riparian habitats during the night and females parasitize nests in the morning. During the afternoon the birds forage in communal groups. Rothstein et al. (1984) reported commuting distances of up to 7 km during the breeding season in the Sierra Nevada of California.

Radiotelemetry of cowbirds showed that males returned to riparian areas much less consistently than did the females. Only four of the eight males equipped with radio transmitters by Rothstein et al. (1984) returned to the egg-laying sites in the evening, whereas all five of the marked females returned every evening. Because of this behavior, female cowbirds might be expected to be more abundant than males in riparian traps. However, while laying eggs, females forage very little; Rothstein et al. (1980) rarely observed cowbirds on the ground in the breeding sites. Mate guarding by the males may keep the dominant males away from the traps in the areas where their mates are laying eggs. If this is so, subordinate males are more likely to forage in the morning in either breeding or foraging areas than the females or the dominant males.

If in southern California cowbirds behave as they do in the Sierra Nevada, trapping in the riparian areas would be less effective at removing females than trapping in the foraging area. In this study the lower numbers of females per trap day in both areas suggests trap bias.

The breeding season may not be the optimal time for trapping, especially if trapping is conducted in the riparian (breeding) areas. The ovaries of the female cowbirds dissected at the San Diego Natural History Museum were only beginning to recrudesce at the time of year when the Sweetwater River traps were most successful. Following the onset of egg laying, indicated by the first appearance of burst follicles, the numbers of both sexes trapped declined. The population may have decreased as a result of the trapping effort; alternatively, the cowbirds may be less attracted to the traps while they are concentrating on egg laying. If the latter hypothesis is true, deployment of traps prior to the breeding season would be more effective in reducing numbers of cowbirds.

Cowbirds show marked regional variation in mating, territorial, and host-selection behavior (P. Mason, pers. comm.). Without some knowledge of their local habits, designing a program for management would be difficult.

In areas where cowbird trapping has been pursued, the cowbirds' foraging areas and commuting patterns remain unknown. More information on sexual differences in cowbird behavior could help improve the efficiency of a management program, but no studies of cowbird biology have been conducted in southern California.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Along the Sweetwater River, trapping in the foraging area yielded more cowbirds of both sexes per trap day than did trapping in the riparian area. The highest trapping success was in April just after the cowbirds arrived and before they began intensive breeding.

The apparent sex bias in the trapping results may be the consequence of the trap design. A trap baited with a single male bird may be insufficient to attract females. Providing a lek-like situation of several males might give females more incentive to enter the trap. Conversely, females forage together before the breeding season (personal observation). If traps are deployed at that time female decoys might be more effective than males in attracting other females. We recommend that

1. Brown-headed Cowbird population size, site fidelity, and host selection be studied in an area where a trapping scheme is proposed before the trapping is begun.
2. Cowbirds be trapped in areas and at times when the probability of reducing numbers of females is greatest; traps should be placed in foraging areas and should be operating well in advance of the breeding season.
3. Alternative cowbird trapping or removal methods be tested. A Potter trap may bias trapping in favor of females (Darley 1971).

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Brown-headed Cowbird *Sketch by Brian Evans*

Use of skin for drawing courtesy of Museum of Southwestern Biology (Albuquerque. New Mexico)

BROWN-HEADED COWBIRDS IN CALIFORNIA: HISTORICAL PERSPECTIVES AND MANAGEMENT OPPORTUNITIES IN RIPARIAN HABITATS

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Two subspecies of Brown-headed Cowbird (*Molothrus ater*) now are known to breed in California. The Sagebrush Cowbird (*M. a. artemisiae*) has probably always been a rare summer resident in the Great Basin portions of California and a rare winter visitor in the remainder of the state (Grinnell 1915, Mailliard 1927). Although the abundance of this subspecies has increased, its distribution has remained constant. The status of the Dwarf Cowbird (*M. a. obscurus*), on the other hand, has changed remarkably during the past 120 years, and it is the latter subspecies that is apparently responsible for the substantial reduction in reproductive success of a number of Central Valley and Southern California passerines.

The Brown-headed Cowbird, a nest parasite, has been implicated in the decline of several species of small, open-cup-nesting passerines, including the Kirtland's Warbler (*Dendroica kirtlandii*) (Mayfield 1977a) in Michigan and the Least Bell's Vireo (*Vireo bellii pusillus*) in California (Goldwasser et al. 1980). Additionally, there is evidence that riparian species, nesting in linear habitats, are more vulnerable to parasitism than species nesting in more exensive habitats (Bleitz 1956, Brittingham and Temple 1983, Airola 1986). Rothstein et al. (1984) showed that cowbirds have expanded into the higher elevations of the Sierra Nevada, but the species' expansion in the lowlands has yet to be examined. This paper documents the spread of cowbirds in California, establishes the mechanism by which cowbirds can drive host species to extinction, and explores methods to control the adverse effects of cowbirds on riparian species.

STUDY AREA AND METHODS

I conducted a literature search and examined museum collections for nesting and specimen records of cowbirds in California west of the Sierra Nevada crest and the desert region north to Mono County. I also reviewed National Audubon Society Christmas Bird Count records and conducted field surveys to locate winter concentrations of cowbirds in central California.

RESULTS AND DISCUSSION

Historical Considerations

It is not known if the Dwarf Cowbird occurred along the Colorado River prior to 1870, when it was first recorded breeding there. However, there is only one record west of the Colorado River prior to 1870 (Table 1). According to the records, the Dwarf Cowbird's range expanded west and north at a rapid rate between 1900 and 1930 (Table 1, Figure 1). By 1925 cowbirds

Table 1 Representative First Records of Dwarf Cowbird Expansion 1850-1960

Year	Location	Reference
1862	E. side of Cuyamaca Mts., San Diego Co.	Cooper 1874
1870	Needles, San Bernardino Co.	Belding 1890
1889	San Bernardino, San Bernardino Co.	Wall 1919
1904	Santa Paula, Ventura Co.	Willett 1933
1905	Los Angeles, Los Angeles Co.	Willett 1933
1908	Mecca, Riverside Co.	Grinnell 1909
1908	Sespe, Ventura Co.	Santa Barbara Nat. Hist. Mus.
1910	Compton, Los Angeles Co.	Law 1910
1911	Bakersfield, Kern Co.	Swarth 1911
1913	Fresno, Fresno Co. (very rare)	Grinnell and Swarth 1913
1914	Buena Vista L., Kern Co.	Maillard 1914
1915	National City, San Diego Co.	Santa Barbara Nat. Hist. Mus.
1915	10 mi. W Santa Barbara, Santa Barbara Co.	Dawson 1916
1915	Snelling, Merced Co.	Grinnell and Storer 1924
1919	LeGrange, Stanislaus Co.	Grinnell and Storer 1924
1923	Livingston, Alameda Co.	La Jeunesse 1923
1926	Lake Merced, San Francisco Co.	Grinnell and Wyeth 1927
1931	Marysville, Yuba Co.	Neff 1931
1936	Inverness, Marin Co.	Grinnell and Miller 1944
1938	Monterey, Monterey Co.	*Bird-Lore* 1938
1941	Humboldt Co.	Talmadge 1948
1943	Hayfork and Hyampon, Trinity Co.	Grinnell and Miller 1944
1951	Coastal Klamath River, Del Norte Co.	*Audubon Field Notes* (AFN) 1951
1956	Dunsmuir, Siskiyou Co.	AFN 1956
1960	Yreka, Siskiyou Co.	AFN 1960

Table 2 Dates and Locations of Detailed Field Studies in Which No Dwarf Cowbirds Were Found

Date	Location	Reference
1870-1890	Central Valley, Stockton to Chico	Belding 1890
1895	Not found west of the Colorado River	Bendire 1895
1908	San Bernardino Mts.	Grinnell 1908
1913	San Jacinto Mts., Hemet to Banning	Grinnell and Swarth 1913
1916	Trinity and Siskiyou Mts.	Kellogg 1916
1924-1929	Red Bluff, Tehama Co.	Grinnell et al. 1930

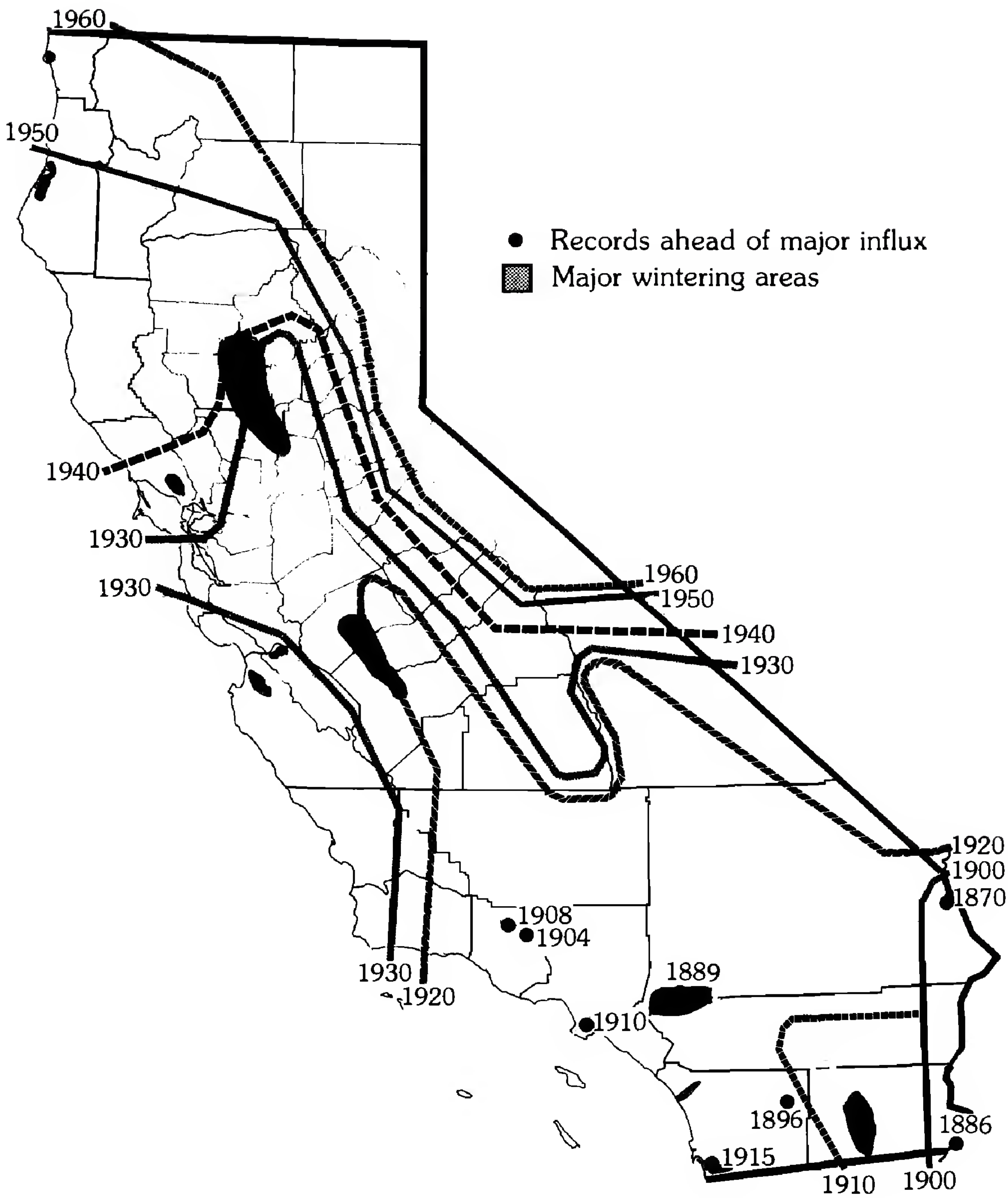

Figure 1. Expansion of the Brown-headed Cowbird's breeding range in California 1900-1960.

were common in the Los Angeles area and by 1930 extended their range to the San Francisco Bay area and the central Sacramento Valley. By 1941 they had expanded into Humboldt County and by 1960 they had reached Del Norte County, the Oregon border, and the highest meadows in the Sierra Nevada. In-depth studies document that cowbirds were absent from areas where they later became common (Table 2).

Numerous other records from the literature and museum collections, which are not presented in this paper, show a pattern of first records of Dwarf Brown-headed Cowbirds in an area followed 10 years later by the first major influx and 10 years after that by population saturation. This pattern suggests that pioneers found a ready source of hosts, reproduced successfully, and in turn provided future pioneers. Cowbirds have a high reproductive potential. For example. a population with a 55% yearly female mortality (Darley 1971), a laying rate of 12 female eggs (i.e., eggs that will produce females) per female per year (Payne 1976) and 25% egg success to fledging (Young 1963) would increase from 10 females to 100 females in 5 years.

Cowbird-Host Relationships

I use the case history of the Bell's Vireo to illustrate the relationship of cowbirds to their hosts. The Bell's Vireo is a small, open-cup nester that is very susceptible to cowbird parasitism (Goldwasser et al. 1980). The vireo's reaction to nest parasitism is either to desert the nest or accept the egg(s) (Barlow 1962). Nonparasitized vireo nests are more successful than parasitized ones. Parasitized nests rarely fledge either cowbird or vireo young (Wiens 1963). A regression analysis of the percentage of nests parasitized versus the percentage of egg success in eight studies shows an inverse relationship explaining 48% of the variance in egg success (Nice 1929, Pitelka and Koestner 1942, Mumford 1952, Nolan 1960, Overmire 1962, Barlow 1962, Wiens 1963, Goldwasser et al. 1980).

Using demographic analysis and the studies listed above, I calculated growth curves for four levels of parasitism: (1) 13%, the lowest rate known; (2) 30%, the average of the three lowest rates; (3) 48%, the average of the eight studies; and (4) 69%, the average of the two highest rates. I used an annual mortality rate of 40% of adults and an average of 2.55 female eggs per female per year (Barlow 1962). At a parasitism rate of 13%, a Bell's Vireo population would grow from 10 to 100 females in 6 years. A population with 30% parasitism would require 37 years to grow to 100 females, while 48% and 69% parasitism rates would lead to extinction in 18 and 8 years, respectively. Thus parasitism rates higher than 48% lead to extinction in a short time and parasitism rates higher than 30% lead to an unstable population that could suffer extinction caused by stochastic events.

Wintering Populations

Through field surveys and analysis of Christmas Bird Count data I located wintering concentrations of Brown-headed Cowbirds. Wintering cowbirds concentrate in rice fields, around dairies, and in feedlots. The main concentrations (Figure 1) are in the Sacramento Valley (U.S. Fish and Wildlife Service unpublished data, personal observation), the Imperial Valley (Christmas Bird

Counts), and in western Riverside (Christmas Bird Counts) and southwestern San Bernardino counties (Christmas Bird Counts).

Management Considerations

The problem of cowbird parasitism reducing host populations, especially in riparian habitats, has been documented. One management tool used to minimize parasitism is the trapping of cowbirds in the vicinity of nests of the affected species. This method, in which live cowbirds in the traps serve as decoys (Mayfield 1977b), has proved very successful in reducing parasitism and halting the decline of Kirtland's Warbler (Kelly and DeCapita 1982). It is, however, a labor-intensive method that may not necessarily capture the offending cowbirds.

Additional methods of direct control of cowbirds should be considered: (1) shooting on the breeding grounds; and (2) trapping on the wintering grounds. It is possible that in narrow, riparian habitats shooting might be more effective than trapping. Both male and female cowbirds can be attracted within shotgun range during the breeding season with taped recordings of a female (S. I. Rothstein pers. comm.). Females could then be shot selectively, leaving the males and an unbalanced sex ratio. The luring of cowbirds with recorded calls is a method that uses behavior related to breeding, so it is unlikely that any birds would be immune to the method, a problem that arises with trapping.

The other direct method is winter trapping at feedlots and dairies. Large traps baited with decoys have proved effective at catching large numbers of cowbirds (Crase et al. 1972). Cowbirds are particularly amenable to this method because of their behavior of concentrating in large numbers on the wintering grounds. Whether the cowbirds wintering in a certain area are the same as those breeding in that area is, however, still unknown. A winter banding program should be initiated to study cowbird movements and test the feasibility of winter trapping. If certain cowbird populations, such as those in southern California, prove to be resident, this method should be given careful consideration.

Habitat management to reduce the impact of cowbirds should also be studied and, if successful, implemented. These indirect methods include (1) elimination of grazing near riparian areas; (2) removal of feedlots, stables, and dairies; and (3) reforestation.

In certain areas the reduction of livestock grazing may be an effective way to control cowbird impacts. For example, if livestock use of mountain meadows were reduced or eliminated, reproductive success of sensitive riparian species such as Willow Flycatchers (*Empidonax traillii*) may be enhanced. The elimination of grazing allows grass to grow too tall to be suitable cowbird foraging habitat and it removes the large grazers with which cowbirds associate. This would also result in denser riparian habitats in which nests would be harder for cowbirds to find.

If feedlots, dairies, and stables were relocated away from riparian woodland, cowbird foraging habitat near the nesting areas of endangered species could be reduced. Cowbirds in the Sierra Nevada travel up to 6.7 km from foraging areas in meadows and pack stations to their hosts' nesting sites (Rothstein et al. 1984). Similar radiotelemetry studies in lowland riparian sites could determine cowbird movement patterns from dairies to riparian sites.

In theory, birds nesting in narrow riparian corridors are more susceptible to cowbird parasitism than those nesting in broad habitats. If this principle is true, the parasitism rate could be lowered by increasing the width of the habitat through reforestation. There is probably a critical, but unknown, minimum width only above which this effect is evident. Recently, The Nature Conservancy's Kern River Preserve embarked on a reforestation project. The current preserve embraces 460 ha of which approximately 140 ha are now riparian forest, with the remainder in pasture and agriculture. In 1986 11 ha of willows and cottonwoods were planted and an additional 27 ha are slated for reforestation in 1987 (Bertin Anderson pers comm.). A total of 360 ha of riparian habitat may eventually be created in the preserve, increasing the average width of the riparian strip from the current 200 m to 750 m. The site is an ideal one on which to test the theory and determine whether reduction of parasitism through reforestation is feasible.

All of the above management techniques mentioned deserve careful study and research. Each site with its individual characteristics may be more conducive for use of a certain method or a combination of methods. Cowbirds have expanded their range and become a problem for a combination of reasons. The riparian species that they parasitize have lost vast tracts of nesting habitat, while habitat for cowbirds in the form of livestock pasture, irrigated agriculture, and forest clearings has increased concomitantly. Reforestation is the method that holds the most promise for long-term management of cowbird parasitism. It is appealing because it is a permanent solution and requires no continuing manpower or funding. In addition, such a program would benefit all bird species in the riparian community, not just the target species in a management plan.

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BANK SWALLOW DISTRIBUTION AND NESTING ECOLOGY ON THE SACRAMENTO RIVER, CALIFORNIA

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Throughout its Holarctic breeding range, the Bank Swallow (*Riparia riparia*) is generally regarded as a riparian species, although it has not been shown to be dependent on riparian vegetation. It is a colonial bird that nests in earthen banks and bluffs, as well as in sand and gravel pits.

Once locally abundant in lowland California (Grinnell and Miller 1944), the Bank Swallow has declined in numbers in recent years and no longer breeds in much of its former range (Remsen 1978). The Bank Swallow has a rather localized distribution in California along rivers, lakes, and ocean coasts (Grinnell and Miller 1944). We estimate that approximately 70-80% of California's remaining Bank Swallows nest along the Sacramento River. The steep earthen banks that are selected for nesting by Bank Swallows are subject to frequent erosion (Freer 1979, Mead 1979). This nest-site selection characteristic conflicts with proposed erosion control projects, which threaten a substantial portion of existing Bank Swallow nesting habitat along the Sacramento River.

The objectives of our study were (1) to determine Bank Swallow population size and distribution along the Sacramento River, (2) to determine reproductive success and colony occupancy, (3) to describe the habitat of nesting colonies, and (4) to identify and assess detrimental impacts to swallow populations and habitat.

STUDY AREA AND METHODS

Our study was conducted from May to August 1986 along the Sacramento River from Shasta Dam, Shasta County, to the Sacramento/San Joaquin Delta, Contra Costa County. We concentrated our research along a 160-mile stretch of river from Red Bluff, Tehama County, to the confluence of the Feather River, Sutter County. We surveyed the river by boat to locate colonies. At each colony, we made field estimates of the number of burrows and plotted locations on aerial photographs. At 34 colonies, complete burrow counts were made and compared to field estimates derived by visual inspection. The estimates were lower than actual counts by an average of 94%, so we divided all estimates by 0.94. Field estimates were adjusted because burrows continued to be excavated after the initial surveys, field estimates were inaccurate, and some burrows were lost because of bank erosion.

We estimated occupancy and reproductive success at 26 colonies from a random sample of 10-100 burrows per colony. Burrows with young, eggs, or a nest were considered occupied. We excluded from analysis collapsed burrows or burrows of unknown status. The number of breeding pairs per colony was estimated by multiplying the adjusted burrow estimates (field estimates divided by 0.94) by an average occupancy rate of 55.9% (MacBriar and Stevenson 1976).

We assigned colonies to one of three groups based upon number of burrows: (1) small, 1-130 burrows (*N* = 21), (2) medium, 131-375 burrows (*N* = 20), and (3) large, >375 burrows (*N* = 19). Thirty-two colonies (11 each from the small and medium groups and 10 from the large group) were randomly selected for intensive study.

At the selected colonies, we made three vertical transects of unequal length at equally spaced locations across the bank and recorded colony and bank length, height of the bank and burrow column, distance from bank to water, and aspect and slope of the bank. These measurements were averaged for each colony. We took soil samples from areas adjacent to transects by using seamless sample tins and determined soil type from bulk density measurements (Hausenbuiller 1978) and U.S. Soil Conservation Service County Soil Surveys. We assessed detrimental impacts to swallow populations and habitats by reviewing proposed erosion control projects and recording land use practices around swallow colonies.

RESULTS AND DISCUSSION

Population Size and Distribution

We located 60 colonies ranging in size from 12 to 1784 breeding pairs (Figure 1); the average was 269 (± a standard error (SE) of 47.9) pairs per colony. Thirty-five (58.3%) colonies had ≤150 pairs, 13 (21.7%) colonies had 151-450 pairs, and 12 (20.0%) colonies had ≥525 pairs. We estimate the total breeding population for the Sacramento River as 16,149 pairs (95% confidence interval = 14,597-17,700). Burrow occupancy was 55.9% (± 2.7% SE) on the basis of 1330 burrows checked at 26 colonies. The number of young per nest averaged 2.84 (± 0.07 SE) on the basis of 211 burrows checked at 14 colonies. We found 43 (71.7%) colonies between River Mile (RM) 140 and RM 240, 10 (16.7%) colonies downstream from RM 140, beneath which the river is channelized by levee systems, and 7 (11.7%) colonies upstream from RM 240, an area of hard sandstone banks and bluffs (Figure 2). Approximately 11,300 (70.0%) pairs were located between RM 150 and RM 220. The largest concentration of 3860 (23.9%) pairs was found between Chico Landing and Woodson Bridge State Recreation Area (RM 200 to RM 220).

Habitat Measurements

Colony banks (*N* = 32) averaged 3.3 (± 0.3 SE) m tall (range = 1.3-7.3) with a slope of 83.3° (± 0.9° SE, range = 68.3°-96.7°). Bank length averaged 454.6 (± 77.9 SE) m (range = 13-1900). There were 2.2 (± 0.2 SE) burrows per transect (range = 0.0-5.3) for a density of 0.8 (± 0.1 SE) burrows/m (range = 0.0-1.9). Burrow columns were 0.5 (± 0.1 SE) m tall (range = 0.0-1.7), and colony banks were 4.1 (± 0.8 SE) m (range = 0.0-21.8) from water. The length of the colony averaged 66.4 (± 12.4 SE) m (range = 2-366). Most colonies (56 of 99 transects) were adjacent to open grass fields. Approximately 25% of the transects were associated with agricultural lands, either row crops (N = 11) or orchards (N = 16). The remaining transects (N = 16) were under riparian and oak forests.

Bank Swallow colonies generally occur in soft soils. Of the 86 soil samples collected, most were taken from fine sandy loam (N = 19, 22.1%), loam (N = 33, 38.4%), and silt loam (N = 7, 8.1%) soils, while the remainder were in sand (N = 3, 3.5%), sandy loam (N = 6, 7.0%), clay loam (N = 2, 2.3%), clay (N = 8, 9.3%), and aggregated clay (N = 8, 9.3%) soils. Spencer (1964) reported a preference for loamy soils by Bank Swallows in Pennsylvania and Vermont. Most colonies (N = 99) faced north (35%) and east (32%). West exposures accounted for 24%, whereas southern exposures were only 8%. Soil moisture and/or presence of suitable banks may be factors in colony orientation.

Detrimental Impacts

Proposed bank stabilization and flood and erosion control projects represent the largest single threat to Bank Swallow colonies and habitat on the Sacramento River. Existing colonies will be destroyed, as will potential habitat. Such construction activity also may adversely affect swallow behavior. A minimum of 32 (53.3%) colonies are threatened by proposed projects, and an additional 3 (5.0%) colonies also may be affected by construction (Figure 2). Construction activities with the greatest potential impact are planned from

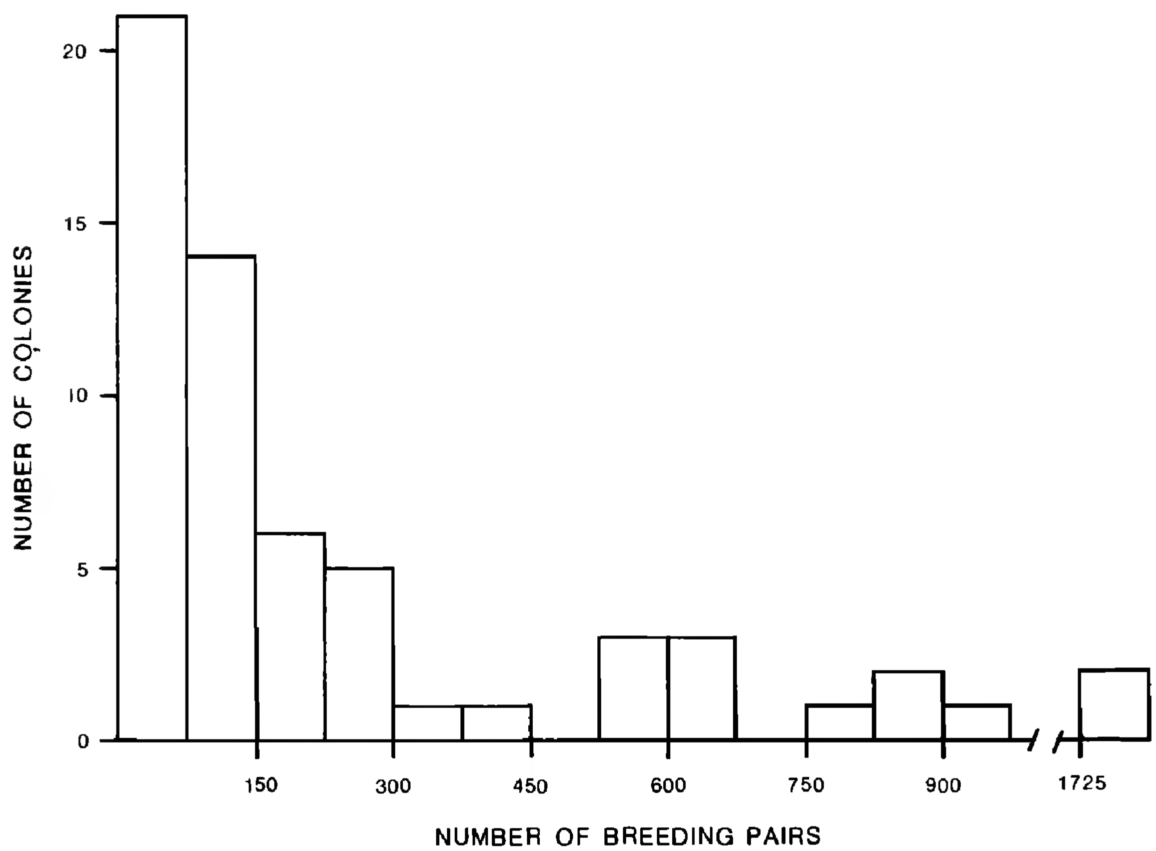

Figure 1. Frequency distribution of Bank Swallow colonies by colony size, Sacramento River, California, 1986.

RM 143 to RM 243 (Army Corps of Engineers 1983, The Reclamation Board, 1986). Coincidentally, this is the region of greatest Bank Swallow abundance.

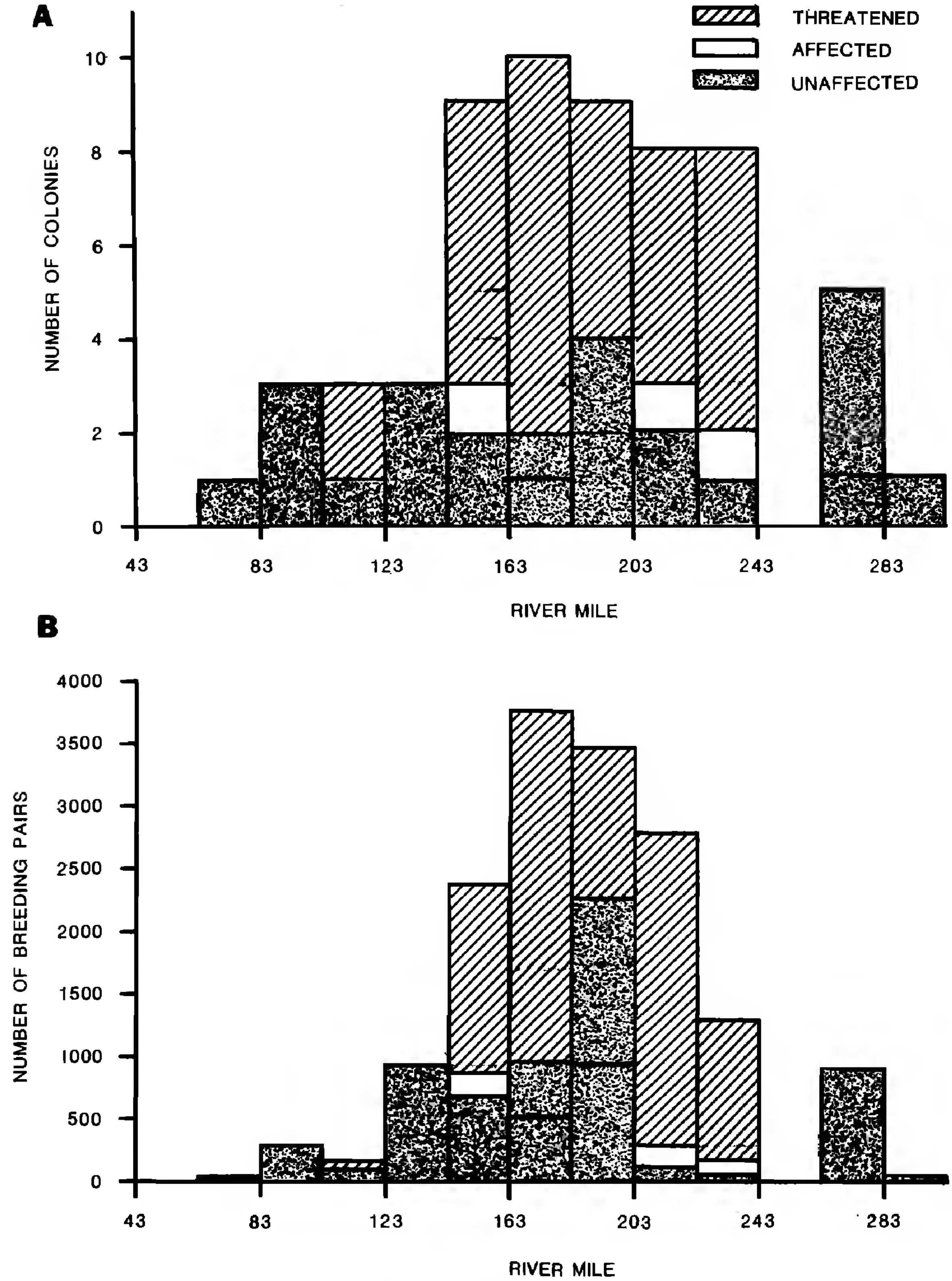

Figure 2. (**a**) Frequency distribution of Bank Swallow colonies by 20-river-mile sections that are threatened, affected, or unaffected by proposed erosion control projects. (**b**) Number of breeding pairs of Bank Swallows by 20-river-mile sections that are threatened, affected, or unaffected by proposed erosion control projects, Sacramento River, California, 1986.

A minimum of 9280 (57.5%) pairs are threatened, and an additional 416 (2.6%) pairs may be affected by construction (Figure 2). These declines will likely occur within the next 5-10 years if all proposed projects are carried out.

The colony at Woodson Bridge State Recreation Area (RM 218.6) is one of the two largest. An experimental bank protection method known as palisading was implemented there in August 1986. The integrity of the bank face was retained, and the colony site was not destroyed. The full impact of this bank protection method on Bank Swallows cannot be evaluated fully for several years. If bank erosion at Woodson Bridge is curtailed, the suitability of the bank for swallow nesting will decline through time as the bank face becomes less vertical because of sluffing. Blem (1979) has demonstrated that when this happens, predation increases and Bank Swallow colonies decline and are eventually abandoned.

CONCLUSIONS

Proposed erosion control projects threaten over 50% of the Sacramento River Bank Swallow population. On the basis of our findings, Threatened status for the Bank Swallow in California may be appropriate. Further research on the statewide distribution of Bank Swallows is scheduled for 1987. Efforts should be made to protect existing colonies and develop mitigation techniques. Alternative means of bank protection that have minimal impact on bank-nesting avifauna and riparian vegetation should be developed and tested. Above all, resource management agencies must realize that a river free from erosion is not compatible with the maintenance of healthy populations of bank-nesting birds.

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Bank Swallows *Sketch by Tim Manolis*

BIRDS OF REMNANT RIPARIAN FORESTS IN NORTHEASTERN WISCONSIN

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Recently much research has been focused on the effect of forest fragmentation on so-called "forest interior" bird species. Forest interior birds are dependent for breeding habitat on the central portions of large forest tracts; a decline in these species has been associated with a reduction in size and quality of remnant forests (Robbins 1979, Whitcomb et al. 1981, and others). Fragmentation creates a greater proportion of edge habitat, resulting in increased nest predation (Wilcove 1985) and brood parasitism (Brittingham and Temple 1983). Ranney et al. (1981) have described edge-related changes in forest vegetation.

Our study considers forest birds of Brown and Kewaunee counties in northeastern Wisconsin, where forested landscapes have been drastically altered over the last two hundred years. A few remnants of the original vegetation type occur in lands considered marginal for agriculture. We focus on those remnant forests that may be considered riparian because they adjoin a stream, river, or wetland.

Brown and Kewaunee counties once were covered entirely by northern mesic forest (Stearns and Kobringer 1975) and scattered areas of lowland black ash (*Fraxinus nigra*) or conifer swamps (Link and Frings 1980). Less than 16% of the original forest remains in Kewaunee County, while only 11% remains in Brown County (Wisconsin Department of Natural Resources 1968). Deforestation undoubtedly has altered the original forest bird assemblages. The great reduction and fragmentation of forests, in light of observations elsewhere in eastern North America, suggest that forest interior bird species in Brown and Kewaunee counties must be greatly reduced in numbers if they persist at all. We ask: "Which forest interior birds, if any, remain today in these riparian remnants?" If forest interior birds are found, we then ask: "Can those sites with forest interior species be distinguished consistently from sites in which these species are absent?"

METHODS

We identified remnant riparian forests from aerial photos and topographic maps. In these forests, we selected 38 survey points in Brown County (Table 1) and 20 points in Kewaunee County (within tracts of 100, 157, 178, 217 and 229 ha). For comparison, we chose 17 additional points in a larger forest (867 ha) in Kewaunee County. The Brown County riparian remnants reflect a gradient from early successional to moderately mature stands of northern mesic forest. The Kewaunee remnants represent lowland conifer (cedar) swamps or mixed coniferous-hardwood swamps. With the exception of the 867-ha site in Kewaunee County, none of our sites is part of a contiguous forest larger than 250 ha; the Brown County sites, in particular, are considerably smaller. Each site was visited at least once during the peak avian breeding season (June through mid-July) of 1985. All visits were completed during calm, non-rainy weather between sunrise and 0900. We recorded all birds seen or heard from a central point during two consecutive 10-minute censuses. We surveyed 30 sites in Brown County and 16 in Kewaunee County (including sites in the larger forest) repeatedly during 1985 and 1986. Details of these extended studies will be reported elsewhere.

Table 1 Environmental Variables and Discriminant-Analysis *F* Ratios for Survey Points in Riparian Remnants of Brown County

Environmental variable	Mean (± std. dev.)	*F* Ratio (initial step)		
		Ovenbird	Wood Thrush	Ovenbird and/or Wood Thrush
Percent forested area within				
1000 m	16.3 ± 7.4	8.0	11.4	21.0
500 m	55.2 ± 19.4	20.1	5.5	18.1
250 m	29.3 ± 13.8	10.4	14.2	28.7
150 m	74.0 ± 20.4	12.2	0.6	5.3
Area of remnant (ha)	35.8 ± 26.7	5.0	9.7	16.1
Contiguous area (ha)	56.3 ± 39.6	3.7	8.3	10.9
Nonagricultural area (ha)	68.1 ± 43.7	1.8	7.6	7.5
Elevation above river (m)	4.4 ± 4.5	8.6	0.2	0.7
Distance to the edge (m)	100 ± 37	2.3	0.8	1.7
Forest length (m)	1153 ± 684	7.8	6.0	15.6
Forest width (m)	225 ± 100	3.8	1.5	3.5
Canopy closure (%)	81.7 ± 17.6	5.4	0.6	2.7
Ground cover (%)	46.2 ± 19.2	0.8	0.8	2.4
Heterogeneity (Roth 1976)				
Canopy	54.4 ± 13.1	1.7	0.2	0.9
Understory	56.1 ± 13.5	1.7	1.1	1.9
Shrub	74.3 ± 13.5	3.4	3.9	5.1
Height (m)				
Canopy	11.1 ± 2.8	1.1	0.6	2.3
Understory	3.7 ± 1.1	0.3	0.1	0.04
Shrub	10 ± 0.2	0.7	0.3	1.4
Basal area (m^2)				
Canopy	0.61 ± 0.31	0.2	1.7	0.03
Understory	0.0044 ± 0.006	0.4	0.7	0.02
Shrub	0.0039 ± 0.0023	0.3	1.7	1.0
Density (stem/m^2)				
Canopy	0.016 ± 0.077	0.1	0.2	0.02
Understory	0.044 ± 0.032	5.1	1.4	1.5
Shrub	0.150 ± 0.110	0.4	3.7	10.2

Vegetation was analyzed in detail for the Brown County sites; analysis of the Kewaunee sites is in progress. Five sample quadrats were evaluated near each Brown County survey point. At each quadrat we recorded data on canopy trees, understory trees (less than two-thirds the height of canopy but at least 2 m tall) and woody shrubs (<2 m tall) by using a modified point-centered quarter method (Cottam and Curtis 1956, James and Shugart 1970). Percentage ground cover and percentage canopy cover were also estimated (Hays et al. 1981). These data, in addition to a review of aerial photos, allowed us to estimate 27 environmental variables (Table 1). We used discriminant analysis to compare these habitat characteristics to the bird census results (Rice et al. 1983).

RESULTS

We found significant numbers of forest interior birds (Whitcomb et al. 1981) even in unexpectedly small riparian remnants. For example, a narrow (<120 m wide) riparian strip in Kewaunee County (not included in Table 2) was occupied by singing Ovenbirds and Black-and-white Warblers, two species considered by Whitcomb et al. (1981) to be sensitive to forest extent. Larger sites in Kewaunee County were inhabited by Winter Wren, Pileated Woodpecker, Veery, Wood Thrush, Brown Creeper, and other forest interior species (Table 2). Width of these riparian areas rarely exceeds 500 m, even though the total area of contiguous forest is greater than 100 ha. Forest birds of Kewaunee County riparian fragments did not precisely reflect bird assemblages in the larger forest tract (Table 2), yet only two species characteristic of lowland forests in Kewaunee County (Red-breasted Nuthatch and Broad-winged Hawk) were absent in the isolated fragments. The Red-shouldered Hawk (*Buteo lineatus*) and several other species probably inhabited many of these areas before settlement but today they are absent even in the 867-ha site. Fewer forest bird species were recorded in the drier riparian forests of Brown County, but several species sensitive to forest extent, such as the Ovenbird, Hairy Woodpecker, and Wood Thrush, were found consistently (Table 2).

A detailed study of remnant riparian forests in Brown County focused on the Ovenbird and the Wood Thrush, two forest interior species from the same foraging guild (ground-feeders). These birds were the species most commonly encountered in Brown County that are widely considered to be sensitive to forest extent. The 38 census points were grouped according to the presence or absence of these two species. Stepwise discriminant analysis identified habitat characteristics that are significantly associated with the presence or absence of either bird.

Percentage forest within 500 m of the census point was most significant in distinguishing sites inhabited by the Ovenbird. This single habitat characteristic provided enough information to classify 76.3% of the points correctly. Discriminant analysis based on presence or absence of the Wood Thrush provided similar results, although in this case the most important discriminating variable was the percentage forest within 250 m. From this variable alone, 72% of the cases could be classified correctly. These results,

Table 2 Forest Interior Birds of Riparian Fragments (<250 ha) and a Larger Forest (867 ha) in Northeastern Wisconsin in 1985

	Percentage occurrence		
	Kewaunee County		Brown County
Species	867 ha (17 points)	100-229 ha (20 points)	<100 ha (38 points)
Ovenbird (*Seiurus aurocapillus*)	88	75	26
Black-capped Chickadee (*Parus atricapillus*)	65	65	36
Hairy Woodpecker (*Picoides villosus*)	53	55	47
Winter Wren (*Troglodytes troglodytes*)	47	50	0
Red-eyed Vireo (*Vireo olivaceus*)	41	10	47
Pileated Woodpecker (*Dryocopus pileatus*)	29	25	0
Red-breasted Nuthatch (*Sitta canadensis*)	29	0	0
Black-and-white Warbler (*Mniotilta varia*)	29	40	0
Veery (*Catharus fuscescens*)	24	30	0
Wood Thrush (*Hylocichla mustelina*)	24	30	42
Scarlet Tanager (*Piranga olivacea*)	24	5	7
Brown Creeper (*Certhia americana*)	18	15	0
Eastern Wood Pewee (*Contopus virens*)	18	15	71
Broad-winged Hawk (*Buteo platypterus*)	12	0	0
White-breasted Nuthatch (*Sitta carolinensis*)	0	20	60

coupled with the species' less frequent occurrence overall, suggest that Ovenbirds are more sensitive than Wood Thrushes to forest fragmentation.

We also performed a discriminant analysis based on the presence/absence of either the Wood Thrush or the Ovenbird. If neither bird was present the point was grouped in the "absent" category and if one or both species were present the point was grouped in the "present" category. Percentage forested area within 250 m of the census point was selected by this analysis as the most important discriminating variable. Other significant variables included shrub density, shrub heterogeneity, average understory height, and forest type (based on varimax factor analysis of tree species importance values). The latter variable differentiates mature forests from stands in earlier stages of succession. The discriminant function with all five variables correctly classifies the samples (those with one or both species versus those with neither species) in 94.7% of the cases.

DISCUSSION

Forest interior birds do indeed exist in riparian forest remnants of these highly modified landscapes. The Ovenbird, Winter Wren, and Pileated Woodpecker bred successfully in Kewaunee County remnants. More intensive studies (in progress) will be needed to determine the status of birds we observed, yet 11 of the 15 forest interior species in Kewaunee County (Table 2) were only slightly less frequent in outlying forest remnants than they were in the larger (867-ha) forest.

The Brown-headed Cowbird (*Molothrus ater*) has been implicated in decreased fledging success of forest interior birds in Wisconsin (Brittingham and Temple 1983). In Kewaunee County, Brown-headed Cowbirds were present in 20% of the smaller sites but were not recorded at all in the 867-ha site. The increased frequency of cowbirds in smaller forests may reduce the breeding success of birds in the smaller remnants.

Robbins (1979) suggested that contiguous forest areas of at least 2650 ha might be necessary to support a population of Ovenbirds and that at least 100 ha are needed for a viable Wood Thrush population. Brown and Kewaunee counties have no forest remnants larger than 2500 ha and few larger than 100 ha, yet, as we have shown, both species (and other sensitive species) are present. Perhaps the extensive forested areas remaining northwest and west of Brown and Kewaunee counties provide a regular source of colonists for populations in our riparian remnants. In other words, the local populations that we have studied might not be self-sustaining. Current studies of the Kewaunee County sites are attempting to resolve this uncertainty.

Another possibility, first implied by Bond (1957), is that moister sites are better able to sustain populations of forest interior birds than are drier upland sites. Whitcomb et al. (1981) observed that forest interior bird species often are more abundant in bottomlands or mesic habitats than they are in drier uplands. Upland sites are more prone to the inevitable drying effects of sun and wind following forest fragmentation. Riparian forest fragments, on the other hand, have a source of moisture and often sheltered slopes to counteract these effects. Thus, riparian remnants might better retain the mesic nature of original forests. Forest interior birds species may, therefore, persist in smaller tracts if the tracts are riparian.

Isolation may be another important element contributing to the decline of habitat-island populations (Whitcomb et al. 1981, Lynch and Whigham 1984). Because riparian forests tend to form corridors that promote movement between local populations, they may be important in maintaining genetic or demographic integrity of regional populations (Noss and Harris 1986). The "interconnectedness" of riparian forests in our study areas, despite relatively small forest sizes and high proportions of edge habitat, may be another explanation for the presence of species sensitive to forest extent.

Results from our investigations illustrate the complexity of the relationships between habitat extent, habitat quality, and bird distributions. Many species, like Ovenbirds, occur in a variety of forest habitats, yet their abundance varies locally. Ovenbirds and several other species seem to be more successful in the moister forests of Kewaunee County, for example, than they are in riparian forests of Brown County (Table 2). The opposite seems to be true for the Wood Thrush, Eastern Wood Pewee, and Red-eyed Vireo. Small areas of highly favorable habitat might be equivalent to larger areas of less favorable habitat. We suggest that riparian or lowland forests are indeed highly favorable for certain forest interior bird species. Hence, these birds might be able to persist in riparian areas that are smaller than their minimum habitable areas in upland forest types.

Changes in forest size may affect the quality of forest vegetation. Red-breasted Nuthatches are fairly common in the large (867-ha) lowland forest of Kewaunee County, yet they are replaced by White-breasted Nuthatches in smaller, more isolated tracts of otherwise similar habitat (Table 2). Red-breasted Nuthatches in northeastern Wisconsin typically occur in shady coniferous forests, whereas White-breasted Nuthatches seem to favor deciduous forests, which for much of the year are considerably more open than coniferous woods. In other words, fragmentation of lowland coniferous forests may create a relatively open forest environment, more suitable for species like the White-breasted Nuthatch. Perhaps other, more subtle interactions between habitat quality and habitat size will be revealed as more types of "habitat islands" are evaluated.

The fact that significant numbers of forest interior specialists still occur in riparian forest remnants of our study area suggests that it is not too late to preserve at least a part of the original forest interior avifauna in this region. Riparian forests, because of their relatively high levels of available moisture and perhaps because of their interconnectedness, might play a crucial role in preservation efforts. The preservation of maximum bird species diversity in these two counties and many like them requires protection of the regional variation in forest habitats. Riparian forests provide a significant system of these forest refugia and thus are vital to regional bird species diversity.

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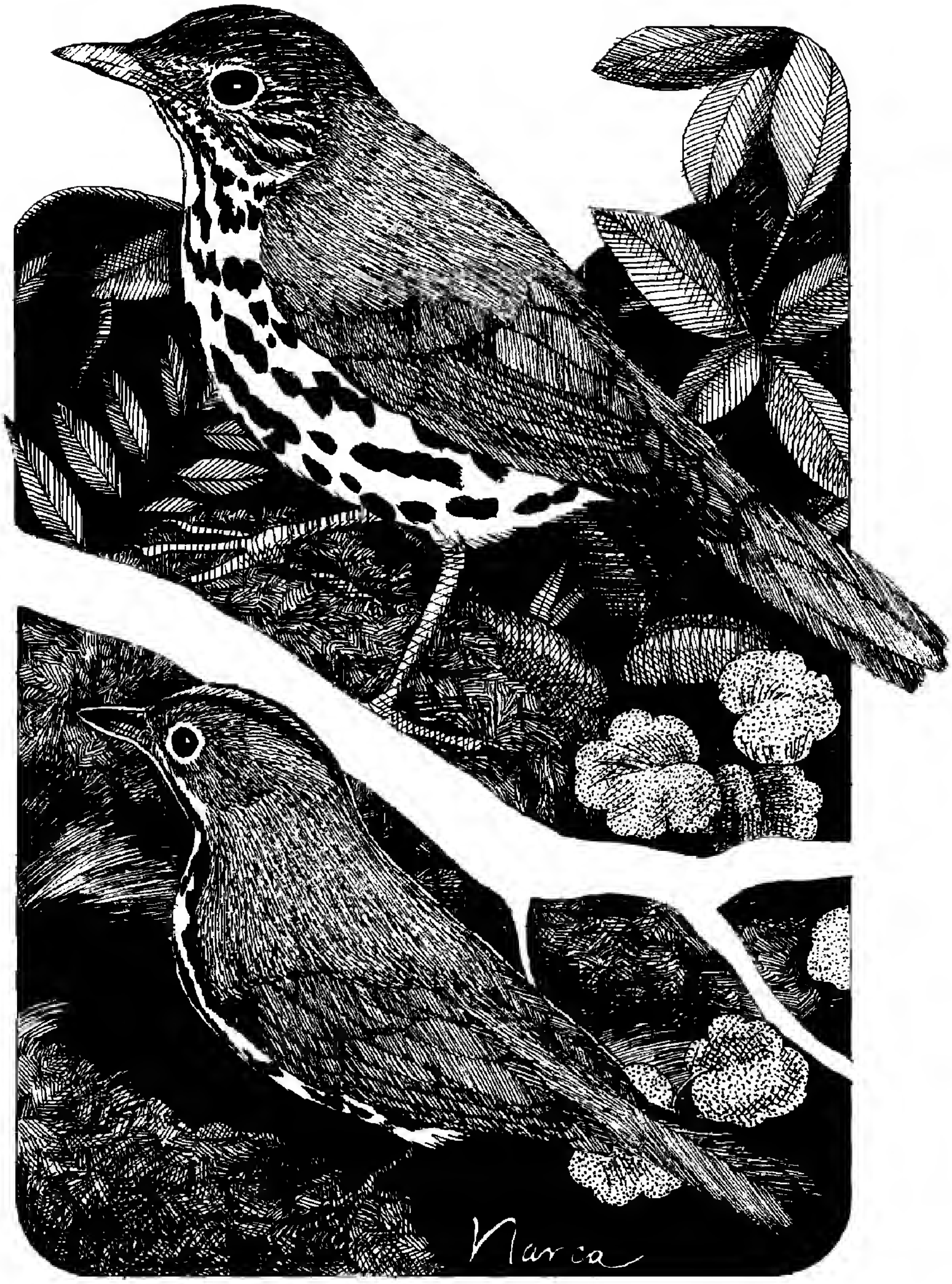

Ovenbird and Wood Thrush *Sketch by Narca Moore-Craig*

THE CALIFORNIA NATURAL DIVERSITY DATA BASE AND RIPARIAN ECOSYSTEM CONSERVATION

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The California Natural Diversity Data Base (Data Base) is an ongoing project of the Department of Fish and Game's Nongame-Heritage Program. This paper presents background information on the Data Base, briefly describes the types of riparian-associated data collected and computerized in it, and explains the importance and usefulness of the Data Base for riparian ecosystem conservation.

THE NATURAL DIVERSITY DATA BASE IN A NUTSHELL

California is well known for the diversity of its natural resources and for the rapid pace at which its lands have been developed. Because of this unhesitating and extensive land development, many species of plants, animals, and some natural communities are threatened with extinction. Others, though not currently endangered, are rare and unique to California. The California Department of Fish and Game recognizes the need to identify these special species and natural communities and to develop plans for their conservation and management. To this end, the Department, in cooperation with The Nature Conservancy, established the California Natural Diversity Data Base. The Data Base was patterned after heritage inventories developed by The Nature Conservancy in the eastern United States. Currently, there are more than forty similar state and several similar international inventories.

The Data Base is an ongoing computerized inventory of the locations and condition of endangered, threatened, and rare animal and plant taxa, as well as of terrestrial and aquatic natural communities. The Data Base staff continually expands, updates, and analyzes the Data Base in order to keep the inventory current and to identify research and conservation needs for a particular site or taxon. The animals and plants included are (1) those on or proposed for governmental lists of endangered or threatened taxa, (2) taxa that are sensitive, fully protected, or of special concern, (3) taxa that are biologically rare, very restricted in distribution, declining throughout their range, or are peripheral to California, and (4) taxa closely associated with ecosystems that are declining in California at an alarming rate (e.g., wetlands, desert aquatic systems, native grasslands, and riparian ecosystems). Current lists of the plants, animals and natural communities inventoried by the Data Base are available on request to the Nongame-Heritage Program, California Department of Fish and Game.

Members of the Data Base science staff (zoologists, botanists, and vegetation ecologists) rarely do original field work. Instead, they rely on data gathered by others and made available to the Data Base. The staff encourages professional, student, and lay biologists to contribute data to the project by submitting field survey forms (available from the Data Base), theses, status reports, articles, and environmental documents, or by communicating personally with the staff.

Currently, Data Base scientists collect information on about 50 riparian-associated animals and plants. Many are riparian obligates such as the Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) or Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*). Others, such as salmonid fishes, require microhabitats that are influenced by the quality of riparian vegetation. Surprisingly, less than one dozen rare plants are associated with riparian ecosystems in California. One example is the California Hibiscus (*Hibiscus californicus*), which grows on moist, freshwater-soaked banks along the lower Sacramento and San Joaquin rivers.

About three dozen riparian plant communities have been described in California. A draft riparian classification groups the communities into three broad types. These are riparian forests, such as the gallery forests along the lower Sacramento River, riparian woodlands, such as the sycamore alluvial woodland along Los Banos Creek in Merced County, and scrub communities, such as the southern riparian scrub along the Santa Margarita River. The riparian communities of the Sacramento and San Joaquin valleys and along the lower Colorado River are the best documented and inventoried by the Data Base at the present time. The riparian vegetation of southern California and the California deserts will be the next areas of research and data acquisition by Data Base vegetation ecologists.

THE IMPORTANCE AND USEFULNESS OF THE DATA BASE

The Data Base is unique and important for several reasons. It is a computerized synthesis of information from many unrelated sources, such as museum or herbarium collections, status reports, field surveys, environmental documents, published articles, and personal communications with researchers. Nowhere else in California is data-gathering and synthesis on sensitive species being done on a statewide scale. The information in the Data Base is provided, on a cost-reimbursement basis, to a large number of interested parties in a variety of formats, principally map overlays and computer reports. An average of 51 requests for data was filled each month during the first 6 months of 1987.

The Data Base is not simply a static, computerized inventory of data on sensitive species; it is an extremetly useful conservation tool. The Data Base is used to select the best sites for land-based conservation projects such as the setting aside of ecological reserves or other natural areas. It is also used in the environmental review of land management plans and development projects. In addition, it is used to provide a statewide perspective on the distribution patterns and population trends of sensitive taxa, and to pinpoint gaps in our knowledge of these taxa and natural communities.

THE DATA BASE AND RIPARIAN ECOSYSTEM CONSERVATION

The Department of Fish and Game's Lands and Natural Areas Project and The Nature Conservancy use the Data Base as a foundation for their conservation efforts in California. For example, much of the best remaining riparian habitat in the Central Valley of California is privately owned. If purchasing a piece of property is not desirable or financially feasible, the site could be a candidate for The Nature Conservancy's Landowner Contact Program. The Nature Conservancy may be able to educate a property owner and help the owner protect or enhance land supporting riparian forest and associated wildlife. On the other hand, many of the most diverse desert riparian areas in California are wholly or partially under the jurisdiction of the U.S. Bureau of Land Management (BLM). A new interagency committee composed of state, federal, and private agencies, the Interagency Natural Areas Coordinating Committee, has been organized by the Department of Fish and Game's Land and Natural Areas Project. The purpose of the committee is to coordinate the protection of natural areas throughout the state. As a member of the committee, the BLM can use the Data Base to help establish a priority for its riparian ecosystem conservation projects.

In the enviromental review process, the Data Base is used extensively in both the project development and document review stages. Recently, the Sacramento District of the U.S. Army Corps of Engineers requested detailed reports and map overlays showing where sensitive species and riparian communities are known to occur in the entire district. The Corps intends to use these data to evaluate the impacts of its bank stabilization projects. The Environmental Services staff of the Department of Fish and Game also has these data. The Department also uses the Data Base to fulfill its trust agency responsibilites under the California Environmental Quality Act, through review of the Corps' environmental documents for projects. The Department urges the Corps and other developers to address, assess, and mitigate adequately the impacts that their projects have on wildlife and natural diversity.

Occasionally the Department of Fish and Game uses the Data Base to fulfill its mandates under special legislation. Recently, Chapter 885 of Senate Bill 1086 appropriated $150,000 for the Wildlife Conservation Board to survey critical wildlife habitat and natural areas along the upper Sacramento River between the mouth of the Feather River and Keswick Dam near Redding. The Data Base will be one of several sources of information used by the Department to identify these important areas and rank them for possible acquisition.

These are just a few examples of how the Data Base is used as a conservation and management tool for riparian ecosystems. As human development puts more and more pressure on California's remaining natural areas, there will be an even greater need for a central, computerized, up-to-date inventory of the state's natural diversity.

FUTURE PLANS FOR THE DATA BASE

The Data Base currently has over 16,000 records—with more being added every day—and the demand for information is increasing rapidly. In the first 6 months of 1987, requests for data increased 41% over the same period in 1986. In order to accommodate more data and fulfill user needs, the Data Base will be converted to a Geographic Information System (GIS) during 1988 and 1989. The new GIS will make data input, storage, retrieval, and analysis much easier, more reliable, and much more flexible. The Data Base will become a more versatile and powerful conservation tool, better suited to serve those people working to protect and manage California's remaining sensitive riparian ecosystems.

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ENDANGERED HABITATS VERSUS ENDANGERED SPECIES: A MANAGEMENT CHALLENEGE

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Riparian ecosystems are the most productive and possibly the most sensitive of the various bird habitats in the arid and semiarid North American Southwest. The highest population densities of noncolonial nesting birds for North America were reported from riparian cottonwood (*Populus fremontii*) forests in central Arizona by Johnson (1971) and Carothers at al. (1974). Most avian studies in southwestern riparian ecosystems have been conducted along perennial and intermittent streams where both species richness (Hubbard 1970) and population densities are extremely high (Johnson et al. 1977, Johnson 1979). Factors contributing to this high avian species richness and density have not been well studied but apparently include (1) high temperatures and soil moisture availability, which contibute to high primary productivity, high insect biomass, and, consequently, many insectivorous birds (Carothers et al. 1974), (2) a diversity of vegetation resulting from well-developed herbs, shrubs, and trees and leading to a large number of foraging layers and available nest sites, and (3) ready access to water during the nesting season. Management schemes, species recovery plans, etc., that concentrate on the conservation of individual species without also emphasizing conservation of the associated critical habitat and ecological processes are inadequate.

METHODS

In 1977 we analyzed the nesting birds of the Southwest lowlands in relation to their use of riparianlands as breeding habitat (Johnson et al. 1977). That analysis included several tropical species that occur in the United States only in the lower Rio Grande Valley of southwestern Texas. Here we have excluded riparian breeding species of the Tamaulipan thorn scrub in the lower Rio Grande Valley (Brown et al. 1979) because that region's biological affinities differ appreciably from those of the desert scrub and desert grasslands of the North American Southwest lowlands. Additionally, we have divided our 1977 "nonriparian" category into "facultative riparian" and "nonriparian" since some species show no nesting preference for either riparian or upland ecosystems while others actually select nonriparian breeding sites (Table 1). Although only three species have been extirpated, 69% of the 161 nesting species of the arid lowlands of the Southwest have apparently suffered population reductions due to loss of riparian and associated aquatic habitats. For nesting birds as for humans, the more arid the region, the more valuable water and its attendant habitats.

This new analysis is based on our combined 84 years of collecting field data in the Southwest and data from literature (Table 1). Papers currently in the literature have dealt almost entirely with hydroriparian (accompaning perennial water) and mesoriparian habitats (associated with intermittent streams), thus limiting our analysis to those (wet) riparian types. The importance of xeroriparian (dry riparian) habitats is addressed elsewhere (Johnson and Haight 1985 and in press).

RESULTS

Although numerous papers have demonstrated the importance of riparian habitats to nesting birds in the Southwest, the reasons for high riparian productivity and species richness are not well understood. Available soil moisture is presumably the key factor. To this, add temperature, since higher temperatures result in greater physiochemical activity such as respiration, photosynthesis, and evapotranspiration (van Hylckama 1980). This combination apparently results in higher primary productivity and hence a high avian biomass. Although no studies have tested this hypothesis directly, numerous studies have documented that populations of birds in the higher, colder areas of the western United States (Beidleman 1978) are generally lower than those in the southwestern lowlands (Carothers et al. 1974). Additionally, according to at least one study, "the most diverse avifauna occurs in riparian zones at lower elevations" (Knopf 1985) where foraging niches for insectivores should be expected to be more numerous because of the greater variety of insects.

Categories of Riparian Dependency

Riparian-nesting species can be divided into several categories based on their dependence on riparian habitats.

Riparian and Other Wetlands: Species that nest either along a river's or lake's edge or in the aquatic habitats of the river or lake itself.

Obligate Riparian: Species that nest almost exclusively in riparian habitats.

Preferential Riparian: Species that nest in numbers in both upland and riparian habitats but whose population densities are greater in riparian habitats.

Facultative Riparian: Species that nest indiscriminately in either riparian or nonriparian habitats; often nesting in desert trees or subtrees, e.g., mesquites and paloverdes, regardless of whether these plants are in a wet riparian, dry riparian, or upland site. Others, such as the Canyon Wren, select canyon walls or other factors that may or may not be associated with a stream.

Nonriparian: Species that select dry habitats, especially grasslands, that are different structurally from most riparian habitats.

Habitat Selection and Distributional Categories

Since birds have long been the subject of behavioral and other studies because of their colorful and, for the most part, diurnal activity, their life histories are better known than those of most other animal groups. Some avian species exhibit relatively consistent patterns of habitat and nesting-site selection from one geographic region to another or from one habitat type to another. Other species vary greatly in some aspect of their natural history from one locality to another. In studies in saltcedar (*Tamarix chinensis*) along three lowland rivers of the Southwest (the Colorado, Rio Grande, and Pecos) Hunter et al. (1985) found certain species of birds acting differently along each river. Factors determining such behavioral differences often go undetected by even the most knowledgeable riparian ecologist, making the categorizing of species difficult.

In establishing riparian dependence (Table 1) the following groupings of southwestern riparian nesting species were considered:

1. Peripheral species: Those at the periphery of their ranges, usually the northern limit, with the bulk of their population in Mexico (e.g., Common Black Hawk, Gray Hawk, and Ferruginous Pygmy-Owl). The major rivers of northwestern Mexico, as well as those of the southwestern United States, have been dammed and diverted for agricultural and urban use, so a large percentage of riparian habitats, and thus the avifauna of the entire North American Southwest, have been greatly affected.

2. Species whose highland as well as lowland populations are riparian (e.g., Bald Eagle, Yellow Warbler, and Blue Grosbeak).

3. Species which, because of their affinity for more mesic vegetation such as deciduous trees, are riparian only at lower elevations (e.g., Cooper's Hawk, Cassin's and Western kingbirds, and White-breasted Nuthatch) and become facultatively riparian or even nonriparian at higher elevations.

4. Species that prefer riparian habitats but adapt to indigenous nonriparian habitats such as saguaros, the only trees in much of the desert Southwest uplands (e.g., Harris' Hawk, Gila Woodpecker, and Screech Owl) and species that adapt to agricultural and/or urban landscapes (e.g., Screech Owl, Black-chinned Hummingbird, and Western Kingbird).

5. Riparian specialists which do not adapt to nonriparian habitats, either natural or man-made (e.g., Yellow-billed Cuckoo, Lucy's Warbler, and Summer Tanager).

6. Site-specific species, such as those showing different preferences between Phoenix and Tucson, Arizona, cities separated by only 100 miles of Lower Sonoran Desert. Ladder-backed Woodpeckers have adapted to urban trees in Tucson but are still restricted to riparian habitats in the Phoenix area. Abert's and Brown towhees have "reversed roles" in Tucson and Phoenix: the Brown Towhee is a common bird around Tucson foothill residences, while the Abert's Towhee occurs only in remote, densely vegetated riparian areas. Conversely, in Phoenix the Abert's Towhee nests commonly in suburban yards, while the Brown Towhee's sparse populations are confined to the arid foothills.

MANAGEMENT IMPLICATIONS

Variation in habitat selection and other aspects of avian behavior should affect the management strategies for different riparian areas. Birds of the same species, occupying the same habitat type along two different segments of the same river or along two lowland rivers in the same geographic region, often exhibit different behavior. Thus, although some generalities can be applied, the manager must be aware of the dangers involved in extrapolating from

Table 1 Breeding Bird Dependence for Lowland Wet Riparian Habitats of the Warm Deserts and Grasslands in the Southwestern United States[a]

Obligate riparian and other wetlands (31 spp. = 19%)	Obligate (47 sp. = 29%)	Preferential (33 spp. = 21%)	Facultative (12 spp. = 7%)
Pied-billed Grebe	Double-crested Cormorant	Harris' Hawk	Red-tailed Hawk
Western Grebe	Great Blue Heron	American Kestrel	Great Horned Owl
Clark's Grebe	Green-backed Heron	Peregrine Falcon	Long-eared Owl
American Bittern	Black-bellied Whistling-Duck	Gambel's Quail	Buff-collared Nightjar
Least Bittern	Common Merganser	Killdeer	Costa's Hummingbird
Great Egret	Mississippi Kite	White-winged Dove	Common (Gilded) Flicker
Snowy Egret	Bald Eagle	Mourning Dove	Common Raven
Black-crowned Night Heron	Cooper's Hawk	Common Ground Dove	Canyon Wren
Mallard	Common Black-Hawk	Greater Roadrunner	Loggerhead Shrike
Northern Pintail	Gray Hawk	Common Barn Owl	Varied Bunting
Blue-winged Teal	Zone-tailed Hawk	Western Screech-Owl	Botteri's Sparrow
Cinnamon Teal	Spotted Sandpipier	Ferruginous Pygmy-Owl	Rufous-winged Sparrow
Gadwall	Yellow-billed Cuckoo	Elf Owl	
Redhead	Broad-billed Hummingbird	Black-chinned Hummingbird	
Ruddy Duck	Violet-crowned Hummingbird	Anna's Hummingbird	**Nonriparian (32 spp. = 20%)**
Osprey[b]	Belted Kingfisher[b]	Gila Woodpecker	
Black Rail	Golden-fronted Woodpecker	Ladder-backed Woodpecker	Turkey Vulture
Clapper Rail	Northern(Red-shafted) Flicker	Ash-throated Flycatcher	Swainson's Hawk
Virginia Rail	Northern Beardless-Tyrannulet	Brown-crested Flycatcher	Ferruginous Hawk
Sora	Western Wood Pewee	Northern Rough-winged Swallow	Golden Eagle
Common Moorhen	Willow Flycatcher	Verdin	Crested Caracara
American Coot	Black Phoebe	Black-tailed Gnatcatcher	Aplomado Falcon[b]
Snowy Plover	Vermilion Flycatcher	Northern Mockingbird	Prairie Falcon
Black-necked Stilt	Tropical Kingbird	Curve-billed Thrasher	Masked Northern Bobwhite
American Avocet	Cassin's Kingbird	Crissal Thrasher	Scaled Quail

Table 1 (Continued)

Obligate riparian and other wetlands (31 spp. = 19%)	Obligate (47 spp. = 29%)	Preferential (33 spp. = 21%)	Nonriparian (32 spp. = 20%)
Marsh Wren	Thick-billed Kingbird	Phainopepla	Burrowing Owl
Common Yellowthroat	Western Kingbird	European Starling	Lesser Nighthawk
Yellow-breasted Chat	Rose-throated Becard	Bell's Vireo	Common Poor-will
Song Sparrow	Bank Swallow	Lucy's Warbler	White-throated Swift
Red-winged Blackbird	Cliff Swallow	Northern Cardinal	Lucifer Hummingbird
Yellow headed Blackbird	Bridled Titmouse	Pyrrhuloxia	Say's Phoebe
	White-breasted Nuthatch	Brown-headed Cowbird	Horned Lark
	Bewick's Wren	House Finch	Purple Martin
	Blue-gray Gnatcatcher		Chihuahuan Raven
	American Robin		Cactus Wren
	Yellow Warbler		Rock Wren
	Summer Tanager		Bendire's Thrasher
	Blue Grosbeak		LeConte's Thrasher
	Lazuli Bunting		Brown Towhee
	Indigo Bunting	Suburban and	Cassin's Sparrow
	Painted Bunting	Agricultural (6 spp. = 4%)	Rufous-crowned Sparrow
	Abert's Towhee		Lark Sparrow
	Bronzed Cowbird	Black Vulture	Black-throated Sparrow
	Hooded Oriole	Rock Dove	Five-striped Sparrow
	Northern Oriole	Inca Dove	Grasshopper Sparrow
	Lesser Goldfinch	Barn Swallow	Eastern Meadowlark
	Lawrence's Goldfinch	Great-tailed Grackle	Western Meadowlark
		House Sparrow	Scott's Oriole

[a]Excludes accidental nesters. Modified from Johnson et al. 1977.
[b]Extirpated as a nesting species in the Southwest lowlands.

one riparian management area to another even if conditions in the two areas are similar. One such example pertains to Brown-headed Cowbird control, designed to prevent extirpation of the Least Bell's Vireo (*Vireo bellii pusillus*) in California (discussed by several papers in this volume). By contrast, our studies during the past 35 years in the heavily dammed Salt-Verde River system of central Arizona show that habitat loss, not cowbirds, is the major problem for the Arizona Bell's Vireo (*V. b. arizonae*).

Research Needs for Management of Riparian Birds

Although a sizable body of knowledge is now available, additional scientific information needs to be gathered before effective riparian management techniques can be instituted. One of the earlier lists of research needs (Carothers and Johnson 1975) is still largely appropriate. We here repeat some of those continuing needs, along with additional needs that are particularly important for "sensitive species," i.e., endangered, threatened, and rare species.

1. Establish "endangered habitat recovery plans," not just endangered species recovery plans. For example, a "San Pedro River Recovery Plan" would address the problems of numerous species instead of those of a single species, as in the "Least Bell's Vireo Recovery Plan."

2. Determine the minimal area and configuration of a particular habitat type necessary to maintain healthy populations of all avian species. These needs differ greatly between species. Lucy's Warbler maintains territories of 30 meters square in optimum mesquite habitat, and Yellow Warblers maintain populations in a narrow fringe of willow-tamarisk along the water's edge. Bald Eagles and Common Black Hawks may need territories of tens of hectares in a configuration that is at least 100 meters or more wide and hundreds of meters long. Size of the bird is not always a good clue. The 60-gram Yellow-billed Cuckoo uses territories, even in optimum cottonwood-willow habitat, of up to 20 hectares or more (S.A. Laymon, pers. comm.).

3. Determine the maximum distance separating "islands" of a given habitat type before the loss of certain species (especially migrants) occurs.

4. Determine both minimal and optimal requirements for each species within a given habitat type for factors such as ground cover, canopy, number of trees or shrubs per unit area, and foliage volume, density, and configuration. Knowledge of these requirements is particularly important for sensitive species.

5. Examine the interrelationships between recreation and riparian birds. With increasing urbanization, "nonconsumptive uses" of riparian resources, such as birdwatching, camping, and picnicking, have grown more rapidly than "consumptive uses," such as hunting, fishing, and logging. Research in this important area has not kept pace with recreational demands. Questions about the compatibility of various recreational activities, such as off-road vehicular usage, with a given avian species remain unanswered.

In addition to these research needs, better methods must be established for applying the information already available. Resource management agencies need "clearing houses" so they can coordinate existing information, identify areas where their policies are weak, and establish sound, uniform guidelines for riparian management. Resource management agencies need to establish a sound riparian management policy. If further elimination of critical riparian resources is to be prevented, scientists, managers, and conservationists must work more closely together to collect new information and to apply better what is already known.

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Send manuscripts to Philip Unitt, 3411 Felton Street, San Diego, CA 92104. For matter of style consult the *Suggestions to Contributors to Western Birds* (8 pages available at no cost from the editor) and the *Council of Biology Editors Style Manual* (available for $24 from the Council of Biology Editors, Inc., 9650 Rockville Pike, Bethesda, MD 20814.

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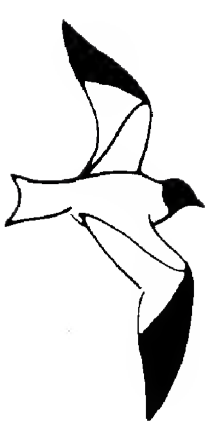
Volume 18, Number 1, 1987

Cover photo by James M. Greaves, Santa Barbara, California: Least Bell's Vireo (*Vireo bellii pusillus*) at nest site, Gibraltar Reservoir, near Santa Ynez River, Santa Barbara County, California, May 1980.



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WESTERN BIRDS

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COLORADO FIELD ORNITHOLOGISTS' RECORDS COMMITTEE REPORT FOR 1978-1985

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The last Colorado Field Ornithologists (CFO) Records Committee report in *Western Birds* is for 1976-1977 (Andrews 1979). The time elapsed since the last report precludes discussion of all records handled by the Records Committee (RC) in this period, so this report covers only first, second, and third state records and new or very unusual definite breeding records for Colorado from 1978 through 1985. The full reports of the RC for this period can be found in Chase (1981, 1982, 1983) and Gent (1984; 1985a,b; 1986). This report discusses 21 additions to and 8 deletions from the CFO state list, resulting in a net gain of 13 species from the 427 mentioned by Andrews (1979). Thus, the CFO state list for Colorado currently stands at 440 species, 5 of which are introduced. Andrews (1980) summarized the state list in 1980, and the present list is summarized by Gent (1987).

The RC has had three chairmen during the period covered by this report: Robert Andrews 1978-1980, Charles Chase 1980-1983, and Peter Gent 1983-1985. The members of the committee during this period were Winston William Brockner, Richard Bunn, Daniel Casey, Kevin Cook, David Griffiths, Edward Hollowed, Mark Holmgren, Harold Holt, Mark Janos, Ron Lambeth, Steve Larson, Tim Manolis, Peter Moulton, Ronald Ryder, James Sedgewick, and Richard Stransky.

The following list is of those species seen in Colorado fewer than 10 times. The RC desires reports if these species, or any unrecorded from the state, are seen or heard in Colorado. The RC also desires reports of new breeding records in the state, species significantly changing their breeding range in the state, and very unusual occurrences of other species. Reports should be sent to Chairman CFO Records Committee, c/o Dept. of Zoological Collections, Denver Museum of Natural History, City Park, Denver, Colorado 80205. A CFO checklist of Colorado birds is available from the above address or the author upon request. Please send reports of Red-throated and Yellow-billed loons, Brown Pelican, Olivaceous Cormorant, Anhinga, Magnificent Frigatebird, Reddish Egret, White Ibis, Roseate Spoonbill, Wood Stork, Black-bellied Whistling-Duck, Trumpeter Swan, Brant, Harlequin Duck, American Swallow-tailed Kite, Common Black-Hawk, Gyrfalcon, Yellow, Black, and King rails, Purple Gallinule, Common Moorhen, Eskimo Curlew, Sharp-tailed Sandpiper, Ruff, Long-tailed Jaeger, Little, Mew, Lesser Black-backed, Glaucous-winged, Great Black-backed, Ross', and Ivory gulls, Arctic Tern, Marbled and Ancient murrelets, Groove-billed Ani, Barred Owl, Lesser Nighthawk, Whip-poor-will, Blue-throated and Anna's hummingbirds, Black Phoebe, Dusky-capped Flycatcher, Long-billed and Bendire's thrashers, Phainopepla, White-eyed Vireo, Lucy's, Hermit, Prairie, Cerulean and Swainson's warblers, Louisiana Waterthrush, Connecticut and Mourning warblers, Painted Redstart, Hepatic Tanager, Henslow's, LeConte's, and Sharp-tailed sparrows, and Brambling.

In the following sections, reports are identified by a three-part number (*A-B-C*). *A* is a code number from 1 to 56 for the bird family (numbers have not been altered despite the recent changes in the AOU taxonomic order), *B* is the year of the report, and *C* is the sequence number in which the report was received during the year.

PART 1. ADDITIONS AND DELETIONS DUE TO AOU TAXONOMIC CHANGES

ARCTIC LOON (*Gavia arctica*). Deleted from the state list by decision of AOU (1985). No Colorado records are known to pertain to this species.

PACIFIC LOON (*Gavia pacifica*). Added by decision of AOU (1985). The Pacific Loon is an uncommon fall migrant in Colorado.

CLARK'S GREBE (*Aechmophorus clarkii*). Added by decision of AOU (1985). Clark's Grebe is an uncommon breeder mainly in the southern part of the state, whereas the Western Grebe (*A. occidentalis*) is a common breeder throughout the state.

WESTERN SCREECH-OWL (*Otus kennicottii*). Added by decision of AOU (1983). The Western Screech-Owl is a fairly common breeder throughout the state except in the eastern and northeastern plains. Here the Eastern Screech-Owl (*O. asio*) is an uncommon breeder.

RED-NAPED SAPSUCKER (*Sphyrapicus nuchalis*). Added by decision of AOU (1985). The Red-naped Sapsucker is a common breeder in the mountains of Colorado. The Yellow-bellied Sapsucker (*S. varius*) is an uncommon migrant throughout the eastern plains and is not known to have bred, nor is it expected to breed, in the state.

GRAY-HEADED JUNCO (*Junco caniceps*). Deleted by decision of AOU (1983). The Dark-eyed Junco (*J. hyemalis*) is a common resident and breeder in the mountains of Colorado.

ROSY FINCH (*Leucosticte arctoa*). Added by decision of AOU (1983). The Rosy Finch is a common resident and breeder in the mountains of Colorado.

GRAY-CROWNED ROSY-FINCH (*Leucosticte tephrocotis*). Deleted by decision of AOU (1983).

BLACK ROSY-FINCH (*Leucosticte atrata*). Deleted by decision of AOU (1983).

BROWN-CAPPED ROSY-FINCH (*Leucosticte australis*). Deleted by decision of AOU (1983).

PART 2. SPECIES DELETED FROM THE STATE LIST

GLOSSY IBIS (*Plegadis falcinellus*). The only reported specimen of this species for Colorado, collected in El Paso Co. on 22 May 1916, is in the Denver Museum of Natural History (DMNH 39079). The specimen was examined by Mark Holmgren and Joe Strauch and found to be a White-faced Ibis (*P. chihi*).

COMMON EIDER (*Somateria mollissima*). The single sight report from Marston Reservoir, Jefferson Co., on 25 Feb 1932 contains no details. The RC thought that this report does not justify the inclusion of Common Eider on the state list.

SMITH'S LONGSPUR (*Calcarius pictus*). The reason for removing this species is that the main field mark used to identify it in submitted reports has been the white shoulder patches. This field mark does not eliminate Chestnut-collared Longspur (*C. ornatus*) in fall, and most reports are for September.

PART 3. ACCEPTED FIRST, SECOND AND THIRD STATE RECORDS

YELLOW-BILLED LOON (*Gavia adamsii*). One male collected in Jan 1944 at Sterling, Logan Co., by K.C. Morse and now in the Denver Museum of Natural History (DMNH 23974). The specimen was identified by Allan R. Phillips. One (1-82-2) observed on the Denver Christmas Bird Count, 19 Dec 1981, at Chatfield State Recreation Area, Jefferson Co. (Robert Andrews, Mark Holmgren, and Jack Reddall). One (1-83-1) seen at the same location on the same event the following year, 18 Dec 1982 (Mark Holmgren and Don Johnson; photo on file). First, second,and third records.

OLIVACEOUS CORMORANT (*Phalacrocorax olivaceus*). One (4-78-42) at Barr Lake State Park, Adams Co., on 15 Jun 1978 (Robert Andrews). One adult (4-81-25) at Red Lion State Wildlife Area, Logan Co., on 29 Jun 1981 (Peter Gent). Second and third records. This species is being observed in Colorado with increasing frequency and there is a recent first report from western Colorado near Delta (4-85-52, Mark Janos).

MAGNIFICENT FRIGATEBIRD (*Fregata magnificens*). One adult female (N-85-35) seen in southwest Denver on 14 Sep 1985 and killed at Green Mountain Reservoir, near Kremmling, Summit Co., 2 days later (Hans Feddern and Betsy Webb; see also Webb 1985). This bird is now in the Denver Museum of Natural History (DMNH 39020), and was killed because of its persistent attacks on a windsurfer! First state record, although there are records from all states surrounding Colorado except Utah and Wyoming.

WHITE IBIS (*Eudocimus albus*). One immature (7-85-15) seen at Nee Noshe Reservoir, Kiowa Co., from 20 Jul through Aug 1985 (Dan Bridges and Peter Gent; see also Bridges 1985). This bird associated with White-faced Ibises (*Plegadis chihi*). First state record, although again there are records from all states surrounding Colorado except Utah.

BLACK-BELLIED WHISTLING-DUCK (*Dendrocygna autumnalis*). One adult (8-80-84) at Chatfield State Recreation Area, Jefferson Co., on 21 Sep 1980 (Robert Andrews and Mike Fitzpatrick). First state record. The CFO RC decided to add this species to the state list once the possibility that the bird had escaped from known local waterfowl collections had been eliminated. The RC decided to accept species that are known to wander even when the possibility of an individual being an escapee cannot be totally eliminated. This policy differs from that of the California RC, which prefers to wait until a clear pattern of vagrancy is established; see Binford (1985).

TRUMPETER SWAN (*Cygnus buccinator*). Seven adults and one immature (8-78-19) between early Dec 1977 and 12 Feb 1978 at Lake DeWeese, Custer Co. (Robert Andrews, Dave Griffiths, Peter Moulton, and Bruce Webb). Third state record. There are several more recent records including one from Mack, Mesa Co., of a bird banded at Red Rock Lakes NWR, Lakeview, Montana (8-84-50, Van Graham).

COMMON BLACK-HAWK (*Buteogallus anthracinus*). One adult (10-80-83) observed 20 and 21 Jun 1980 at Chatfield State Recreation Area, Jefferson Co. (Robert Andrews and Cate Kittleman). First state record.

BLACK RAIL (*Laterallus jamaicensis*). One (17-76-59) tape-recorded at Fort Lyon, Bent Co., on 11, 18, and 25 Jun 1975 (John Griese). One (17-82-11) briefly seen on 30 Apr 1982 at Fort Collins, Larimer Co. (David Palmer). First and second records. The RC decided to accept diagnostic sound recordings as documenting first state records.

KING RAIL (*Rallus elegans*). One adult (17-85-12) from 12 May to 2 Jun 1985 at Lower Latham Reservoir, Weld Co. (Jerry Cairo and Peter Gent; see also Cairo 1985). Second state record.

PURPLE GALLINULE (*Porphyrula martinica*). One adult (17-78-55) observed near Durango, La Plata Co., on 6 and 7 Aug 1978 (Elva Fox and Howard Winkler; photos on file). First state record. This species is known to wander far from its usual range, although again the possibility of an escapee cannot be totally eliminated; see the discussion under Black-bellied Whistling-Duck above.

LITTLE GULL (*Larus minutus*). One subadult (23-80-68) at Barr Lake, Adams Co., on 13 Sep 1980 (Robert Andrews and Peter Moulton). Third state record.

MEW GULL (*Larus canus*). One (23-80-17) in first winter plumage observed on 7 Mar 1980 at Sloans Lake, Denver Co. (Robert Andrews, Charles Chase, Mark Holmgren, and Robert Rozinski; Figure 1; photos on file). One adult (23-81-7) on 28 Apr 1981 at Union Reservoir, Longmont, Weld Co. (Timms Fowler, Mark Holmgren, and Mike Middleton). One adult (23-82-71) again at Sloans Lake, Denver Co., on 22 Mar 1982 (B.J. Rose; Figure 2; photo on file). First, second, and third records.

GLAUCOUS-WINGED GULL (*Larus glaucescens*). One first-summer bird (23-82-72) at Antero Reservoir, Park Co., on 24 and 25 Jul 1981 (Charles Chase and Peter Gent; photos on file). First state record.

GREAT BLACK-BACKED GULL (*Larus marinus*). One immature (23-80-14) at Centennial Park, Arapahoe Co., from 1 to 30 Jan 1980 (Tim Manolis and Bruce Webb; Figures 3 and 4; photos on file). First state record.

ROSS' GULL (*Rhodostethia rosea*). One immature (23-83-32) observed between 28 Apr and 7 May 1983 on Jumbo Reservoir, Sedgwick Co. (Robert Andrews, Barry Knapp, and Inez and Bill Prather; Figures 5 and 6; photos on file; see also Knapp 1983). First state record, and only the fourth in the contiguous 48 states.

CASPIAN TERN (*Sterna caspia*). One (23-78-40) at Cherry Creek Reservoir, Arapahoe Co., between 22 and 29 May 1978 (Robert Andrews and William Lybarger). Third state record; this species is being seen with increasing frequency in Colorado.

ARCTIC TERN (*Sterna paradisaea*). One immature collected on 16 Sep 1912 near Windsor, Weld Co., by G.E. Osterhaut is in the Denver Museum of Natural History (DMNH 39080). This bird was previously identified as a Common Tern (*S. hirundo*); see Conry and Webb (1982). One adult (23-80-2) at Union Reservoir, Weld Co., on 11 and 12 Sep 1979 (Charles Chase, Peter Gent, and Peter Moulton). First and second records.

Figure 1. Mew Gull (23-80-17) in first winter plumage. Sloans Lake. Denver Co., Colorado. 7 Mar 1980.

Photo by Robert Rozinski

Figure 2. Adult Mew Gull (23-82-71). Sloans Lake. Denver Co., Colorado. 22 Mar 1982.

Photo by B.J. Rose

Figures 3 and 4. Great Black-backed Gull (23-80-14) in first winter plumage, Centennial Park, Arapahoe Co., Colorado, 3 Jan 1980. Note white background of tail with black barring and spotting: heavy barring is strongest subterminally and medially.

Photos by Bruce Webb

Figures 5 and 6. Immature Ross' Gull (23-83-32). Jumbo Reservoir, Sedgwick Co., Colorado, between 28 Apr and 7 May 1983.

Photos by Inez Prather (above) and William R. Maynard (below)

MARBLED MURRELET (*Brachyramphus marmoratus*). One of the Asiatic race (*B.m. perdix*) found in Aspen, Pitkin Co., on 22 Aug 1982. The bird died and is now in the Denver Museum of Natural History (DMNH 37691); see also Kingery (1983). First state record. This race was also recorded in Indiana in Dec. 1981 (Peterjohn 1982) and in Massachusetts in Sep 1982 (Forster 1983).

GROOVE-BILLED ANI (*Crotophaga sulcirostris*). One (26-80-5) on 15 Oct 1975 at CF and I Reservoir, Pueblo, Pueblo Co. (Eddie Blatnick). Second state record chronologically; the first and third records were discussed by Andrews (1979).

ANNA'S HUMMINGBIRD (*Calypte anna*). One male (31-79-2) at Grand Junction, Mesa Co., from 19 Nov to 6 Dec 1978 (Helen Traylor). Third state record.

ALDER FLYCATCHER (*Empidonax alnorum*). One male collected on 28 May 1904 in Arvada, Jefferson Co., by H.G. Smith and now in the Denver Museum of Natural History (DMNH 36457). The specimen was identified by Allan R. Phillips. First state record chronologically; the second and third records were discussed by Andrews (1979).

HERMIT WARBLER (*Dendroica occidentalis*). One female (52-78-39) at Red Rocks Park, Jefferson Co., from 7 to 9 May 1978 (Robert Andrews). One male (52-79-9) in Lakewood, Jefferson Co., from 27 to 29 Apr 1979 (Robert Andrews, Joyce and John Cooper; photos on file). Second and third records.

MOURNING WARBLER (*Oporornis philadelphia*). One immature collected by Mildred Snyder at Sedalia, Douglas Co., on 18 Oct 1964 and now in the Denver Museum of Natural History (DMNH 34586). The specimen was identified by Allan R. Phillips. One male (52-80-26) on 18 May 1975 at the U.S. Air Force Academy, El Paso Co. (Camille Cummings, David Griffiths, and David Thomas). One female collected north of Boulder, Boulder Co., on 25 Sep 1979 by Craig Williams and now in the Denver Museum of Natural History (DMNH 37882). First, second, and third records.

HENSLOW'S SPARROW (*Ammodramus henslowii*). One adult (56-85-55) at Jackson Reservoir, Morgan Co., on 10 Sep 1985 (Larry Halsey and Wade Leitner). First state record.

BRAMBLING (*Fringilla montifringilla*). One female (56-83-59) in Colorado Springs, El Paso Co., between 30 Oct and 4 Nov 1983 (Martha and Ed Curry, Larry Halsey, Barry Knapp and William Maynard; photos on file; see also Curry and Curry 1984). One female (56-83-60) in Boulder, Boulder Co., between 17 Dec 1983 and 15 Mar 1984 (Marjorie Foland and Robert Jickling; Figures 7 and 8; photos on file; see also Jickling 1984). First and second records. There were several other North American records in the same winter, which were summarized by Lehman (1984).

PART 4. CONFIRMED FIRST STATE BREEDING RECORDS

This section updates the breeding status given by Andrews (1980) in the 1980 state list. In that list, Ovenbird (*Seiurus aurocapillus*) should be a confirmed breeder.

YELLOW-CROWNED NIGHT-HERON (*Nycticorax violaceus*). A pair bred successfully on an island at the Denver Zoo, Denver Co., in 1983 (Charles Chase), and returned in 1984 and 1985.

BARROW'S GOLDENEYE (*Bucephala islandica*). A pair (8-82-64) bred 2 miles west of Walden, Jackson Co., in 1982, producing five young (Jos Grzybowski and Michael Szymczak; photo on file). This is the first confirmed breeding in Colorado for nearly a century.

BROAD-WINGED HAWK (*Buteo platypterus*). A pair bred successfully in a Fort Collins cemetery, Larimer Co., in 1978 (Daniel Casey and Charles Chase).

MARBLED GODWIT (*Limosa fedoa*). One pair (19-84-44) found on nest with two eggs on 26 May 1984 at Grover, Weld Co. (Lois Webster). Four eggs were in the nest on 10 Jun, but only eggshells remained on 24 Jun, so a predator may have destroyed the eggs.

LEAST TERN (*Sterna albifrons*). The first breeding records (23-78-76) since 1949 were of pairs in 1978 at Adobe Creek Reservoir, Kiowa Co., and Horse Creek Reservoir, Otero Co., in southeast Colorado (Charles Chase; see also Chase 1979).

BOREAL OWL (*Aegolius funereus*). A pair (28-81-48) bred at Corral Park, Larimer Co., in 1981 (David Palmer and Ronald Ryder; Figure 9; photo on file). The breeding attempt failed, and the eggs are in the Denver Museum of Natural History collection. In 1982 a pair (28-82-33) bred successfully in the same location (David Palmer; Figure 10; photo on file; see also Palmer and Ryder 1984). This species has now been found in Hinsdale Co. in southwestern Colorado (28-85-45, John Rawinski; photo on file) and in Delta Co. in western Colorado (28-85-47, Mark Janos).

VERMILION FLYCATCHER (*Pyrocephalus rubinus*). One pair (34-81-18) bred near Akron, Washington Co., in 1981 (Helen Downing and Larry Halsey; photos on file). The female and two young were killed in a hailstorm 13 Jun 1981 and are now in the Denver Museum of Natural History (DMNH 37401).

BAY-BREASTED WARBLER (*Dendroica castanea*). A pair (52-78-56) bred at Westcreek, Douglas Co., in 1978 (Charles Campbell).

HEPATIC TANAGER (*Piranga flava*). Breeding was confirmed in 1980 on Mesa de Maya, near Kim, Las Animas Co. (Charles Chase). Observations since 1980 show that there is a small, but stable, breeding population of this species on Mesa de Maya.

NORTHERN CARDINAL (*Cardinalis cardinalis*). A pair bred just south of Wray, Yuma Co., in 1982 (Bruce Bosley). This is the first known Colorado nesting since 1926.

GREAT-TAILED GRACKLE (*Quiscalus mexicanus*). This species was first found breeding in the state at Monte Vista, Rio Grande Co., in 1973. It has recently been found breeding on the eastern plains at Fountain, El Paso Co. (54-82-31, Richard Bunn) and at Buena Vista, Chaffee Co. (54-84-28, Peter Gent). These records indicate a rapid expansion of this species' breeding range east and north in Colorado.

SCOTT'S ORIOLE (*Icterus parisorum*). Breeding was first confirmed at Rangely, Rio Blanco Co., in 1979 (54-80-45 and 54-80-48, Austin Johnson). In 1981 breeding was confirmed at Pleasantview, Montezuma Co. (54-81-17, Clair Button) and at Mormon Gap, Rio Blanco Co. (54-81-57, Edward Hollowed). This species now breeds in most northwest Colorado counties south to Grand Junction, Mesa Co., and in Montezuma Co. in the southwest. These records indicate a recent expansion of the breeding range.

ACKNOWLEDGMENT

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Figures 7 and 8. Brambling (56-83-60) in female plumage, Boulder, Boulder Co., Colorado, 22 Dec 1983.

Photos by Stephen Vaughan

Figure 9. Adult Boreal Owl (28-81-48), Corral Park, Larimer Co., Colorado, 1 May 1981.

Figure 10. Young Boreal Owls (28-82-33), Corral Park, Larimer Co., Colorado, 31 Jul 1982.

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IMPACTS ON WATERBIRDS FROM THE 1984 COLUMBIA RIVER AND WHIDBEY ISLAND, WASHINGTON, OIL SPILLS

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Two major oil pollution events in Washington in 1984 resulted in significant oiling of waterbirds. The first occurred 19 March 1984 when a tanker ran aground near St. Helens, Oregon, releasing oil into the Columbia River. The second occurred 21 December 1984 when a vessel released oil into southern Admiralty Inlet off the south end of Whidbey Island in Puget Sound, Washington. During both spills many waterbirds were found dead, and many others were found incapacitated. This paper documents the species of waterbirds oiled in each event. Although some impacts of oil spills on waterbirds on the Pacific Coast of North America have been documented (Aldrich 1938, Moffitt and Orr 1938, Richardson 1956, Smail et al. 1972, Vermeer and Vermeer 1975, PRBO 1985), many others are undocumented and doubtless will remain so (Vermeer and Vermeer 1975, Speich unpubl. data).

THE OIL SPILLS

The Columbia River Spill

The tanker *Mobiloil* ran aground in the Columbia River near St. Helens, Oregon, on Warrior Rock (river mile 88.2) on 19 March 1984 (Figure 1). Its tanks ruptured, releasing an estimated 170,000 to 233,000 gallons of heavy residual oil, number six fuel oil, and an industrial fuel oil into the river (Kennedy and Baca 1984). A portion of the released oil sank but the rest floated downstream, reaching the mouth of the Columbia River 21 March 1984. It was then carried north by ocean currents, reaching Ocean Shores, Washington, by 25 March 1984. Oil was deposited on much of the Washington shoreline of the Columbia River, and lesser amounts were found on ocean beaches. Small amounts of oil were observed in Grays Harbor and in Willapa Bay. Later, a small number of oil globs and tar balls were reported on ocean beaches north to Cape Flattery, at the entrance to the Strait of Juan de Fuca. Small amounts of oil were also reported as far south as Cannon Beach, Oregon.

The Whidbey Island Spill

An unidentified vessel released about 5000 gallons of number six fuel oil into Puget Sound near Whidbey Island on 21 December 1984 (Figure 1). When first reported that day a slick extended about 10 miles from Seattle north to Possession Sound. About 1500 gallons came ashore on south Whidbey Island on 22 December 1984, and large amounts appeared on shore there over the next 5 days. The majority of the oil covered shorelines from Columbia Beach to Scatchet Head on the southern end of Whidbey Island. Additional small amounts were found on other beaches on south Whidbey Island and on beaches of other land areas such as Marrowstone Island, Bainbridge Island, and the Kitsap Peninsula.

EFFECTS ON WATERBIRDS

Columbia River Impacts

Part of the response to both spills was the cleaning of oil from shorelines and from shoreline and marsh vegetation. For the Columbia River spill this process started 24 March 1984 and continued daily through 16 April 1984, with crews, hired by Mobil Oil Co., working along the Columbia River and on the Washington ocean beaches, especially of the Long Beach Peninsula, just north of the mouth of the Columbia River. The crews disposed of many dead oiled birds without recording their identity, numbers, sex, age, etc.

Altogether, 450 oiled live birds were retrieved and taken to the cleaning center set up at the Columbia White-tailed Deer National Wildlife Refuge (A. Berkner pers. comm., Table 1). The center opened 23 March 1984 and operated until 23 April 1984, although no new birds were accepted after 9 April 1984. The most numerous species were Western Grebe (50%), White-winged Scoter (17%), and Common Murre (26%). The birds were released as soon as possible after treatment. In total, 284 (68%) birds were released, but the species' identities were not recorded, the birds were released unbanded, and no data were collected on the survival rates of the released birds. Birds found oiled and alive after the center ceased accepting birds on 9 April 1984 were cared for by concerned citizens and a rehabilitation center in Tillamook, Oregon. Unfortunately, no data on the species involved, their numbers, or their fate are available. In addition, at least 200 lightly oiled, free-roaming waterbirds were observed, including Western Grebes, unidentified scaups, unidentified mergansers, and gulls.

Table 1 Numbers and Percentages of Bird Species Oiled, Captured, and Brought to the Cleaning Station for Treatment after the Columbia River Oil Spill

Species	Number	Percentage
Red-throated Loon (*Gavia stellata*)	4	<1%
Common Loon (*G. immer*)	2	<1
Western Grebe (*Aechmophorus occidentalis*)	227	50
Goose (domestic, species unknown)	1	<1
Mallard (*Anas platyrhynchos*)	3	1
Greater Scaup (*Aythya marila*)	1	<1
Common Scoter (*Melanitta nigra*)	9	2
Surf Scoter (*M. perspicillata*)	8	2
White-winged Scoter (*M. fusca*)	77	17
Common Murre (*Uria aalge*)	118	26
Total	450	

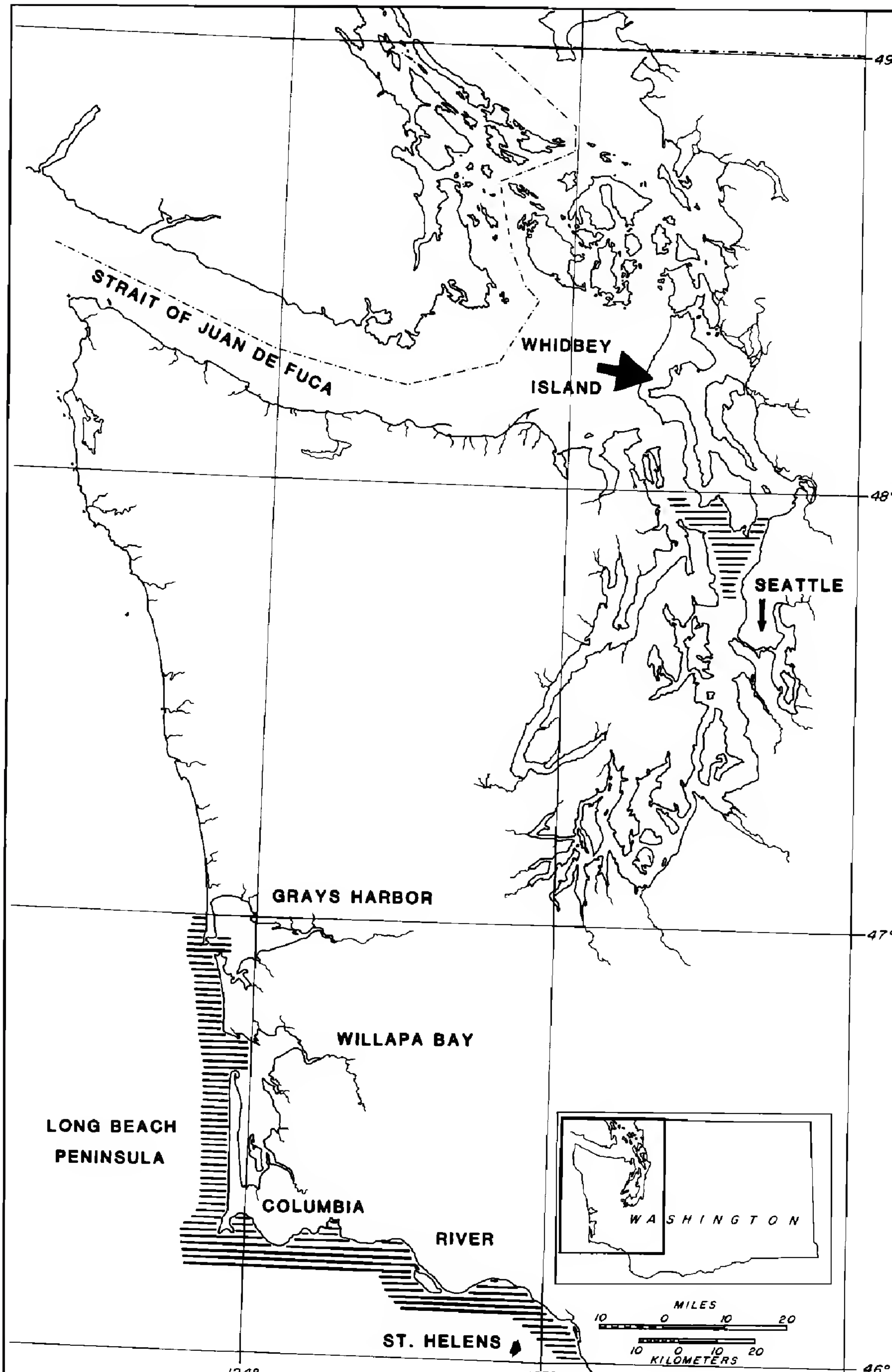

Figure 1. Approximate areas of water and shoreline oiled following the Columbia River and Whidbey Island, Washington, spills, 1984.

Table 2 Numbers and Percentages of Bird Species Observed after the Whidbey Island Oil Spill

Species	Oiled and free-roaming		Oiled and dead		Alive to cleaning station		Totals	
	N	%	*N*	%	*N*	%	*N*	%
Red-throated Loon (*Gavia stellata*)	—	—	—	—	1	<1	1	<1
Common Loon (*G. immer*)	33	5	1	<1	38	9	72	5
Unidentified loon	10	2	—	—	—	—	10	1
Horned Grebe (*Podiceps auritus*)	7	1	1	<1	47	11	54	4
Red-necked Grebe (*P. grisegena*)	7	1	2	<1	—	—	9	1
Western Grebe (*Aechmophorus occidentalis*)	15	2	2	<1	1	<1	18	1
Western/Red-necked Grebe	—	—	2	<1	95	21	97	6
Unidentified grebe	16	2	1	<1	—	—	17	1
Double-crested Cormorant (*Phalacrocorax auritus*)	2	<1	—	—	—	—	2	<1
Pelagic Cormorant (*P. pelagicus*)	+	<1	—	—	—	—	+	<1
Great Blue Heron (*Ardea herodias*)	1	<1	1	<1	—	—	2	<1
Domestic goose	—	—	1	<1	—	—	1	<1
Green-winged Teal (*Anas crecca*)	3	<1	—	—	—	—	3	<1
Unidentified teal	—	—	—	—	3	<1	3	<1
Mallard (*A. platyrhynchos*)	1	<1	—	—	2	<1	3	<1
Domestic duck	—	—	1	<1	—	—	1	<1
Northern Pintail (*A. acuta*)	4	1	—	—	—	—	4	<1
Gadwall (*A. strepera*)	1	<1	—	—	—	—	1	<1
American Wigeon (*A. americana*)	3	<1	—	—	4	<1	7	<1
Greater Scaup (*Aythya marila*)	+	<1	1	<1	—	—	1	<1
Lesser Scaup (*A. affinis*)	5	1	1	<1	—	—	6	<1
Unidentified scaup	55	8	6	1	31	7	92	6
Harlequin Duck (*Histrionicus histrionicus*)	1	<1	—	—	2	<1	3	<1

Table 2 (Cont.)

Species	Oiled and free-roaming N	Oiled and free-roaming %	Oiled and dead N	Oiled and dead %	Alive to cleaning station N	Alive to cleaning station %	Totals N	Totals %
Oldsquaw (*Clangula hyemalis*)	4	1	—	—	3	1	7	<1
Black Scoter (*Melanitta nigra*)	6	1	—	—	77	17	83	6
Surf Scoter (*M. perspicillata*)	22	3	—	—	11	2	33	2
White-winged Scoter (*M. fusca*)	33	5	—	—	24	5	57	4
Unidentified scoter	19	5	18	4	—	—	37	2
Common Goldeneye (*Bucephala clangula*)	1	<1	—	—	38	9	39	3
Barrow's Goldeneye (*B. islandica*)	1	<1	—	—	—	—	1	<1
Unidentified goldeneye	23	4	2	<1	—	—	25	2
Bufflehead (*Bucephala albeola*)	9	1	1	<1	26	6	36	2
Hooded Merganser (*Lophodytes cucullatus*)	+	<1	—	—	—	—	+	<1
Common Merganser (*Mergus merganser*)	+	<1	—	—	3	1	3	<1
Red-breasted Merganser (*M. serrator*)	9	1	—	—	2	<1	11	1
Unidentified merganser	6	1	—	—	—	—	6	<1
American Coot (*Fulica americana*)	1	<1	—	—	—	—	1	<1
Black-bellied Plover (*Pluvialis squatarola*)	2	<1	—	—	—	—	2	<1
Killdeer (*Charadrius vociferus*)	3	<1	—	—	—	—	3	<1
Dunlin (*Calidris alpina*)	2	<1	—	—	—	—	2	<1
Glaucous-winged Gull (*Larus glaucescens*)	11	2	—	—	—	—	11	1
Unidentified gull	58	9	1	<1	—	—	59	4
Common Murre (*Uria aalge*)	—	—	—	—	16	4	16	1
Pigeon Guillemot (*Cepphus columba*)	+	<1	—	—	3	1	3	<1
Waterbirds, unknown species	282	43	364+	90	20+	4	652	43
Totals	656+		406+		447+		1509+	

One measure of the probable effects of the oil spill on waterbirds is the proportion of birds found oiled on ocean beaches before and after the spill. Starting in September 1981, G. Lippert (pers. comm.) surveyed selected ocean beaches on the Long Beach Peninsula each month for live and dead waterbirds and for the presence of oil on the birds found. In 1981, only 1 of 110 (1%) birds, in 1982, 8 of 396 (2%), and in 1983, 2 of 577 (<1%) were found oiled. The proportion found oiled increased greatly in 1984, when 87 of 581 (15%) were oiled. Other evidence of the effect of the oil spill on waterbirds is the number of oiled live birds found on ocean beaches. Between September 1981 and the end of February 1984 Lippert found 1136 dead birds but no live disabled birds. Between 22 and 26 March 1984, however, he found 40 oiled live birds on a portion of the same beaches (G. Lippert pers. comm.).

Whidbey Island Impacts

As with the Columbia River spill, part of the response to the Whidbey Island oil spill was the removal of oil and oiled vegetation from affected shorelines. Clean-up crews, contracted by the Coast Guard, removed material primarily on the southern end of Whidbey Island from 23 December 1984 to 9 January 1985. In the process over 360 unidentified oiled birds were removed (L. Kittle pers. comm., Table 2). In addition, after the spill we, Kittle, and L. Leschner (pers. comm.) found another 42 individuals of at least 13 species (Table 2). Dead birds were also removed from beaches by concerned persons who came to observe the oil spill's effects; species and numbers are unknown. Thus, over 400 oiled dead birds were removed from beaches near the oil spill.

In response to this spill, by D. Yearout and K. Baxter (pers. comm.) established and operated a bird cleaning station at Mukilteo, Snohomish Co., from 23 December through 29 December 1984. Of 428 oiled birds (Table 2) brought to the cleaning station, 81 died in the clinic, and 347 were transported to local rehabilitation centers for intensive long-term care (D. Yearout and K. Baxter pers. comm.). At least another 20 birds were taken to another center, but their fate is unknown. Additionally, some people took an unknown number of oiled birds home to care for them, so we can report only that 448 oiled birds of 20 species were taken to cleaning stations for treatment. The principal species were Western and Red-necked grebes (21%), Black Scoter (17%), Horned Grebe (11%), Common Loon (9%), and Common Goldeneye (9%) (Table 2). D. Yearout (pers. comm.) estimated that only about 50 of the birds transferred to the rehabilitation centers were released.

We, Kittle, and Leschner searched the south end of Whidbey Island by boat and on foot on 23, 24, and 26 December 1984 and 4 January 1985, and from a helicopter on 27 and 28 December 1984. We saw more than 650 oiled, free-roaming individuals of 34 species (Table 2).

The behavior of many oiled birds observed after the Whidbey Island oil spill appeared to change drastically. Many oiled individuals were able to avoid capture by humans but spent considerable time loafing in the same area. Many severely oiled, flightless birds roosted in unlikely locations on shore. Some sought shelter in recesses on the upper beach. Several of these birds were apparently taken by Bald Eagles (*Haliaeetus leucocephalus*), as eagles were observed eating oiled birds on the beaches after dead birds had been removed.

In 1978 and 1979 Speich and Wahl (1986) surveyed more than 470 km of several beaches north of this spill site for oiled and incapacitated birds. They found only 110 dead and no live incapacitated birds. Immediately after this spill more than 400 dead oiled birds and about 450 oiled live but incapacitated birds were found on just a few kilometers of beach, demonstrating the spill's effect.

DISCUSSION

Studies of oiled and dead waterbirds (Coulson et al. 1968, Hope Jones et al. 1970, Bibby and Lloyd 1977) in England demonstrated that between 11 and 58% of carasses sink at sea (see also Dunnet 1982, Bourne 1970), so probably many more birds were oiled and killed than actual carcass counts document. The British data suggest that factors of 2 to 9 might be applied to the counts. However, we doubt that the mortality from these two spills, especially the Whidbey Island event, was as great, because these factors were derived from data collected on beaches facing the North Atlantic Ocean and the Irish Sea, whereas the Washington spills occurred in relatively sheltered and enclosed areas. In the Columbia River birds were undoubtedly often oiled within a few meters of shore, but an unknown number was probably oiled at sea. At Whidbey Island, birds may have encountered the oil from a few meters to perhaps a few kilometers off shore. Oiled birds were probably in the water for relatively short periods of time before they were beached, decreasing the sinking rate. In enclosed waters such as these a higher proportion of the birds oiled may reach shore alive. Indeed, during the Whidbey Island oil spill oiled birds were found on beaches the same day the spill was reported, and 40-50 were found oiled and alive and 30-40 were found oiled and dead in the first 24 hours after the spill (J. James pers. comm.). Oiled birds were first found on ocean beaches 3 days after the spill occurred on the Columbia River (G. Lippert pers. comm.).

CONCLUSIONS

Only 450 oiled birds were documented from the Columbia River oil spill, which is clearly a minimal total. More than 1500 birds were oiled as a result of the Whidbey Island oil spill, also a minimal total. Of the more than 1500 oiled waterbirds, 650 were observed free-roaming, about 450 were brought to cleaning stations, and at least 400 birds were found dead. It is unclear how these figures should be used to indicate the numbers of birds actually affected.

More effort is needed to document the loss of waterbirds from oil spills; the effort in these spills was inadequate. An emergency response team of experienced waterbird biologists should be on call to respond to spills. Standard waterbird survey techniques and beach transects on foot would result in data adequate for analysis of the immediate impacts of oil spills on waterbirds. Standardized methods would allow comparison of impacts on waterbirds from different spills and better evaluation of the impacts on waterbirds of individual oil spills. Although difficult to determine, the survivability and reproductive potential of released rehabilitated oiled birds and of free-roaming oiled birds are important but unknown variables.

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This paper is possible because of the contributions of many individuals. Foremost are the unnamed volunteers who felt compassion for the oiled birds and contributed countless hours in their rescue. Jules James, and Kay Baxter and Douglas Yearout, D.V.M., of the Wildlife Care Center of Everett, Washington, provided many details pertinent to the Whidbey Island volunteer response and cleaning station and to the fate of treated birds. Lora Leschner, Washington Department of Game, and Leu Kittle, Washington Department of Ecology, provided results of their Whidbey Island surveys. Kittle also provided observations from the Columbia River spill. Alice Berkner of International Bird Rescue, Berkeley, California, made available her notes from the Columbia River oil spill clinic. Greg Lippert provided unpublished observations on beached bird rates. The comments of Alan Craig and the present editor greatly improved this paper.

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DISTRIBUTION OF BREEDING MALE SAGE GROUSE IN NORTHEASTERN UTAH

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Leks are of central importance to the life cycle of the Sage Grouse (*Centrocercus urophasianus*). When a lek or its surrounding habitat is altered or destroyed, Sage Grouse breeding often is reduced or ceases altogether, leading to poor recruitment and population decline (Patterson 1952, Rogers 1964, Peterson 1970, Wallestad 1975, Tate et al. 1979). To identify areas in the vicinity of a lek used by females for nesting and brooding and by males for feeding and loafing (day use), many studies have investigated the movements and distribution of breeding Sage Grouse (Klebenow 1969, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974, Rothenmaier 1979, Emmons 1980, Schoenberg 1982). With the exception of a brief treatment by Schoenberg (1982), no attempt has been made to determine if these areas change or remain the same from year to year. Information of this nature must be known if wise decisions are to be made concerning Sage Grouse habitat alteration or destruction.

We undertook this study of breeding male Sage Grouse (1) to determine if birds show an affinity for the same day-use areas from year to year, and (2) to compare the distribution and movement patterns of Utah birds to those of other states.

STUDY AREA AND METHODS

The lek under study is 8 km north of Duchesne, Duchesne County, northeastern Utah, at an elevation of 1547.7 m (see Ellis 1984 for map). The vegetation of the nearly flat area is dominated by Big Sagebrush (*Artemisia tridentata*) and cactus (*Opuntia*) interspersed with open areas of mustard (*Brassica*). Mean annual rainfall is 223.8 mm; mean annual temperature, 6.8° C. The average annual frost-free period is 113 days. The area was severely overgrazed in the past, resulting in an almost total lack of native grasses and forbs. Crude oil production and localized winter sheep grazing are the major economic activities in the area.

We used radio telemetry to determine the spatial and temporal distribution of male Sage Grouse. Between 19 March and 16 May 1983 and 21 and 24 March 1984, we trapped male grouse, using a spotlight and long-handled net (Giesen et al. 1982), as they roosted on the lek. Captured grouse were fitted with radio transmitters attached to either poncho collars (Amstrup 1980) or to "necklaces" (Biotrack, Sawtrey, United Kingdom). Radio-tagged grouse were located 1 to 3 times per day (2 to 4 days per week) between 2

April and 25 May 1983 and 2 April and 17 May 1984. Because of mortality and transmitter failure during the study, we did not find all birds each day monitoring was done. We began locating the grouse by triangulation typically ½ to 1 hour after they left the lek and terminated no later than 2 hours prior to sunset. To receive the signals we used either a dual 4-element Yagi null-peak antenna or a single 4-element Yagi. Both antenna systems were attached to a Telonics TR-2 receiver. All angles were adjusted for previously determined bias (Springer 1979) and plotted on a 7.5-minute series U.S. Geological Survey map. Each 2.56 km^2 of the map was divided into 36 equal cells and each radio location was classified into the cell that encompassed the majority of the error polygon. At the end of each monitoring day, we calculated grouse use for each cell by the following formula:

$$\text{Amount grouse } x \text{ used cell } y = \frac{\text{number of times grouse } x \text{ is in cell } y}{\text{total number of locations for grouse } x}$$

At the end of each field season these data were summed for all birds, across all cells. These data were then transformed to obtain percentage of grouse usage per cell by means of the following formula:

$$\frac{\text{number of grouse use days per cell}}{\text{total number of grouse use days}} \times 100$$

Grouse were periodically flushed to determine if radio-tagged grouse were associating with other male grouse from the lek.

RESULTS AND DISCUSSION

In 1983, 8 males (7 adults, 1 juvenile) were monitored on 27 days, resulting in 78 grouse use days. In 1984, 10 males (adults) were monitored on 18 days, resulting in 130 grouse use days. Primary day-use areas during both years were north of the lek. Although the same area was used during both years, core areas (> 5% use) during 1984 shifted (by 0.4 to 0.5 km) to the west of those used during 1983 (Figure 1).

In both years, lengths of dispersal flights were typically 0.5 to 0.8 km. The longest flights recorded in 1983 and 1984 were 2.1 and 1.9 km, respectively. These data are comparable to those of other investigators. Carr (1967) reported that males had a maximum cruising radius of 1.4 to 1.8 km from the lek at his study area. Wallestad and Schladweiler (1974) reported that movements of males of up to 1.3 km from a lek were common and that 82% of all movements were greater than 0.3 km. Rothenmaier (1979) found that 64% and 86% of the radio locations of males using the "section 17 strutting ground" were within a 1.0- and 1.2-km radius, respectively. Emmons (1980) stated that dispersal distances to day-use areas of 0.2 km were common and that 67% of all day-use areas were over 0.5 km from the lek. Schoenberg (1982) found that daily movements of males to day-use areas averaged 0.9 km (range 0.03 to 2.4 km).

After arriving at feeding and loafing sites, birds remained fairly sedentary. Observations coupled with radio locations revealed that, if not disturbed,

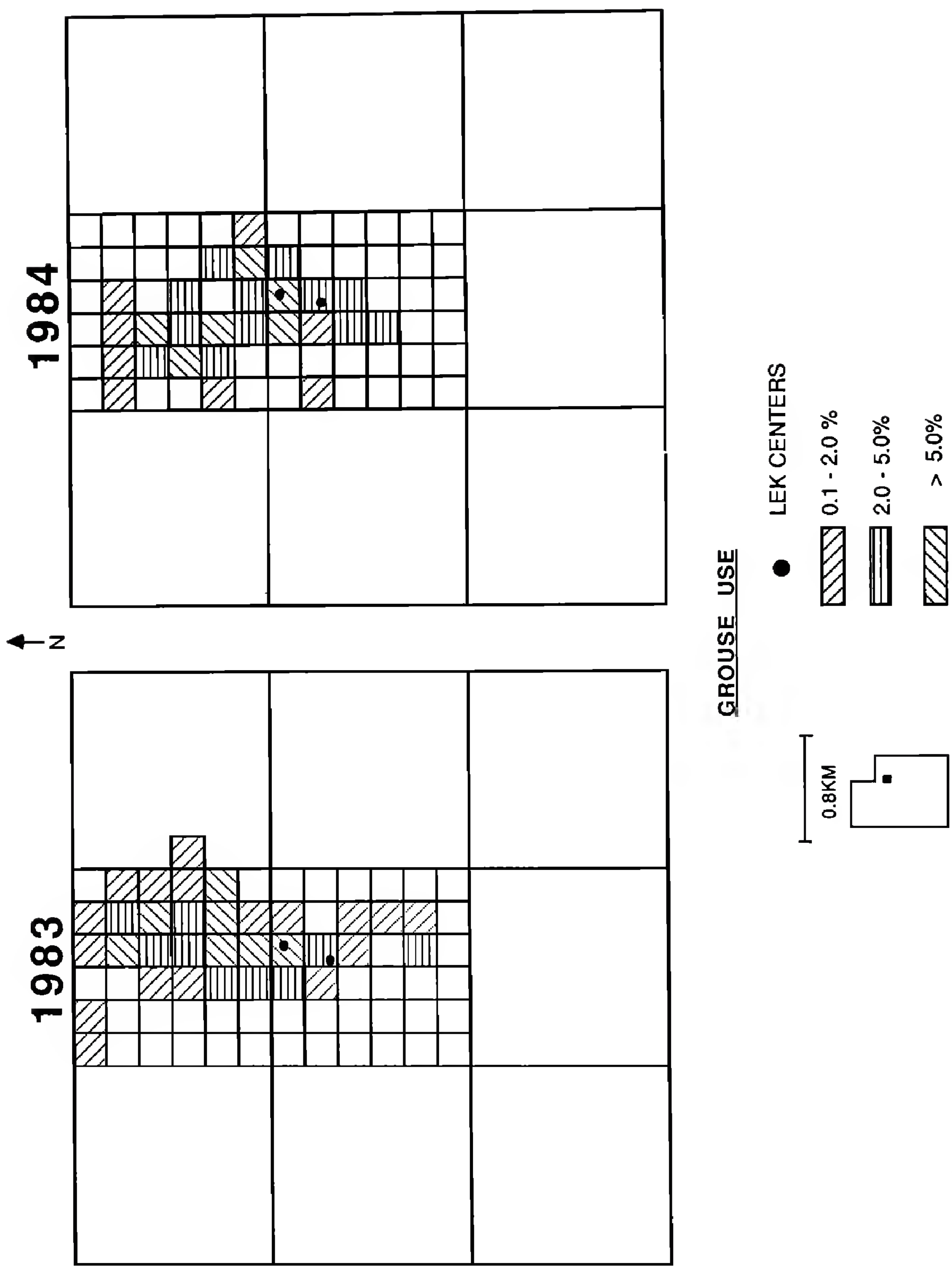

Figure 1. Distribution of radio-tagged Sage Grouse near Duchesne, Utah, in 1983 and 1984.

birds seldom moved more than 0.2 km between 0900 and 1500. Birds often moved back toward the lek 2 hours before sunset. If disturbed while in day-use areas birds would flush and commonly fly beyond 0.8 km. Similar behavior was reported by Emmons (1980). Radio-tagged grouse were commonly with 15 to 30 other grouse when flushed.

The nonrandom dispersal patterns of breeding male Sage Grouse to day-use areas reported here are similar to those found by Rothenmaier (1979) in Wyoming, and by Emmons (1980) and Schoenberg (1982) in Colorado. These patterns are most likely the result of habitat selection for certain sagebrush characteristics (Schoenberg 1982, Ellis et al. unpubl.). None of these studies, however, intensively monitored the same lek from year to year to see if similar patterns persisted.

On the basis of similar dispersal distances and distribution patterns, we believe that breeding male Sage Grouse in other areas most likely continue to select the same day-use areas year after year. Such areas, once identified, should be protected to the greatest extent possible. Alteration of these areas may cause abandonment of a lek.

ACKNOWLEDGMENTS

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Sage Grouse *Photo courtesy of California Department of Fish and Game*

NOTES

A NORTHERN JACANA IN TRANS-PECOS TEXAS

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At 0945 on 7 October 1982, Melissa J. Renfro and I found a single Northern Jacana (*Jacana spinosa*) on a pond at a site known as "The Post" (elev. 1200 m), located at the end of a county road about 8 km south-southwest of Marathon, Brewster County, Texas. We watched the bird, which was in typical immature plummage, for about 45 minutes, then we left the area. We returned that afternoon (1430-1900) and obtained a series of 27 color slides of the bird; representative slides were subsequently verified and deposited in the Texas Photo-Record File as No. 404, a-d (Texas Cooperative Wildlife Collections, Texas A&M University, College Station, TX 77843). The jacana was still present at the site on 11 October 1982, when it was seen by Geth and Edmund White of Alpine, Texas. I do not know if the bird was seen after that date; it was not present when I next visited the site on 18 October 1982.

The small (90 m × 13 m) pond was the result of a low dam across Peña Creek and seemed to be several decades old. Cattails (*Typha*) bordered the open water, which was almost completely choked with a dense stand of pondweed (*Potomogeton*), the pondweed forming a solid mat just below the surface. The jacana spent most of its time walking about on the vegetation mat and feeding actively, presumably on aquatic insects. At one point, however, it captured, dispatched, and consumed a large dragonfly. The bird was wary and alert and would fly to the center of the pond, calling loudly, if approached too closely or otherwise disturbed. There it would remain, watchful for a while, before resuming its feeding.

Marathon lies about equidistant (some 800 km) from resident Northern Jacana populations on the west coast in Sinoloa and on the east coast in southern Texas and Tamaulipas; it is less than half again as far from resident populations on the Mexican Plateau due south in Guanajuato, Jalisco, and Michoacan. There are scattered inland Texas records, presumably from the eastern population, in Real (Am. Birds 34:177, 1980), Kerr (Am. Birds 40:492 and 1223, 1986), Uvalde, Bexar, Webb, and Victoria counties (Oberholser, H.C., The Bird Life of Texas, Vol. 1:306, 1974; Univ. Tex. Press, Austin) (but not Mitchell County; see below), and an immature jacana was noted upriver in the Rio Grande valley at Santa Ana National Wildlife Refuge, Hidalgo County, 10-30 November 1982 (Am. Birds 37:200, 1983). Of interest, however, is a Pacific storm, Hurricane Paul, that crossed the Sinaloa coast in late September and tracked northeastward through the Trans-Pecos region of Texas on 30 September 1982, one week before I discovered the Brewster County bird. Also of interest are the many impoundments that now stretch northward across the Mexican Plateau, from central Mexico through Durango and Chihuahua to the United States border; these impoundments, typically recharged during the summer-fall rainy season, appear to be providing a northward avenue for several other waterbirds that are similarly common in the central highlands (S.O. Williams, unpubl. data). Because the Brewster County jacana could conceivably have arrived from any one of these three geographic areas, I believe it is incorrect to assume automatically that it originated from the east coast population. The recent (7 June 1985-3 January 1986) appearance of an adult jacana near Nogales, Arizona (Am. Birds 39:946, 1985; 40:311, 1986) which, after the Brewster County bird, represents only the second record for the southwestern United States, is of similar uncertain origin, there being but one record for adjacent Sonora, a specimen labeled only "Sonora, 1961" (S.M. Russell, pers. comm.).

Contrary to the 5th and 6th editions of the American Ornithologists' Union's Check-list of North American Birds (1957:163, 1983:176), there is no record, valid or otherwise, of a Northern Jacana in Mitchell County in north-central Texas. The error apparently resulted from confusion of Mitchell Lake in Bexar County, site of a valid 1922 record, with Mitchell County.

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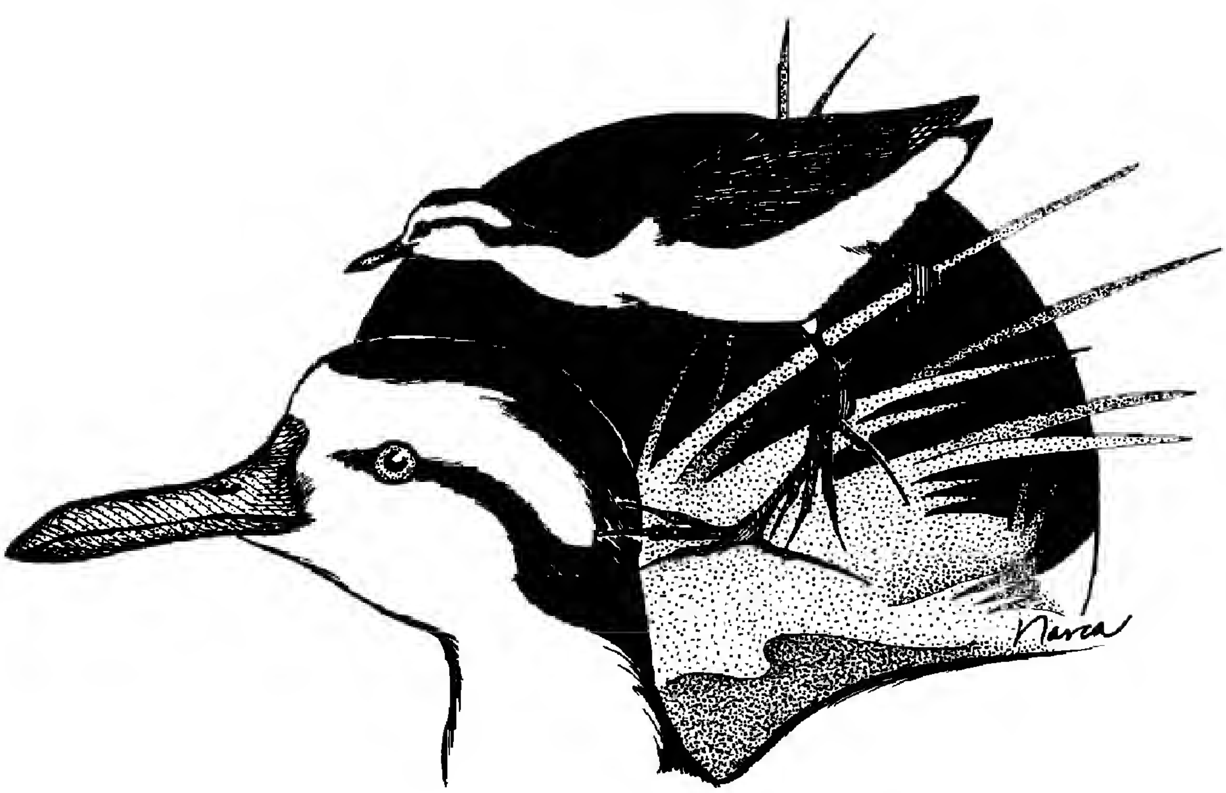

Immature Northern Jacana *Sketch by Narca Moore-Craig*

GREAT HORNED OWL PREDATION ON CAVE SWALLOWS

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Both Great Horned Owls (*Bubo virginianus*) and Cave Swallows (*Hirundo fulva*) occur in the caves of southeastern New Mexico, but no interaction between the two species has been recorded. On 1 June 1984, Tom and Bobbie Bemis, Ron Kerbo, and I visited Ogle Cave, Slaughter Canyon, Carlsbad Caverns National Park, Eddy County, New Mexico, to check on the approximately 100 Cave Swallows nesting there. As we rappelled into the cave, we flushed a Great Horned Owl, which was mobbed by Cave Swallows as it left the cave. Beneath a Great Horned Owl nest I found a pellet containing bird bones and a U.S. Fish and Wildlife Service band. The band (number 970-75444) was from a Cave Swallow that had been banded in the entrance of Carlsbad Cavern, about 13 km northeast of Ogle Cave, on 3 August 1983. Our banding studies suggest that Cave Swallows move among the caves after their nesting season. The pellet contained 313 bones representing at least four individual swallows, as well as insect parts. It is now in the collection of the Carlsbad Caverns National Park museum.

On several occasions since 1978 I have banded Cave Swallows at Swallow Sinkhole, Glass Mountains, Brewster County, Texas; usually Great Horned Owls are present at this site too. On 9 June 1984, when Orlando Ornelas and I visited Swallow Sinkhole, we flushed from its nest a Great Horned Owl, which was then vigorously mobbed by Cave Swallows. An owl pellet found in the sinkhole entrance also contained bones the size of a Cave Swallow's.

I thank Jim Walters for providing helpful advice on an earlier draft of the manuscript.

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FIRST RECORD OF LONG-TOED STINT IN OREGON

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The Long-toed Stint (*Calidris subminuta*) breeds in northeast Asia and migrates through southeast Asia to India and Australia (King et al. 1978). In Alaska it is a rare spring and fall visitant to the western Aleutian Islands. There are spring records for the Pribilof Islands, St. Lawrence Island, and the Seward Peninsula (Kessel and Gibson 1978).

The first Long-toed Stint for North America outside of Alaska was photographed and tape recorded at the base of the South Jetty of the Columbia River, Clatsop County, Oregon, on 5 September 1981. On that day, Gilligan, Schmidt, Irons, Mike Houck, Jake Redlinger, and Mark Smith flushed a small *Calidris* from thick *Salicornia* near the tidal pools. When flushed, the bird rose rapidly and gave repeated calls that suggested a soft version of the familiar Pectoral Sandpiper (*C. melanotos*) call. Gilligan based his original identification as *C. subminuta* on the bird's small size, habitat choice, and calls. We had ample opportunity to confirm the identification during extraordinary views as close as 3 m for the next 4 hours. Other observers included Nehls, Richard Smith, Matt Hunter, Steve Heinl, Alan Contreras, Richard Palmer, David Hofmann, John Gatchet, Durrell Kapan, and many others. The bird was last seen on 12 September 1981. Final identification of the bird as a juvenile Long-toed Stint was based on its field marks, behavior, and voice.

Field Marks. The bird was larger and more chestnut colored than a typical juvenile Least Sandpiper (*C. minutilla*). The upperparts were mostly dark, with the crown feathers, scapulars, and tertials edged in bright chestnut. The dark crown extended to the bill and lores. There was a very conspicuous whitish "V" on the back, similar to that of juvenile Least Sandpiper. The wing coverts were rich brown and broadly edged in buff to whitish-buff; the tertials were dark with very noticeable bright chestnut fringes. The supercilium was nearly clear white, broadening over the eye and flaring onto the nape over a chestnut ear patch. The underparts were whitish with the breast smudged gray-brown and prominently streaked through the center.

The bill tapered to a fine point and was slightly decurved near the tip. The upper mandible and tip were black, but the base of the lower mandible was tan, which distinguishes the Long-toed Stint from other small *Calidris* sandpipers (Wallace 1974).

The legs were yellow, appearing brighter than a Least Sandpiper's. The toes appeared exceptionally long, the middle about as long as the tarsus, giving the bird a big-footed appearance as it walked on the flats. Prater et al. (1977) suggest that long toes may be a useful field mark. When the bird stood on one leg, the toes on the raised leg projected from the belly feathers, accenting their length.

Behavior. The Long-toed Stint seemed to run faster than the Least and Western Sandpipers (*C. mauri*) that were nearby, and it had an unusual forward-leaning posture. It took long, loping strides, quite unlike the more scurrying footsteps of the other species. When alarmed it erected its posture and craned its neck, giving it an elegant, tall, thin appearance. Kitson (1978) observes that this neck-stretching and generally elongated appearance are more typical of Long-toed Stint than of other small sandpipers. In our opinion, however, a Least Sandpiper can appear nearly equally upright, long-necked, and elongated when alarmed.

The most notable behavioral characteristic of the Long-toed Stint was its preference for cover. On several occasions it was flushed from the mudflats, flew back over the

Figure 1. The juvenal Long-toed Stint had a bright chestnut crown with its supercilium flaring behind the eye, chestnut ear coverts, streaked breast, very bright chestnut edges on the scapulars and tertials, and particularly long toes.

Photo by Owen Schmidt

Figure 2. The juvenal Long-toed Stint (right) is larger than the juvenal Least Sandpiper (left) and shows much brighter chestnut on the crown, ear coverts, and back, and also has longer and brighter yellow legs.

Photo by Owen Schmidt

observers, descended steeply, and disappeared into thick *Salicornia* taller than itself. This behavior was somewhat reminiscent of the manner in which a Common Snipe (*Gallinago gallinago*) plunges into vegetation. On one occasion a Least Sandpiper descended with the Long-toed Stint, but at the last instant, as the Long-toed Stint dropped into the vegetation, the Least Sandpiper hovered for a moment just above the vegetation and then rose again and flew off. On the flats the Long-toed Stint tended to remain close to grass and driftwood, often crouching in a depression near cover.

Voice. We noticed immediately that the Long-toed Stint's calls differed from those of the other small *Calidris* familiar to us. The bird usually called in sets of 2 or 3 notes as it flew. We interpreted the calls as dry, low-pitched, muted "preep," "prr-rrp," or "treeet" notes. Several observers described the call as more of a 2-syllable "churr-up," "prr-up," or "tirr-et." One observer reported that the Long-toed Stint gave a weak, mellow "chert" call when flushed, similar to the Pectoral Sandpiper's sharper "cherk." Viet and Jonsson (1984) say the call is a softly rolling "chrrup," which is perhaps the same sound. The bird was silent except when flushed.

The Least Sandpiper's typical calls are a harsher, more shrill "kreeet" or "breeep." Since the sighting of the Long-toed Stint, Irons and Gilligan have on rare occasions heard Least Sandpipers give calls somewhat similar to those of the Long-toed Stint, but higher in pitch.

The calls of the Long-toed Stint were recorded on a cassette recorder with the aid of a parabolic reflector. A copy of the recording is filed with the Oregon Bird Records Committee, P.O. Box 10373, Eugene, OR 97440. The record has been accepted by the Oregon Bird Records Committee. Theodore Tobish, Dan Gibson, and Richard Veit have examined several of the photographs of the bird and agree with this identification.

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A BREEDING RECORD OF THE DARK-EYED JUNCO ON SANTA CATALINA ISLAND, CALIFORNIA

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A total of 56 species of land birds has been recorded breeding on the eight Channel Islands off the coast of southern California (Diamond and Jones 1980). Many are permanent resident species breeding every year, while others are migrants or immigrants that only infrequently or briefly establish breeding populations. This dynamic equilibrium of the breeding birds of the Channel Islands has been addressed by several authors (Lynch and Johnson 1974, Jones 1975, Jones and Diamond 1976, Diamond and Jones 1980) and predicts that from time to time additions will be made to the list of breeding species (see Haemig 1986). This report documents a successful breeding of the Dark-eyed Junco (*Junco hyemalis*) on Santa Catalina Island and the first record of this species breeding on any of the Channel Islands.

On 14 April 1986, I observed an adult Dark-eyed Junco accompanied by two juvenal-plumaged fledglings in a small gully in Renton Mine Canyon, located on the southeastern side of the island. Much of the vegetation on Santa Catalina Island has been greatly altered by man. However, the vegetation in Renton Mine Canyon consists of some of the best-recovered native island plant communities. On the south slope there is an island version of sage scrub with *Eriogonum giganteum* and a chaparral dominated by *Ceanothus arboreus*. The north slope is mostly an oak woodland made up of a variety of hybrid oaks. The canyon bottom is dominated by *Prunus lyonii* and *Quercus* × *macdonaldii*. There are some scattered introduced *Eucalyptus* on the edge of a road high on the north slope. Others present who also saw the birds were T. Martin, S. Critchfield, C. Boardman, and G. Hoffman. The two young birds were giving fledgling location notes and begging vocalizations and were attended and periodically fed by the adult. Although they appeared capable of flight, it is improbable that they were strong enough to have made an over-water flight to the island. It is most likely that they were hatched near the point of observation in Renton Mine Canyon. The attending adult had the coloration of a female of one of the races of Oregon Junco. The mainland breeding populations closest to Santa Catalina Island have been assigned to *Junco hyemalis thurberi* (Grinnell and Miller 1944).

Dark-eyed Juncos have been recorded as winter visitors on several of the Channel Islands (Garrett and Dunn 1981, pers. obs.). A single early summer observation suggested they might have bred on Santa Cruz Island but convincing evidence was lacking (Diamond and Jones 1980, H.L. Jones pers. comm.). This species has recently expanded its breeding range in coastal southern California, particularly in the Santa Monica Mountains (H.L. Jones pers. comm.); its appearance as a breeder in the Channel Islands is perhaps not unexpected. It remains to be seen, of course, if this is an isolated occurrence or the establishment of a new breeding population.

I am indebted to Terry Martin and the Catalina Conservancy for transportation on the island and for providing the vegetative description of Renton Mine Canyon.

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THE FIRST RECORD OF A FOUR-EGG CLUTCH FOR SANDHILL CRANES

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We determined clutch sizes in 815 Greater Sandhill Crane (*Grus canadensis tabida*) nests in Oregon from 1966 through 1984. Of these, 744 (91.3%) nests contained two eggs 67 (8.2%) one egg, 3 (0.4%) three eggs, and 1 (0.1%), which we report on here, contained four eggs. Average clutch size was 1.92. Three-egg clutches from Sandhill Cranes are rare, but there are records from Florida (Walkinshaw 1973), Idaho (Drewien 1973), Michigan (Walkinshaw 1973), Oregon (Littlefield 1981), and Wisconsin (Gluesing 1974). There is no previous record of a wild Sandhill Crane producing a four-egg clutch. Furthermore, there are no such records for other members of the family Gruidae, except for the Common Crane (*G. grus*) (cf. Johnsgard 1983) and South African Crowned Crane (*Balearica regulorum regulorum*). Four-egg clutches are not uncommon for the latter (Walkinshaw 1973).

On 18 April 1983, we located a crane nest about 8.0 km WNW of Diamond, Harney Co., Oregon, on Malheur National Wildlife Refuge (NWR). When discovered, the nest contained two eggs that measured 95.6 × 61.5 mm and 98.7 x 61.4 mm, respectively. On 21 May, after the normal 30-day incubation period, the pair was still incubating. Assuming the eggs were infertile, we flushed the male off the nest. Surprisingly, the nest contained four eggs. The two additional eggs measured 95.8 × 61.1 mm and 95.0 × 61.5 mm. Two eggs were in the nest bowl, but the other two were near the nest's edge. By Westerskov's (1950) method for incubational stages, one egg was at stage 5, one at stage 4, and two at stage 3, indicating that all four eggs were not being incubated simultaneously. On 28 May, all eggs were together in the nest bowl and were being tended by an adult. The pair abandoned the nest on the morning of 29 May after incubating at least 43 days. The nest was adjacent to Kiger Creek, which flooded during the afternoon of 29 May, washing away the nest and eggs.

The pair (Pair 216) occupy a large territory and receive no disturbance from other Sandhill Crane pairs, eliminating the possibility of another female dumping eggs into the nest. In addition, all four eggs were very similar in size and coloration: whitish tan with a few small reddish spots on the blunt end. The nearest neighbors (Pair 186) nest about 0.8 km south of the site and lay olive-brown eggs. Furthermore, territorial Sandhill Crane pairs are intolerant of other cranes in spring and it is highly unlikely another female would be permitted on Pair 216's territory long enough to deposit two eggs, particularly since the nest was not concealed and could be seen from a great distance.

Pair 216 has had an interesting history since establishing the territory in 1971. The pair's nests were examined in 1974, 1982, and 1983. In 1974, their clutch consisted of three eggs and represented the first three-egg clutch located on Malheur NWR. They laid a normal two-egg clutch in mid-April 1982; however, one egg was infertile. The fertile egg hatched on 16 May. After hatching, one adult tended the young crane while the other adult continued to incubate the infertile egg at least through 22 May. Eggs laid in 1974 and 1982 were similar in size and coloration to those laid in 1983, indicating the same female has occupied this territory since at least 1974. Another interesting behavior is the pair's tolerance of human disturbance. The nest was on the same site in 1982 and 1983, adjacent to a corral within 75 m of a well-traveled county road. In 1974, the nest was within the corral. A ranch house was within 50 m of the nests and refuge vehicles passed daily within 5 m of the site without excessively disturbing the incubating bird.

The circumstance involved in the female's laying four eggs is unclear. Up to seventeen eggs per year have been laid by captive Greater Sandhill Cranes, with six eggs being the average number produced (Erickson 1976). However, eggs from these birds were removed shortly after being laid, thus stimulating females to produce additional eggs. Perhaps the first eggs of Pair 216 were displaced from the nest bowl, resulting in the female's laying two additional eggs. Because the female had laid a three-egg clutch in the past, however, it is likely she is unique both behaviorally and physiologically, and her future nesting efforts will be interesting to monitor.

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LOGGERHEAD SHRIKE FEEDS ON A DEAD AMERICAN COOT

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In the early afternoon of 8 December 1984, we observed a Loggerhead Shrike (*Lanius ludovicianus*) feeding on the carcass of an American Coot (*Fulica americana*) along the shore of a marsh at Chula Vista, San Diego County, California. For about 2.5 min the shrike tore off and swallowed at least a dozen pieces of meat before flying away. After waiting 30 min for the shrike to return, we examined the carcass. The head of the coot was missing; the shrike had been feeding on the blood-clotted meat in the neck area. No mammal tracks, scattered feathers, talon on tooth punctures, or maggots were evident. The coot was lying under the high-voltage power lines, suggesting that it died after colliding with the power lines.

Either the shrike found the coot dead or it successfully attacked and killed an unusually large item of prey. Both the Northern Shrike (*L. excubitor*) and Loggerhead Shrike are well known for their predatory habits, but they seldom feed on carrion. Bent (1950:117) reported a Northern Shrike feeding on a dead cow, Lloyd (1887) observed a Loggerhead Shrike feeding on a dead sheep, Anderson (1976) noted Loggerhead Shrikes eating the remains of prey left by Northern Harriers (*Circus cyaneus*) and a Rough-legged Hawk (*Buteo lagopus*), and Reid and Fulbright (1981) found the impaled remains of two coots presumably cached by Loggerhead Shrikes. Lloyd (1887) speculated that shrikes may resort to carrion more often during the winter when normal food items are scarce. In support of this, Craig (1979) found that in central California in December the density of Loggerhead Shrike prey was low and that shrikes were apparently stressed, as evidenced by two collected individuals that were well below mean weight. Perhaps our Loggerhead Shrike was similarly stressed and opportunistically fed on the coot carcass.

Since the shrike was feeding on the neck, where shrikes typically attack prey (Miller 1931, Smith 1973), it may have killed the coot. Although Cade (1962) gave 80-100 g as the weight of the largest prey the slightly larger Northern Shrike (average weight ca. 60 g) can handle, White (1963) observed a Northern Shrike unsuccessfully attack a Sharp-tailed Grouse (*Tympanuchus phasianellus;* ca. 675 g), Ellison (1971) saw a Northern Shrike unsuccessfully attack a Spruce Grouse (*Dendragapus canadensis;* ca. 600 g), and Balda (1965) witnessed a Loggerhead Shrike successfully attack a Mourning Dove (*Zenaida macroura;* ca 130 g).

Slack (1975) demonstrated that shrikes normally select smaller, easier-to-catch prey rather than larger prey that once captured provides more food. He suggested that shrikes attack unusually large prey only when motivated by severe hunger. Although our shrike may have been exceptionally hungry, because Loggerhead Shrikes are not known to kill prey larger than the ca. 130-g dove, we suspect the shrike discovered the coot as carrion. Shrikes probably feed on carrion more frequently than the literature suggests.

We thank L.C. Binford and E.R. Schwabb for reviewing the manuscript.

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SONG IN A FEMALE PLAIN TITMOUSE

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Although females of some temperate-zone species sing regularly, in most species females do not sing. There have, however, been numerous reports of singing by females that are normally non-singers (reviewed by G. Ritchison, Auk 100:105-116, 1983). In the titmouse family (Paridae), female song is common in some species and absent in others. Males of the three species of North American crested titmice, the Tufted, Plain, and Bridled titmice (*P. bicolor, P. inornatus, P. wollweberi*), do sing well-developed true songs, but consistent female singing of male-like songs has been reported in only some populations of the Tufted Titmouse (H. Brackbill, Auk 87:552-536, 1970; P.K. Gaddis, Ornis Scand. 14:16-23; D.J. Schroeder and R.H. Wiley, Anim. Behav. 31:1128-1138, 1983). I report here on an occurrence of song in a female Plain Titmouse.

On 20 March 1983, 22 km N of Flagstaff, Arizona, I recaptured a banded female Plain Titmouse on her territory in a drop-door wire mesh Potter-type trap. Prior to release, she appeared abnormally agitated, moving rapidly and often from side to side in the trap even before I approached closely. This was possibly the result of her being trapped for a time much longer than normal, as I was unable to check the trap for approximately 45 min after it was set. Upon release, she flew to a branch 2 m away and sang one song similar to some of the 18 song types I have recorded from males in the same population (L.S. Johnson, Ornis Scand. 18:24-32, 1987). This female was paired with a male who sang regularly in the same territory. This incident was the only occurrence of female song I observed, although I trapped females more than 50 times during a 2-year study of Plain Titmice.

This observation suggests that female Plain Titmice have the capacity to sing but do not normally do so. A closer comparison of the natural history of the three North American crested titmice may reveal why females sing regularly in only one of these three congeners.

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Cover photo by Alan S. Hopkins, San Francisco, California: Buff-breasted Sandpiper (*Tringytes subruficollis*), Abbott's Lagoon, Marin County, California, 30 September 1984

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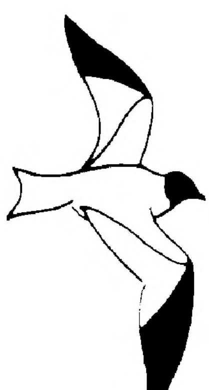

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EMPIDONAX TRAILLII EXTIMUS: AN ENDANGERED SUBSPECIES

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The Willow Flycatcher (*Empidonax traillii*) is a widely distributed species with a breeding range extending from southern British Columbia south to northern Baja California and east to the Atlantic coast. Small passerines with such wide ranges usually show some geographic variation, and several subspecies of *E. traillii* have been described by Oberholser (1918, 1932, 1947), Phillips (1948), and Aldrich (1951). But proof that the former "Traill's Flycatcher" is composed actually of two sibling species (Stein 1958, 1963), now known as the Willow and Alder (*E. alnorum*) flycatchers, disrupted the study of intraspecific variation in this pair. Mayr and Short (1970) wrote "we consider these species monotypic in view of their variability and difficulties in determining the specific, let alone subspecies, status of individual birds." Traylor (1979) likewise recognized no subspecies of *E. traillii*, but wrote "both species are almost certainly polytypic, but the subspecies cannot be worked out without long series of fresh material of known song type."

The problem of intraspecific variation in *E. traillii* is especially acute in view of the precarious status of the populations breeding in the southwestern United States, where the birds are restricted to riparian woodland. Although the species remains common east of the Mississippi, Garrett and Dunn (1981) considered the breeding population of southern California "virtually extirpated." In Arizona, Monson and Phillips (1981) noted that no nests were found between 1970 and 1981.

My purpose in this paper is to integrate the intimately related problems of the taxonomy, distribution, current status, reproductive biology, and conservation of the southwestern populations of *E. traillii*, with an emphasis on those in southern and Baja California.

TAXONOMIC PROCEDURES

Specimen Resources

To study geographic variation and migration of *E. traillii* in southern and Baja California, I examined 305 study skins: 60 in the San Diego Natural History Museum (SD), 126 in the Museum of Vertebrate Zoology, Berkeley (MVZ), 20 in the San Bernardino County Museum (SBCM), 15 from the

University of California, Los Angeles (UCLA), 16 from the Los Angeles County Museum (LACM), 10 from the University of Arizona (UA), 5 from the New York State Museum (NYSM), 50 from the United States National Museum (US), and one from the collection of Amadeo M. Rea (AMR).

Specimen Analysis

The first step necessary in analyzing geographic variation in breeding populations of *E. traillii* is to segregate specimens that were on their breeding territories when collected from those taken in migration. Ideally, this segregation should be made on the basis of a specimen label providing data on gonad development, fat condition, habitat, behavior, and song. Unfortunately, however, few labels on Willow Flycatchers bear this information; scientific collecting of birds declined about the time most ornithologists realized the importance of preserving such data with specimens. Therefore, I assumed that specimens collected from 24 June to 17 July, when Willow Flycatchers have not been reported migrating through the southwestern United States, also were on their breeding territories. In samples of specimens collected near the northern limit of the Willow Flycatcher's range, the likelihood of encountering birds far from their breeding range is low, so I assumed that all specimens from Oregon, Washington, and Idaho represented the breeding populations of the sites where they were collected. In the central and eastern United States the Alder Flycatcher migrates throughout the Willow Flycatcher's range, so from this area I used only specimens known to be *traillii* on the basis of song or that had been identified as such by R. C. Stein.

I examined these specimens for evidence of geographic variation in measurements, wing structure, and color. Measurements I took were wing chord, tail length from insertion of central rectrices, bill length from nostril, and bill width at base. From these data I calculated for each specimen wing length minus tail length, the ratio of wing length to tail length, and the ratio of bill length to bill width. I measured only adults, excluded measurements of structures that were badly worn or damaged by shot, and compared the sexes separately. I measured only the specimens in the SD, AMR, UA, NYSM, and US collections.

Phillips (1944) and Snyder (1953) reported that the eastern and western populations of *E. traillii* differ in wing formula, that the tenth primary is equal to or shorter than the fifth in western populations, longer in eastern. I examined the relative lengths of the fifth and tenth primaries in the same sample of specimens that I measured. Again, I compared the sexes separately, because I observed that within each population the wings of males average slightly more pointed than those of females.

Evaluation of Willow Flycatcher coloration requires more careful analysis than evaluation of size and structure. Age, length of time since collection, and degree of plumage wear are additional complicating factors contributing to color variation. Not all specimens suitable for measuring were suitable for color comparison.

An understanding of the species' molt schedule is essential to an understanding of the effects of age and wear on the birds' coloration. Willow Flycatchers have a single annual molt, which takes place in their winter range, after the birds have migrated south of the United States. Therefore, they are in their freshest plumage when they arrive in the spring, wear during the breeding season, and are badly worn when they depart in the fall. Young birds migrate while still in their juvenal plumage, and return the following spring in a plumage identical to that of older adults. That is, the first basic plumage is definitive.

Juvenal Willow Flycatchers differ from adults by their buff wing bars and flimsy-textured plumage, which wears and fades much faster than the adult plumage.

Foxing, the change in plumage color that affects aging study skins, occurs in *E. traillii*. Foxing is manifested in *E. traillii* as a buff-brown tint to the greenish-gray parts of the plumage. It is usually slight, but I have noticed it in specimens collected as recently as the 1950s. The skins prepared by some collectors, particularly Frank Stephens, have foxed more than others. Therefore, the possibility of foxing must be considered when recently collected specimens are compared with older ones.

Plumage wear also affects the birds' appearance, particularly on the crown, where in extremely worn individuals the greenish distal portion of the feathers may be completely lost, leaving only the dark gray bases. Therefore, it is essential that worn birds not be compared with fresh ones and that conclusions be drawn from the least worn specimens possible.

Phillips (1948) reported that in *E. t. brewsteri* males average darker than females, and that in *E. t. extimus* males average more olive than females, but sexual differences are negligible in the specimens I examined. I therefore combined the sexes when comparing colors.

A Standard for Definition of the Subspecies

One definition of subspecies that ornithologists traditionally have used is the "75% rule": For population *A* to be considered a subspecies distinct from population *B*, 75% of the individuals of population *A* should overlap with no more that 3% of the individuals of population *B* (Mayr 1969). I have selected this purely morphological definition for characterizing the subspecies of *E. traillii* because it is more restrictive than the statistical significance of differences between population means, also used in some taxonomic studies. The 75% rule allows more individual specimens to be assigned to subspecies and is more easily applied to the characters in which the populations of *E. traillii* show the most external difference. Genetic definitions of subspecies have been introduced recently (Zink 1986) but genetic techniques were not available to me and would require the collection of more additional specimens than is currently practical.

If the variation in a mensural character is normally distributed, the 75% criterion can be expressed mathematically by

$$x_A + 0.675s_A > x_B - 1.88s_B$$

where x represents the mean, s the standard deviation, and $x_A < x_B$. The factors 0.675 and 1.88 derive from the table of z values of the normal distribution. If the standard deviations of the two populations are different, this test may not give the same results when B is compared to A as when A is compared to B. I therefore performed the test in both directions between each pair of subspecies in each character.

TAXONOMIC RESULTS

The most comprehensive study of geographic variation in *E. traillii* was by Aldrich (1951), who recognized five subspecies: *E. t. brewsteri* Oberholser (1918), breeding from the Pacific Ocean east to the Cascade Range and Sierra Nevada, *E. t. adastus* Oberholser (1932), breeding between the Cascades and the Rocky Mountains, *E. t. extimus* Phillips (1948), breeding in the desert Southwest, southern Great Basin, and "the southern Great Plains" (though breeding Willow Flycatchers are very rare to absent in that region), *E. t. traillii* (Audubon 1828), breeding from Alaska through the boreal forest of Canada to the northeastern United States, and *E. t. campestris* Aldrich (1951), breeding from the Great Plains east through the Great Lakes states. Subsequently, Stein (1958, 1963) demonstrated that Aldrich's nominate *traillii* is the separate species now known as the Alder Flycatcher, and Snyder (1953) and the A. O. U. Committee on Classification and Nomenclature (A. O. U. 1973) suggested that Audubon's name *traillii* is better applied to the Willow Flycatcher.

Measurements and Proportions

Measurements and proportions of the four subspecies of *E. traillii* are listed in Tables 1 and 2. The sharpest distinctions in size or proportion among the subspecies of *E. traillii* are the functions of wing and tail lengths. In males, the greatest difference is in the wing − tail difference between *extimus* and *traillii*, but in even that character the 75% rule is satisfied in only one direction of comparison. In females, *traillii* might be distinguishable from the three western subspecies in both wing − tail difference and wing/tail ratio. The 75% criterion is met in both directions when *traillii* is compared to *brewsteri*, and in one direction when *traillii* is compared to *extimus* or *adastus*. However, the sample of female *traillii* is so small ($n = 4$) that any conclusion drawn from it can be considered only tentative. Therefore if subspecies exist in *E. traillii* they must be defined on a basis other than size.

Color

My results with respect to plumage color and wing structure, however, accord for the most part with those of Aldrich (1951) and Snyder (1953). The back color in specimens 40 to 80 years old (the great majority of those available) of all four subspecies is close to Olive (color 30) of Smithe (1975) but somewhat greener. In *brewsteri* the green is in the direction of Olive Green (color 48), in *adastus* in the direction of Greenish Olive (color 49), and in *extimus* and *traillii* in the direction of Grayish Olive (color 43). That is, *brewsteri* is a dark brownish olive, *adastus* a dark grayish green, and *extimus* and *traillii* a pale grayish green. In less worn individuals the contrast between a paler cap and darker back often noticeable in *brewsteri* and *adastus* is usually lacking in *extimus* and *traillii*. In *extimus* and *traillii* the underparts as well are often paler than in *brewsteri* and *adastus*, and the grayish breast band is less distinct, but these differences are less constant than those on the upperparts. I saw no consistent differences in color between *extimus* and *traillii* and cannot confirm Aldrich's (1951) statement that "*campestris*" (i. e., *traillii*) is "somewhat more greenish" than *extimus*. The sample of "*traillii*" with which

Table 1 Measurements and Proportions of Male *Empidonax traillii*

	extimus[a]	*traillii*[b]	*adastus*[c]	*brewsteri*[d]
Wing chord				
n	9	10	25	22
Mean	68.7	70.8	70.4	68.0
Range	65.7-72.5	68.8-74.2	66.8-73.9	65.9-71.2
SD[e]	2.04	1.73	1.68	1.35
Tail length				
n	9	9	25	22
Mean	59.3	59.1	59.7	58.1
Range	56.8-62.5	56.3-62.6	56.4-62.7	54.8-60.7
SD	1.91	1.96	1.57	1.61
Wing minus tail				
n	9	9	25	22
Mean	9.4	11.9	10.6	9.9
Range	7.9-11.6	10.6-12.8	8.4-13.4	7.5-12.5
SD	1.26	0.71	1.04	1.14
Wing/tail ratio				
n	9	9	25	22
Mean	1.16	1.20	1.18	1.17
Range	1.13-1.20	1.18-1.22	1.14-1.23	1.13-1.22
SD	0.023	0.016	0.019	0.023
Bill length from nostril				
n	9	10	24	21
Mean	9.7	9.2	9.5	9.5
Range	9.2-10.2	8.9-9.7	8.6-10.2	8.5-10.0
SD	0.32	0.25	0.37	0.36
Bill width at base				
n	9	10	25	22
Mean	7.1	7.2	7.2	7.3
Range	6.7-7.5	6.7-7.8	6.5-8.1	6.8-8.0
SD	0.26	0.36	0.41	0.34
Bill length/width ratio				
n	9	10	24	21
Mean	1.37	1.27	1.32	1.31
Range	1.29-1.50	1.18-1.39	1.14-1.48	1.18-1.44
SD	0.069	0.060	0.085	0.063

[a]Localities represented: Calif., Imperial Co., Potholes (4); Baja Calif. Norte, Las Cabras (2); Ariz., Navajo Co., ½ mi. E Fort Apache (1); Pinal Co., 9 mi. S Mammoth (1); Pima Co., Tucson (1).

[b]Localities represented: N. Dak., Ward Co., Kenmare (1); Kidder Co., Dawson (1); Dickey Co., Oakes (2); S. Dak., Miner Co. (1); N. Y., Monroe Co., Hilton (1); Tompkins Co., Ithaca (4).

[c]Localities represented: Wash., Okanagan Co., Riverside (1); Lincoln Co., Sylvan Lake (1), Sprague Lake (1), 6 mi. S Sprague (1); Spokane Co., Spokane (1); Whitman Co., Pullman (1), Uniontown (2); Asotin Co., Anatone (1), Grande Ronde River (1); Ore., Umatilla Co., Pendleton (1); Wallowa Co., Swamp Creek (1); Baker Co., Homestead (1); Harney Co., Stinking Water Mt. (1); Malheur Co., Beulah (1), 3 mi. W Juntura (2), Rockville (1); Nev., Washoe Co., Reno (1); Pershing Co., Winnemucca Lake (1); Ida., Boundary Co., Porthill (1); Butte Co., Big Lost River (1); Utah, Davis Co., Antelope Island (1); Carbon Co., Clear Creek (1); Mont., Flathead Co., Java (1).

[d]Localities represented: Wash., Clallam Co., Forks (1); Ore., Multnomah Co., Portland (6); Marion Co., Salem (1), Scotts Mills (1); Calif., San Diego Co., La Jolla (1), Bonita (1), Ballena (1); Imperial Co., Potholes (5), Bard (2); Baja Calif. Norte, Ojos Negros (1); Ariz., Yuma Co., Yuma (1); Sonora, Isla Tiburon (1).

[e]SD, standard deviation.

Table 2 Measurements and Proportions of Female *Empidonax traillii*

	extimus[a]	*traillii*[b]	*adastus*[c]	*brewsteri*[d]
Wing chord				
n	15	4	16	12
Mean	65.7	66.9	67.0	64.8
Range	62.7-70.1	65.8-68.2	64.4-69.4	61.3-69.3
SD	1.98	1.00	1.25	2.09
Tail length				
n	15	4	16	12
Mean	57.3	54.8	57.5	56.5
Range	54.5-60.2	53.1-56.7	55.7-59.5	55.0-59.8
SD	2.04	1.49	1.20	1.43
Wing minus tail				
n	15	4	16	12
Mean	8.4	12.1	9.5	8.2
Range	4.5-11.9	11.3-13.5	8.0-11.2	4.0-10.0
SD	1.90	0.99	1.05	1.58
Wing/tail ratio				
n	15	4	16	12
Mean	1.15	1.22	1.16	1.15
Range	1.08-1.20	1.20-1.25	1.14-1.20	1.07-1.18
SD	0.035	0.023	0.020	0.028
Bill length from nostril				
n	13	4	16	11
Mean	9.5	9.4	9.1	9.3
Range	8.7-10.1	9.0-9.6	8.5-10.0	8.8-9.8
SD	0.47	0.29	0.46	0.35
Bill width at base				
n	15	4	15	12
Mean	7.4	7.3	7.2	7.4
Range	6.8-7.9	7.2-7.4	6.7-7.6	6.8-8.0
SD	0.33	0.08	0.29	0.35
Bill length/width ratio				
n	13	4	15	11
Mean	1.30	1.29	1.27	1.25
Range	1.20-1.45	1.25-1.32	1.13-1.46	1.14-1.40
SD	0.075	0.031	0.088	0.071

[a]Localities represented: Calif., San Diego Co., Doane Valley (1), 3.6 km NW Lake Henshaw Dam (1), National City (1); Imperial Co., Potholes (2), Bard (2); Ariz., La Paz Co., Bill Williams Delta (1); Yuma Co., Yuma (6); Pima Co., Tucson (1).

[b]Localities represented: N. Dak., Kidder Co., Dawson (2); Richland Co., Lidgerwood (1); Illinois, Fulton Co., Canton (1).

[c]Localities represented: Wash., Lincoln Co., Sylvan Lake (1), 6 mi. S Sprague (1); Whitman Co., Palouse (1), Pullman (1); Ore., Wallowa Co., Enterprise (1), Swamp Creek (1); Baker Co., Homestead (1); Crook Co., 20 mi. S Paulina (1); Klamath Co., head of Whiskey Creek (1); Ida., Latah Co., Potlatch (1), Harvard (1), Moscow (1); Power Co., American Falls (1); Utah, Box Elder Co., Bear River mouth (1); Wyo., Stanley (not located; possibly Stansbury, Sweetwater Co., Wyo., or Stanley, Custer Co., Ida.) (1); N. Mex., Guadalupe Co., Santa Rosa (1).

[d]Localities represented: Wash., King Co., Seattle (1); Ore., Multnomah Co., Portland (4); Calif., Yolo Co., Grafton (1); San Diego Co., La Jolla (1); Imperial Co., Potholes (2), Bard (2); Baja Calif. Norte, Las Cabras (1).

Phillips (1948) compared *extimus* consisted largely if not entirely (A. R. Phillips pers. comm.) of *alnorum*, which is usually if not always darker and greener than even *adastus* (pers. obs. of specimens in NYSM and US).

One hundred percent of specimens of *extimus* from the lower Colorado River and Arizona are paler and grayer on the back than all specimens of *brewsteri*. For specimens from southwestern California and northwestern Baja California, the figure drops to 82%. Eighteen of 20 specimens (90%) from Arizona, southern California, and northern Baja California that should have been *extimus* on the basis of range are paler-backed than *adastus*, while 26 of 28 specimens (93%) from eastern Washington, eastern Oregon, northern Nevada, Idaho, northern Utah, and Wyoming are darker than *extimus*. Twenty-five of 28 *adastus* (89%) are grayer or purer green than *brewsteri*, while 15 of 18 *brewsteri* (83%) are browner or more olive than *adastus*.

Wing Formula

Phillips (1944) and Snyder (1953) reported that the eastern and western populations of *E. traillii*, as then considered, differ in wing formula, that in eastern birds, the tenth primary is longer than the fifth, while in the western birds, the tenth is equal to or shorter than the fifth. My results (Table 3) support this conclusion. The wing formula thus distinguishes 93% of the *extimus* and *traillii* in my sample, 88% of the *adastus* and *traillii*, and 89% of the *brewsteri* and *traillii*. It is more reliable for females than for males; the western

Table 3 Relative Lengths of Primaries 10 and 5 in the Four Subspecies of *Empidonax traillii*[a]

	10 > 5		10 = 5		10 < 5	
	n	%	*n*	%	*n*	%
Males						
traillii	20	95	1	5		
extimus	3	18	4	24	10	59
adastus	9	20	19	41	18	39
brewsteri	7	17	18	45	15	38
Females						
traillii	6	86			1[b]	14
extimus			3	11	24	89
adastus	1	4	8	31	17	65
brewsteri			2	8	22	92

[a]Each individual wing scored separately; wings with primaries 10 or 5 broken or badly worn not scored. Of 93 specimens with primaries 5 and 10 intact on both sides, 11 were sufficiently asymmetrical that the two wings fell into different categories. All cases of asymmetry, however, included the 10 = 5 category; that is, in no case was 10 > 5 in one wing and 10 < 5 on the other. Asymmetry was most frequent in *adastus* (7 of 34 specimens).

[b]Specimen poorly prepared, with wings apparently tied to body, so primary formula possibly disrupted.

birds in which the tenth primary is longer than the fifth are mostly long-winged males (wing chord > 70 mm).

Summary

I conclude that the four races of *E. traillii* recognized by Aldrich (1951) are valid by the criterion of the 75% rule and may be distinguished from each other by color, wing formula, or both. Figure 1 shows the approximate original breeding ranges of all four subspecies of *E. traillii* plus that of *E. alnorum*. The morphological differences among the races of *E. traillii* are minor, but differ little in magnitude from those distinguishing the species *traillii* from *alnorum*. In *Empidonax*, small differences in morphology may mask large differences in biology.

My concern in this study is the Willow Flycatchers of the southwestern United States and therefore with *E. t. extimus*. Although *E. t. extimus* was omitted from the 1957 edition of the A. O. U. Check-List of North American Birds, it has been recognized in all taxonomic studies of *E. traillii* since its original description. Its existence has been generally unappreciated probably because migrants of other subspecies occur commonly in its range during most of its breeding season, because of the dearth of original research on subspecies during the last 30 years, and because of fear of confusion of *E. traillii* with the sibling species *E. alnorum*, which does not occur in the southwestern states. During this period of neglect, *extimus* has dwindled nearly to extinction as the habitat on which it depends has been degraded and decimated.

Empidonax traillii extimus in California

Phillips (1948) and Aldrich (1951) included southern California in the breeding range of *brewsteri*, but my study shows that instead *extimus* occupies this area. All southern and Baja California specimens that either were labeled as breeding or were collected from 20 June to 15 July are listed in Table 4. These data indicate that only race *extimus* breeds in southern and Baja California and that intergradation with the subspecies to the north begins around Independence and Los Angeles. All specimens from Mono and northern Inyo counties are *adastus* or migrant *brewsteri*, so I suggest that Independence represents the northern limit of the range of *extimus* in eastern California. Three probably breeding specimens (MVZ) from the Sierra Nevada of Fresno County were all *brewsteri*, so it seems reasonable to regard Weldon as the northern limit of *extimus* along the axis of the Sierra Nevada. A single specimen (US 264166) collected at Tulare Lake 9 miles south of Lemoore, Kings County, on 20 June 1907 is too worn and poorly prepared to identify. I could find no specimens that unquestionably represent the population of coastal central California, so the northern limit of *extimus* along the coast is uncertain. However, no specimens of *extimus* have been collected in coastal California north of the San Fernando Valley.

New Specimen

Table 4 makes it obvious that the number of specimens of breeding Willow Flycatchers from southern California is small. Because only a small sample, or even a single individual, is preserved from most localities, further specimens would be desirable to support the conclusion that *extimus* is the subspecies breeding in southern California. Since the populations remaining in southern California are now so small and few, such collecting must be done judiciously, preferably from the largest remaining colonies. The only suitable site where I was able to collect is along the San Luis Rey River 3.6 km northwest of the Lake Henshaw dam in the Cleveland National Forest, San Diego County, where I obtained one female on 21 May 1984. The specimen, my original number 375, is now SD 44653. Its ovary was beginning to enlarge (7.5 × 4 mm, largest ovum 1.5 mm diameter) and it had only slight fat, indicating that it was on its breeding territory but had not yet begun to nest. This specimen is clearly *extimus*, on the basis of comparison with other unfoxed specimens, as it matches closely one collected at Fort Apache, Arizona, on 29 May 1972 (AMR 3915) but is much paler than a migrant *brewsteri* found dead at Borrego Springs, San Diego County, on 1 June 1980 (SD 42124).

Although the concept of the occurrence of *extimus* in California rests on a small number of specimens, there is little likelihood that this base can be added to soon. Therefore, the range of the subspecies must be estimated on

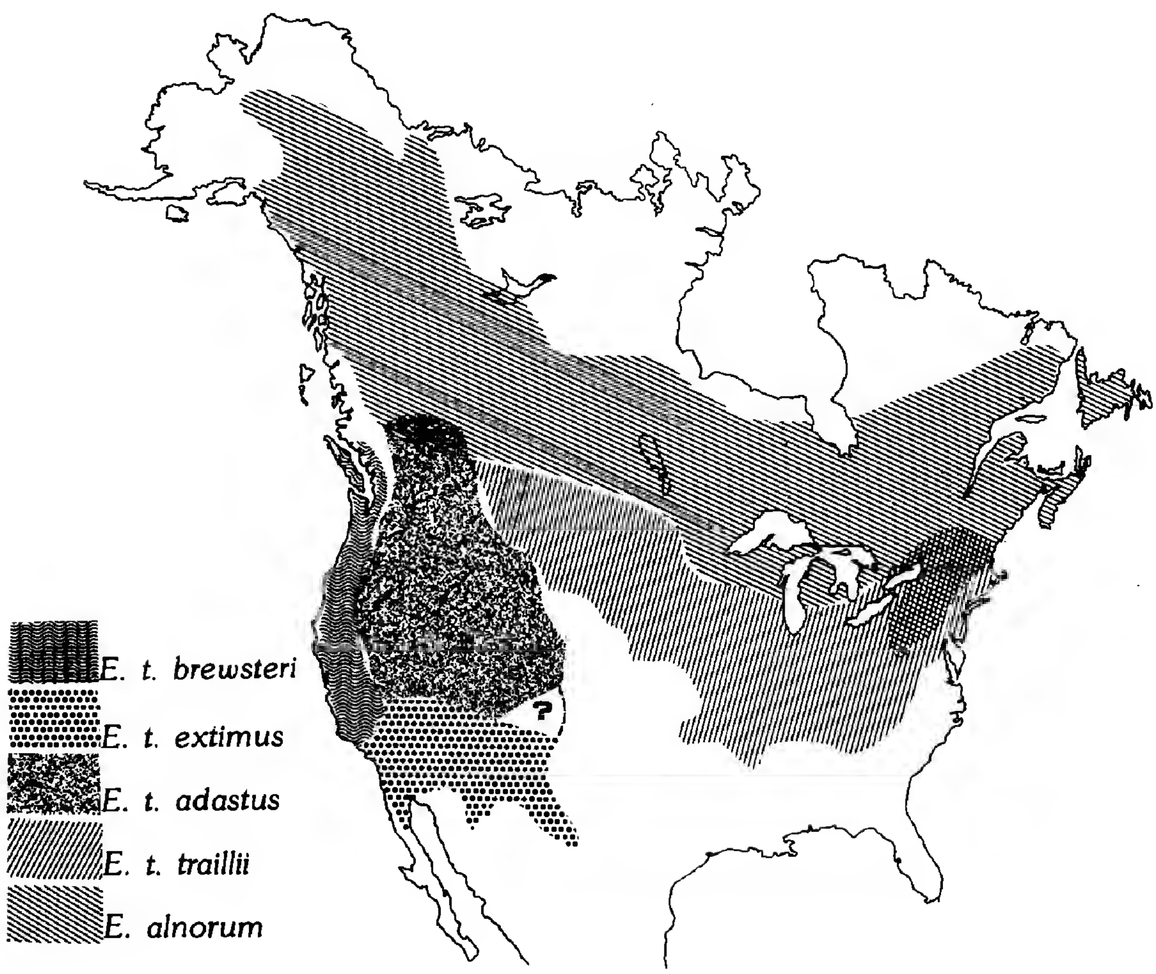

Figure 1. Breeding ranges of the subspecies of *E. traillii* and of *E. alnorum*.

Table 4 Southern and Baja California Specimens of Willow Flycatcher Labeled as Breeding or Collected from 20 June to 15 July

Specimen number	Locality	Date collected	Indication of breeding on specimen label	Subspecies
MVZ 29766	2 mi. N of Independence, Inyo Co.	28 Jun 1917	"breeding"	*extimus*
MVZ 27967	2 mi. N of Independence, Inyo Co.	28 Jun 1917	"breeding"	*brewsteri*
MVZ 19993	Weldon, Kern Co.	5 Jul 1911	none	*extimus*
MVZ 40543	Oro Grande, San Bernardino Co.	26 May 1920	"testes large"	*extimus*
LACM 7015	Cienaga (= West Los Angeles), Los Angeles Co.	21 Jun 1889	none	*extimus*
LACM 7012	El Monte, Los Angeles Co.	20 Jun 1903	none	*extimus*/ *brewsteri* intermediate
LACM 7013	El Monte, Los Angeles Co.	20 Jun 1903	none	specimen too dirty to identify
LACM 7017	El Monte, Los Angeles Co.	20 Jun 1903	none	*extimus*
MVZ 136340	Rivera, Los Angeles Co.	9 Jul 1920	none	*extimus*
LACM 22295	Los Cerritos, Los Angeles Co.	12 Jun 1908	"breeding"	*extimus*
LACM 22296	Los Cerritos, Los Angeles Co.	12 Jun 1908	"breeding"	specimen too poorly prepared to identify

Table 4 (Continued)

Specimen number	Locality	Date collected	Indication of breeding on specimen label	Subspecies
SBCM 36127	Colton, San Bernardino Co.	26 Jun 1918	nest and eggs collected with specimen	*extimus*/ *brewsteri* intermediate
LACM 66116	Capistrano Beach, Orange Co.	8 Jul 1966	"testes enlarged"	*extimus*
LACM 66117	Capistrano Beach, Orange Co.	8 Jul 1966	none	specimen too dirty to identify
SD 31867	National City, San Diego Co.	5 Jun 1913	"inc[ubating]"	*extimus*
SBCM 36116	3 mi. W of Niland, Imperial Co.	13 Jun 1953	"testes 5 mm"	*extimus* (specimen foxed)
SD 13233	Potholes (= Laguna Dam), Imperial Co.	26 Jun 1930	none	*extimus*
SD 17825	Potholes (= Laguna Dam), Imperial Co.	22 Aug 1938	"feeding grown young"	*extimus*
SD 9903	La Grulla, Sierra San Pedro Martir, Baja California	27 Jun 1925	"breeding"	*extimus*

the basis of the currently available specimens. All identifiable southern California specimens labeled as breeding or collected between 13 June and 17 July are *extimus* except for the two intermediates from El Monte and Colton listed in Table 4.

Table 5 Additional Southern and Baja California Specimens of *Empidonax traillii extimus* (No Indication of Breeding on Specimen Label)

Specimen number	Locality	Date	Age
MVZ 27965	Wild Rose Canyon, Panamint Mts., Inyo Co.	12 Jun 1917	ad.
LACM 7011	San Fernando, Los Angeles Co.	13 Jun 1899	juv.
MVZ 33378	San Fernando Valley, Los Angeles Co.	13 Sep 1903	juv.
LACM 7016	Cienaga (= West Los Angeles), Los Angeles Co.	28 Jul 1888	juv.
MVZ 33375	El Monte, Los Angeles Co.	12 Aug 1897	juv.
UCLA 23810	Long Beach, Los Angeles Co.	10 May 1913	ad.
MVZ 33381	Seven Oaks, San Bernardino Co.	13 Jun 1905	ad.
MVZ 3187	Santa Ana R. near Colton, San Bernardino Co.	20 Jul 1908	ad.
MVZ 3182	Santa Ana R. near Colton, San Bernardino Co.	25 Jul 1908	juv.
MVZ 11753	Riverside, Riverside Co.	26 Jul 1892	juv.
MVZ 11755	Riverside, Riverside Co.	26 Jul 1892	juv.
MVZ 3078	Palm Canyon, San Jacinto Mts., Riverside Co.	12 Jun 1908	ad.
SD 19184	Doane Valley, Palomar Mts., San Diego Co.	12 Jun 1945	ad.
UCLA E128	Sunnyside, Sweetwater R., San Diego Co.	6 Jun 1917	ad.
MVZ 3615	Campo, San Diego Co.	13 May 1908	ad.
SBCM 36114	3 mi. W of Niland, Imperial Co.	5 Oct 1952	juv.
SBCM 36115	3 mi. W of Niland, Imperial Co.	13 Jun 1953	ad.
SBCM 36117	3 mi. W of Niland, Imperial Co.	4 Sep 1953	juv.
SBCM 36118	3 mi. W of Niland, Imperial Co.	4 Sep 1953	juv.
SBCM 36119	3 mi. W of Niland, Imperial Co.	4 Sep 1953	juv.
UCLA 31873	Salton Sea, Imperial Co.	26 May 1934	ad.
SD 13037	Potholes (= Laguna Dam), Imperial Co.	5 May 1930	ad.
SD 13038	Potholes (= Laguna Dam), Imperial Co.	5 May 1930	ad.
SD 13200	1 mi. N of Potholes (= Laguna Dam), Imperial Co.	30 May 1930	ad.
SD 13222	1 mi. N of Potholes (= Laguna Dam), Imperial Co.	10 Jun 1930	ad.
SD 19164	Bard, Imperial Co.	3 Jun 1945	ad.
SD 10019	2 mi. N of Bard, Imperial Co.	28 Sep 1925	juv.
SD 13204	3 mi. N of Bard, Imperial Co.	31 May 1930	ad.
MVZ 12910	Colorado River 5 mi. NE of Yuma, Imperial Co.	4 May 1910	ad.
SD 8714	Las Cabras, Rio San Telmo, Baja California	4 Jun 1923	ad.
MVZ 52932	7 mi. E of Cerro Prieto, Colorado delta	5 Jun 1928	ad.
MVZ 52933	7 mi. E of Cerro Prieto, Colorado delta	6 Jun 1928	ad.
MVZ 52934	7 mi. E of Cerro Prieto, Colorado delta	11 Jun 1928	ad.
MVZ 52935	7 mi. E of Cerro Prieto, Colorado delta	11 Jun 1928	ad.

DISTRIBUTION OF *EMPIDONAX TRAILLII EXTIMUS*

In addition to the museum study skins listed in Tables 4 and 5, I used the data cards accompanying the egg collections of SBCM and the Western Foundation for Vertebrate Zoology, Los Angeles (WFVZ), as my sources of information on the subspecies' original range in southern California. Literature reports of *Empidonax* species may be questioned in this genus of difficult-to-identify birds unless the identifications are supported by specimens still available for reexamination. Fortunately, however, published accounts of Willow Flycatchers in southern California do not deviate much from the evidence verifiable through preserved specimens.

My primary sources of information on the range of *extimus* east of California were Behle (1985) and a list of specimens identified and supplied by A. R. Phillips. I used published literature as a supplementary source for additional breeding localities within the range delineated by these sources. Egg collections, though a major information resource for coastal southern California, are nearly lacking from the region east of the Colorado River.

Breeding or probable breeding localities for the entire range of *extimus* are plotted in Figure 2, where crosses indicate localities where Willow Flycatchers were found before 1970 but have not been reported since.

California

Willett (1912, 1933) stated that Willow Flycatchers bred commonly in coastal southern California, and the large numbers of egg sets collected before 1940 in the Los Angeles basin (67), the San Bernardino/Riverside area (34), and San Diego County (42) bear this out. I have plotted egg records from the Santa Clara River in Ventura County also in Figure 2, although I have seen no unquestionably breeding specimens that would indicate the subspecific identity of that population. In southeastern California, substantial Willow Flycatcher populations probably existed only along the Colorado River, as indicated by 37 nests collected by Herbert Brown near Yuma in 1902, 33 of which are now in the University of Arizona (J. Bates and T. R. Huels, pers. comm.).

Baja California

The six specimens from the three Baja California localities listed in Tables 4 and 5 constitute all available information on the summer range of Willow Flycatcher in that region. Previously, the species' status in the peninsula had not been determined precisely. The specimen from La Grulla is the only evidence indicating that the Willow Flycatcher has ever nested in Baja California. The "almost certain" *E. traillii* reported from various locations in northern Baja California between 5 and 24 April 1967 (Short and Crossin 1967) were almost certainly misidentified because the species is unknown in southern California earlier than 28 April and does not normally winter north of southern Mexico.

Arizona

In the other parts of its range, which are largely desert, *extimus* was always localized and usually uncommon. It is known to have occurred at a few localities along the San Pedro River, and one of these, Feldman, is its type locality. Other areas of known occurrence in Arizona were the Santa Cruz River near Tucson, Camp Verde, the Colorado River (Lee's Ferry and junction of Little Colorado River as well as along the California border), and the White Mountain region (Whiteriver, Springerville, and Alpine) (Phillips 1948 and pers. comm.; Phillips et al. 1964).

Nevada

E. t. extimus has been recorded at only three Nevada localities: Indian Springs (three nesting pairs in 1932, two specimens collected on 8 and 11 July, Linsdale 1936), Corn Creek (one specimen on 16 May 1962), and Colorado River at the southern tip of the state (one specimen on 9 May 1953, A. R. Phillips, pers. comm.).

Utah

The northern limits of *extimus* in the eastern part of its range have been subject to widely different interpretations. Snyder (1953) ascribed the subspecies to northeastern Utah, Burleigh (1972) to southern Idaho, and Aldrich (in Bailey and Niedrach 1965) to Colorado. Aldrich (1951) outlined its range rather vaguely as including the southern Great Basin and the southern Great Plains. The reason for these varying concepts is that the intergradation between *extimus* and *adastus* in the Great Basin/Rocky Mountain area is much more gradual than that between *extimus* and *brewsteri* in California, where the intermediate population, if any, in central California was never collected and is now extinct. Behle (1985) addressed the problem of intergradation between *extimus* and *adastus* explicitly. He found that in Utah there is a fair-

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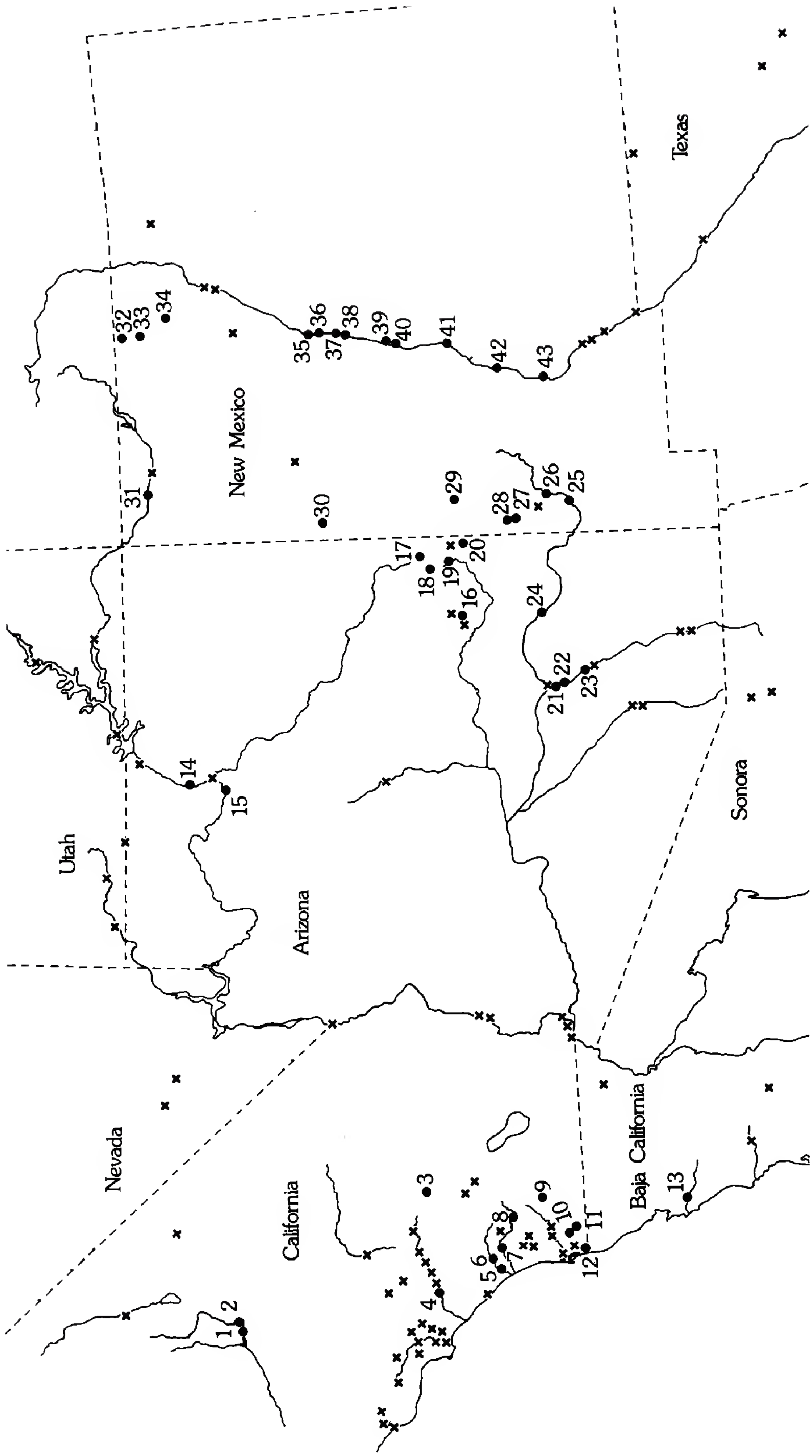
Figure 2. Past and present breeding distribution of *E. t. extimus*. Crosses, localities where breeding or probably breeding *extimus* were recorded before 1970 but not since; dots, localities where definitely or possibly breeding *extimus* have been recorded since 1970. 1, South Fork of Kern River at Weldon; 2, South Fork of Kern River 18 km E of Onyx Ranch; 3, Big Morongo Wildlife Preserve; 4, Prado Basin; 5, Santa Margarita River, Camp Pendleton; 6, Santa Margarita River, 3 km NE of Fallbrook; 7, San Luis Rey River, 3 km NE of Bonsall; 8, San Luis Rey River, Lake Henshaw to La Jolla Indian Reservation; 9, Cuyamaca Lake; 10, Sweetwater Reservoir; 11, Lower Otay Lake; 12, Tijuana River Valley; 13, Rio Santo Tomas, 5 km NW of Santo Tomas; 14, Colorado River, Grand Canyon, River Miles 47 to 54; 15, Colorado River, Grand Canyon, River Mile 71; 16, 1 km E of Fort Apache; 17, South Fork of Little Colorado River near Springerville; 18, Greer; 19, Black River, White Mountains; 20, Blue River, White Mountains; 21, San Pedro River at Dudleyville; 22, Cook's Lake; 23, San Pedro River near San Manuel; 24, Gila River at Fort Thomas; 25, Gila River at Redrock; 26, Gila River at Cliff; 27, Pleasanton, San Francisco River; 28, Glenwood, San Francisco River; 29, Reserve, San Francisco River; 30, Zuni; 31, Kirtland, San Juan River; 32, Rio Chama at Chama; 33, Rio Chama at Los Ojos/Park View; 34, Canjilon, San Juan Mountains; 35, Rio Grande at Alameda; 36, Rio Grande at Albuquerque; 37, Rio Grande at Isleta; 38, Rio Grande at Los Lunas; 39, Rio Grande at Bernardo; 40, Rio Grande at La Joya; 41, Rio Grande at Bosque del Apache National Wildlife Refuge; 42, Rio Grande at Elephant Butte Marsh; 43, Rio Grande at Caballo Lake. →



Utah
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ly smooth cline from darker birds in the north to paler birds in the south, but that specimens from only the southern tier of Utah counties are closer to *extimus* than to *adastus*.

In Utah the subspecies occurred along the Virgin River in the St. George and Springdale areas, 3 miles south of Kanab (Behle et al. 1958), along the San Juan River, and along the Colorado River in Glen Canyon (now under Lake Powell), where the species was found nesting in 1958 (Behle 1960).

New Mexico

The taxonomy of *E. traillii* in north-central New Mexico and Colorado has not been studied in detail and probably cannot be determined without further collecting. A. R. Phillips (pers. comm.) has identified as *extimus* Willow Flycatchers that were collected in southwestern New Mexico, along the Rio Grande north to Bernardo, Socorro County, and near Farmington on the San Juan River in northwestern New Mexico. One *extimus* collected in eastern New Mexico at Boone's Draw, Roosevelt County, on 22 May 1975 was probably a migrant. I have arbitrarily used the New Mexico/Colorado line as the northern limit of *extimus* at the eastern extreme of its range, on the speculation that the transition there from *extimus* to *adastus* may be at approximately the same latitude as in Utah.

Hubbard (1970, 1978, pers. comm.) reported several breeding or probable breeding localities in New Mexico, extending east at least to the Rio Grande, south to Anthony on the Texas line. Because the current range of Willow Flycatcher in New Mexico is nearly the same as its originally known range, I have described the species' distribution there under Current Status below.

Texas

The eastern edge of the range of *extimus* probably lies between the Rio Grande and Pecos River in western Texas. The subspecies has been collected at Fort Hancock on the Rio Grande (Phillips 1948), in the Guadalupe Mountains (A. R. Phillips, pers. comm.), 9 miles southeast of Glenn Springs, and 15 miles northwest of Alpine, Brewster Co., and has been reported breeding in the Davis Mountains (Oberholser 1974). Wauer (1973) called the Willow Flycatcher a rare summer resident in Big Bend National Park, but cited no specific records of breeding or occurrence outside migration periods.

Sonora

Two specimens of *extimus* from northern Sonora (17 June 1955, 2 km south-southwest of La Casita, 37 km south of Nogales; 1 June 1952, Agua Caliente, 48 km south of Nogales; A. R. Phillips, pers. comm.) are the only evidence that Willow Flycatchers may breed in mainland Mexico.

CURRENT STATUS

I derived information on the current status and distribution of *extimus* from published literature, contract reports to government agencies, personal communication with field ornithologists active in the southwestern states, and my own field work. Localities where breeding or summering Willow Flycatchers have been reported since 1970 are plotted as solid circles in Figure 2. The information is most complete for southern California, where intensive surveys of riparian woodlands for Bell's Vireos have resulted in discovery of a few Willow Flycatcher colonies. Still, the picture for even this area is undoubtedly incomplete. Researchers studying Bell's Vireos observed Willow Flycatchers only incidentally; several of them stressed to me that their results could not be considered exhaustive. Probably these observers' abilities to detect and identify this species varied. Nevertheless, the primary reason that so few Willow Flycatchers have been found is that there are so few left to find. The number of localities where the species is known to occur at present is only a fraction of the number of historic localities. *E. t. extimus* is now absent from the major areas where it formerly occurred, such as the Los Angeles basin, the Santa Ana River near Riverside and San Bernardino, and the Colorado River.

California

The largest remaining colony of *extimus* in California is on the South Fork of the Kern River near Weldon just east of Lake Isabella, Kern County. Serena (1982) reported 26 singing birds on and near the Nature Conservancy Kern River preserve in the summer of 1982. In addition, a single singing bird was reported farther upstream along the South Fork of the Kern River 18 km east of Onyx Ranch. R. Hewitt (in McCaskie 1984) reported 23 in the Weldon area in 1984. The population increased substantially, to 39 singing birds, by 1986 (Harris et al. 1987). Harris et al. suggested that this increase may be due to the recovery of the vegetation since the Nature Conservancy acquired the area and reduced cattle grazing.

At Big Morongo Wildlife Preserve in southwestern San Bernardino County Cardiff et al. (1982) found one nesting pair in 1981. In the seven years from 1977 to 1983 that Cardiff et al. censused breeding birds at this locality, however, they found Willow Flycatchers in only that one year.

L. R. Hays (in McCaskie 1986) reported four pairs in the Prado Basin, Riverside County, in 1986. This constitutes the only report from the Santa Ana River, a former center for the species, in over 30 years.

All other localities where Willow Flycatchers summer in southern California are in San Diego County. The largest population is on the Santa Margarita River in Camp Pendleton, where L. Salata (pers. comm.) has kept careful notes on the Willow Flycatchers he has observed incidentally during his work on Bell's Vireos from 1981 through 1986. He recorded 5 territorial birds in 1981, 10 in 1982, 10 in 1983, 16 in 1984, 15 in 1985, and 17 in 1986. This apparent increase in the population size at this site coincides with the years in which Brown-headed Cowbirds (*Molothrus ater*) were trapped there.

The other major Willow Flycatcher colony in southern California, which R. Higson and I discovered in 1984, is along 10 km of the upper San Luis Rey River between Lake Henshaw and the La Jolla Indian Reservation. Higson (pers. comm.) searched this entire section of river on 31 May 1984 and located 12 territorial birds. Goldwasser (pers. comm.), during a survey for Bell's Vireos on 15 May 1986, detected six singing Willow Flycatchers in this area.

All other Willow Flycatcher colonies in southern California are small and apparently occupied only intermittently. Along the Santa Margarita River 3 km northeast of Fallbrook, a short distance upstream from Camp Pendleton,

S. Goldwasser (pers. comm.) found two singing birds 2 June-12 July 1980; I did not find any there on 8 and 9 May 1984 and there have been no subsequent reports from this locality. Goldwasser also found one singing bird along the lower San Luis Rey River 3 km northeast of Bonsall 4-25 June 1978. Again, I did not find any Willow Flycatchers at that locality on 7 May 1984 and there are no other reports.

On 5 June 1984 I found three singing Willow Flycatchers, plus a silent bird collecting nest material, at the south end of Lake Cuyamaca. I did not find any there, however, on 4 May and 28 June 1986. Eight egg sets of this species had been collected at this locality in 1920 and 1921.

E. Copper (pers. comm.) found two territorial Willow Flycatchers at the upper end of Sweetwater Reservoir in 1984. But the only observation there in 1986 was of a single singing bird on 9 July (J. Griffith, pers. comm.). Two egg sets were collected at Sweetwater Reservoir in 1920 and 1921.

I found one singing Willow Flycatcher on Jamul Creek at the east end of Lower Otay Lake on 13 July 1975, but this habitat was later flooded by the rising level of the reservoir. Although suitable habitat has regenerated, no Willow Flycatchers have been reported subsequently from that locality.

The Willow Flycatcher population in the Tijuana River Valley increased from one territorial bird in 1981 to two in 1982 to five on 9 June 1984 (G. McCaskie, pers. comm.). McCaskie found no Willow Flycatchers during a visit to part of the habitat there on 22 June 1986, however. Riparian woodland suitable for breeding Willow Flycatchers has developed along the Tijuana River only since the late 1970s, so occurrence of the species there indicates that it still has the potential to colonize new localities.

Baja California

Outside of southern California, available information on the current distribution of *extimus* is very sketchy. During a two-day trip to several tracts of riparian woodland in northern Baja California, M. Evans, P. Fromer, and I found only a single singing individual, along the Rio Santo Tomas 5 km northwest of the town of Santo Tomas on 21 June 1986. Particularly in comparison to our finding of 21 territorial Bell's Vireos during this same survey, it is clear that Willow Flycatchers are extremely rare in Baja California.

Nevada/Utah

I have no recent information from southern Nevada.

W. H. Behle (pers. comm.) states that no recent information is available on the species' status in southern Utah. He notes that the Willow Flycatcher was always rare in that region and believes that a recent change in status is likely only along the Virgin River in the vicinity of St. George, where riparian habitat has been lost to urban development. Some habitat along the Colorado River in southeastern Utah was lost by the creation of Lake Powell, but Behle believes that suitable habitat still persists along tributaries.

Arizona

Probably the steepest decline in the population levels of *extimus* has occurred in Arizona, though the subspecies was always localized and uncommon there. The largest known colony occurs along the Colorado River in the upper Grand Canyon, where B. T. Brown (Brown and Johnson 1985, 1987; Brown et al. 1985) found two pairs in 1982, four in 1983, four in 1984, eight in 1985, and 11 in 1986. The Grand Canyon birds occur in two areas: between River Miles 47 and 54, about 24 km above the confluence of the Colorado and the Little Colorado rivers (9 pairs in 1986) and at River Mile 71 (2 pairs in 1986). Along the San Pedro River in 1985, W. C. Hunter (pers. comm.) located at four singing birds at Dudleyville and three at San Manuel, plus one nesting pair and two apparently unmated singing birds on the Gila River at Fort Thomas. One pair summered at Cook's Lake, 5 miles south of Dudleyville, in 1978 and 1979, but the species was absent there in 1986 (W. C. Hunter, pers. comm.). According to Hunter (pers. comm.), a small population probably persists in the White Mountains, since the birds have been seen recently in summer along the south fork of the Little Colorado River near Springerville, along the Black and Blue rivers, and at Greer. A. M. Rea collected one *extimus* ½ mile east of Fort Apache on 29 May 1972 (AMR 3915), but no more recent information is available from the White River. Further exploration is needed, but it is clear that *extimus* has been extirpated from much of the area from which it was originally described, the riparian woodlands of southern Arizona.

New Mexico

Most of the remaining population of *extimus* breeds apparently in New Mexico. The largest known population lives along the upper Gila River in southwestern New Mexico, where Montgomery et al. (1985) in 1983 found 19 pairs or singing birds along 3-km section of river near Redrock and 53 along an 8-km section near Cliff. Egbert (1981) found 28 and 50, respectively, in these same areas in 1981, though some of these may have been migrants. J. P. Hubbard and G. Monson (pers. comm.) found a nesting pair at Glenwood, San Francisco River valley, on 10 July 1972, and Hubbard (1970 and pers. comm.) cites Pleasanton and Reserve as additional breeding localities on this river. "Small numbers" were reported at Zuni, McKinley County, from 21 June to 27 July 1982 and two or three were there in the summer of 1984 (J. Trochet in Hubbard 1982, 1984); the species has now been confirmed as breeding there. Schmitt (1976) found the species at Kirtland, San Juan River (five on 15 July 1971), and collected on 28 July 1972 a female that had recently finished breeding. Near the Colorado line, Willow Flycatchers occur along the Rio Chama in the Chama and Los Ojos/Park View areas (Hubbard and Hundertmark, pers. comm.) and near Canjilon in the San Juan Mountains (one on 20 June 1982, Hubbard 1982).

Willow Flycatchers summer in small numbers at many places along the Rio Grande from Alameda (and at least formerly, Dixon; Hubbard pers. comm.) south. Hink and Ohmart (1984) reported eight probably breeding pairs along the middle Rio Grande in 1981 and 1982. According to W. H. Howe (pers. comm.), this report is based on observations of one singing bird at Albuquerque in 1981, two or three at Isleta in both 1981 and 1982, one at Los Lunas in 1981, and four at La Joya in 1982. C. A. Hundertmark (pers. comm.) found two singing Willow Flycatchers at Oxbow Marsh, Albuquerque, on 6 July 1985 and one on 7 June 1986. Howe (pers. comm.) found two singing

3 miles north of Bernardo on 20 June 1983 but noted that the birds were absent from La Joya in 1986 and that the habitat there had been dredged by the local water conservancy authority. Farther south along the Rio Grande, summering Willow Flycatchers have occurred recently at Bosque del Apache National Wildlife Refuge (one 6-26 June 1982, D. and S. Huntington in Hubbard 1982) and Caballo Lake (J. P. Hubbard, pers. comm.). At Elephant Butte Marsh, Hundertmark (1978) found 10 nests or family groups in 1974, six in 1975. The tract where these Willow Flycatchers occurred has since been flooded by rising water levels, and although additional suitable habitat has grown farther upstream, Willow Flycatchers were not relocated there during surveys conducted from 1979 to 1981 (C. A. Hundertmark, pers. comm.). The Willow Flycatcher may now be absent from the Rio Grande in Dona Ana County, where it nested at Radium Springs and Anthony (Hubbard 1970) and was collected at Las Cruces (A. R. Phillips pers. comm.) but has not been reported recently. Hubbard (1970, 1978) lists several other New Mexico localities as possible breeding sites or as sites of records needing further substantiation (not plotted in Figure 2).

Hubbard (pers. comm.) believes the species' status in New Mexico has not changed in recent years and that the population there may number several hundred pairs. He notes that many tracts of suitable habitat remain uninvestigated, however.

Summary

On the basis of the maximum population counted in any year at each of the 10 sites, the known Willow Flycatcher population in the California range of *extimus* consists of 87 pairs. Because so much of the riparian woodland of this area has been surveyed in recent years, I believe this number represents a substantial majority of the actual population. The population in Arizona cannot be more than a few dozen pairs and may be less. Even if a few hundred pairs persist in New Mexico, the total population of the subspecies is well under 1000 pairs; I suspect 500 is more likely. Although the data reveal no trend during the past few years, the population is clearly much smaller now than 50 years ago, and no change in the factors responsible for the decline seems likely.

GENERAL BIOLOGY

Migration Schedule

Proper field studies of Willow Flycatchers require an understanding of the species' migration. The northwestern race *E. t. brewsteri* is far more numerous than *extimus* and is common in migration in the western part of the latter's range. *E. t. brewsteri* is one of the latest spring migrants in western North America, not arriving until about 15 May. The earliest specimens I have identified were collected on 7 May (1908, near Cabazon, MVZ 1686) and 11 May (1906, Ventura, MVZ 6898). Peak numbers pass through southern California around 1 June, and Garrett and Dunn (1981) state that Willow Flycatchers are still migrating north until about 20 June. The latest spring date on which I have identified *brewsteri* in the California range of *extimus* is 13 June (1953, 6 miles southwest of Niland, SBCM 31042), but Phillips et al.

(1964) reported a *brewsteri* collected in Arizona on 23 June (1932, Bates Well, Organ Pipe Cactus National Monument). Fall migrant *brewsteri* arrive in southern California by 18 July (1908, near Colton, MVZ 3184). This date may seem inordinately early for fall migration of a land bird, but is in fact no earlier than the beginning of fall migration of such familiar species as Western Tanager (*Piranga ludoviciana*) and Black-headed Grosbeak (*Pheucticus melanocephalus*). Thus *brewsteri* is present in the range of *extimus* during most of the latter's breeding season, so single observations are often useless for indicating the local status of Willow Flycatchers. Any survey must encompass the period 20 June-15 July and must include repeated visits to each site to verify that any Willow Flycatchers seen are resident and territorial. Surveys for *E. t. extimus* must be more intensive than surveys for a sedentary species or a migratory species, such as Bell's Vireo, that is uncomplicated by large numbers of nonlocal breeders.

The spring migration of *extimus* is earlier than that of *brewsteri*. The normal arrival of *extimus* in both southern California and southern Arizona (Phillips et al. 1964) is the first week of May. Hubbard (pers. comm.) found apparently territorial Willow Flycatchers along the Gila River in New Mexico on 6 May in 1960 and 1961. In four out of five years L. Salata recorded a first arrival date on the Santa Margarita River in the first week of May; his average date was 6 May. In 1981 E. Copper found the Willow Flycatcher in the Tijuana River Valley on 2 May. On the basis of sight records, April arrival has been reported twice: at Potholes, Colorado River, on 28 April 1910 (Grinnell 1914) and at Weldon on 30 April 1977 (McCaskie 1977). The Grand Canyon population, near the northern edge of the subspecies' range, is an exception to this pattern; B. T. Brown (pers. comm.) has found that breeding Willow Flycatchers do not arrive there until 15 May.

Vocalizations

Territorial Willow Flycatchers are most easily located by their songs, the notorious "witch-pew" (usually rendered "fitz-bew") and a less frequent but equally characteristic "brrrit!" My very limited observations suggest that only early to mid morning is a suitable time for counting *extimus*. Near Weldon on 15 May 1984 I counted from one bird 52 songs between 0805 and 0815 and 56 between 0935 and 0945, but only four between 1105 and 1115 and none between 1515 and 1525. A secondary peak of singing occurs near dusk (S. A. Laymon pers. comm.).

Willow Flycatchers begin singing in spring as soon as they arrive on their breeding territories, but stop singing in July, well before their fall departure. I found the birds still present but not singing on the San Luis Rey River on 26 July 1986. L. Salata (pers. comm.) finds that the frequency of singing on the Santa Margarita River drops after about 15 July, and B. T. Brown (pers. comm.) does not believe that Willow Flycatchers can be located reliably by song after 1 July.

Any accurate survey of Willow Flycatcher populations must accommodate the birds' singing frequency with respect to both time of day and time of year. Uncertainty in song frequency as much as uncertainty in occurrence of migrants demands that accurate censuses include repeated visits to each colony site.

Migrating Willow Flycatchers rarely sing in southern California, contra Scott (1983). For example, between 1 and 10 June 1977, when I visited Point Loma, San Diego County, and saw migrant Willow Flycatchers almost daily, I did not hear a single song. This is one of the few factors that simplifies interpretation of Willow Flycatcher observations. A bird heard singing repeatedly is probably on its breeding territory. Still, migrants do sing occasionally. This possiblility must be considered especially in May because male Willow Flycatchers tend to migrate before females. In northern California, migrants apparently sing more frequently (T. Manolis pers. comm.), possibly reflecting increasing hormone levels as the birds approach their breeding grounds.

Reproductive Biology

The following data on nesting season, clutch size, and nest placement are based largely on the egg collections in WFVZ, SBCM, and UA. Most sets from the range of *extimus* were from the coastal slope of southern California; 35 were from the Colorado River, and one was from Fairbank, upper San Pedro River, Arizona. On the basis of 187 dated sets, *extimus* usually begins nesting about 1 June. The sets range in date from 24 May to 30 July; the mean date is 16 June. In coastal California, the complete clutch consists of either three or four eggs; 60% of the sets had three eggs, 40% had four. On the Colorado River, average clutch size is smaller: of 28 unparasitized sets with clutch size recorded, 18% had two eggs, 82% had three eggs, and none had four.

The usual natural nest site for *extimus* is the fork of a willow. Of 172 nests whose site was specified, 148 (86%) were in willows (*Salix* spp.), 7 (4%) were in nettles (*Urtica dioica*), 4 (2%) were in grapevines (*Vitis girdiana*), 3 (2%) were in blackberry vines (*Rubus ursinus*), 3 (2%) were in unidentified vines, 3 (2%) were in alders (*Alnus rhombifolia*), 2 (1%) were in arrowweed (*Pluchea odorata*), 1 (0.5%) was in a sycamore (*Platanus racemosa*), and 1 was in a rosebush (*Rosa californica*). In New Mexico, Hubbard (pers. comm.) has found the species nesting predominantly in *Salix gooddingii*. At least in the eastern part of its range, however, the subspecies may now be adapting to the tamarisks (*Tamarix* spp.) that are replacing the natural vegetation in desert riparian areas. B. T. Brown (pers. comm.) has data suggesting that Willow Flycatchers in the Grand Canyon select tamarisks for nest sites in preference to native vegetation, and Hundertmark (1978) found that the species nested predominantly in tamarisks at Elephant Butte Marsh, New Mexico.

The elevation of the nest above the ground is quite variable, ranging from 0.6 m (2 feet) to 5.5 m (18 feet). The mean nest height is 2.3 m with a standard deviation of 0.92 m. Although the flycatchers nest exclusively in trees or in vegetation under trees, marsh plants such as cattails (*Typha* spp.) are often part of their territories and foraging habitat.

Cowbird Brood-Parasitism

Brown-headed Cowbirds, which invaded coastal southern California between 1910 and 1920, were parasitizing *extimus* heavily by the 1930s. W. C. Hanna (in Willett 1933) reported that it was "now difficult to find a nest of this flycatcher, near Colton [San Bernardino Co.], that does not contain at least one egg of the Dwarf Cowbird." On the card accompanying an egg set he collected at the Santa Clara River mouth, Ventura Co., on 11 July 1937, M. C. Badger noted that cowbird eggs were "nearly always found in nests of this species."

Cowbirds have been present throughout recorded history in most of the range of *extimus* from the Colorado River eastward. Yet only two of 34 nests collected in 1902 near Yuma had been parasitized, and in New Mexico, only four of 21 nests found by Hubbard (pers. comm.) had been parasitized. Brood-parasitism by cowbirds undoubtedly has played some part in the decline of *E. t. extimus*, but its relative contribution and the ways, if any, that the flycatchers have adapted to parasitism remain unknown.

OUTLOOK

The available evidence indicates that the population of *extimus* has declined precipitously and that the subspecies is now rarer than many other birds formally designated as endangered. The subspecies is now absent from many areas were it was once common, and most of the remaining population is restricted to a few colonies. Even in New Mexico, where the largest numbers persist, the Willow Flycatcher's continuing survival is threatened by progressive loss of riparian habitat, especially the marshy situations the birds use most extensively (J. P. Hubbard, pers. comm.).

Riparian habitat destruction is probably most responsible for the decline of *extimus*. For example, the water conservancy authority along the middle Rio Grande regularly dredges out the willow thickets in drainage channels where the flycatchers occur, at a minimum forcing the birds to shift frequently from site to site and leaving no opportunity for population recovery (W. H. Howe, pers. comm.). Several of the colony sites are threatened by proposed reservoirs. Recent bird surveys that have located Willow Flycatcher colonies, such as those of Montgomery et al. (1985) and Hink and Ohmart (1984), were prompted by proposals for dams whose construction would inundate extensive riparian zones. Protection and restoration of riparian woodland is clearly the flycatchers' primary need, but their basic biology, particularly habitat requirements and response to cowbird parasitism, must be known better before specific management practices can be adopted.

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BREEDING BIRDS OF AN ALPINE HABITAT IN THE SOUTHERN SNAKE RANGE, NEVADA

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Alpine ecosystems occur as isolated islands on the highest of the Great Basin mountain ranges. These include the Wassuk, White, Humboldt, Toiyabe, Toquima, East Humboldt, Ruby, Grant, Schell Creek, Snake, Deep Creek, and Stansbury mountains (Cronquist et al. 1972). Like other altitudinally zoned ecosystems of Great Basin mountain ranges, alpine ecosystems have been neglected in the past because of difficult access and false impressions of biotic sterility (Johnson 1978). Recently, more attention has been directed to the scientific study of these unique environments and to their wise use and management (Ives and Barry 1974, Thilenius 1975, Billings 1978, Johnson 1979, Braun 1980).

There are few quantitative assessments of alpine breeding bird populations. Such data are basic to understanding the ecology of alpine birds and to the preservation of their habitats (Freedman and Svoboda 1982). This paper describes features of the passerine breeding bird population of an alpine habitat in the southern Snake Range of east-central Nevada.

STUDY AREA

I conducted the study above timberline (about 3350 m) on Bald Mountain in Great Basin National Park, 62 km southeast of Ely, Nevada. Bald Mountain (3524 m) is shaped like a shallow inverted bowl and joined to the higher and larger mass of nearby Wheeler Peak by a long, narrow saddle. Wheeler Peak (3981 m), the highest peak in the eastern Great Basin, is the dominant feature of the local landscape.

Mean annual precipitation is about 76 cm, most of it falling as snow in late winter (Beasley and Klemmedson 1980). Large and persistent snowfields are on the north-facing slope of the alpine zone on Bald Mountain. Soils, derived mostly from quartzite, are shallow and rocky. Boulderfields and talus slopes are scattered throughout the area. Over 40% of the study site is covered by rock.

There has been little or no grazing by domestic livestock in the alpine environments of Bald Mountain and Wheeler Peak (R. P. DeMeule, pers. comm.). The only access is by foot or horseback. There is substantial recreational use, especially along developed trails.

At their lower elevational limits the treeless slopes of Bald Mountain grade into the mixed conifer forest of Engelmann Spruce (*Picea engelmannii*) and Limber Pine (*Pinus flexilis*) typical of the Snake Range. The alpine vegetation is open and scanty, consisting mostly of low perennial herbs. Common grasses and forbs include Alpine Fescue (*Festuca ovina*), Skyline Bluegrass (*Poa epilis*), Alpine Avens (*Geum rossii*), Powder Phlox (*Phlox pulvinata*), and Moss Silene (*Silene acaulis*). Blackroot Sedge (*Carex elynoides*) is locally abundant. Alpine Prickly Currant (*Ribes montigenum*) occurs in scattered clumps (M. E. Lewis, unpubl.).

METHODS

Using the Williams spot-mapping method (International Bird Census Committee 1970), I censused a 20-ha plot for breeding birds. Oelke (1981) summarized the methodological difficulties and limitations of this mapping method. I chose the plot location that best represented the alpine environment on Bald Mountain. In general, the square plot straddled the summit of the mountain with the sides of the plot sloping downward in all directions. The lower boundaries of parts of the plot approached timberline. The plot was surveyed and gridded in a Cartesian coordinate system with points numbered with stakes at 75-m intervals.

I made 10 census visits annually to the plot between 20 June and 21 July from 1981 to 1983 and did most of the census work from sunrise to late morning. With the exception of the large snowfields on the north-facing slope, I censused the plot by walking within 50 m of all points on the grid, varying the census routes through the plot. At the end of each annual sampling period, I marked concentrated groups of observations and coded activity patterns to indicate areas of activity or approximate territories. Fractional parts of boundary territories were included in the results. Species richness was expressed as the total number of bird species nesting on the plot.

Plant names are from Welsh et al. (1981). Bird nomenclature follows the 1983 AOU check-list (American Ornithologists' Union 1983).

RESULTS AND DISCUSSION

The density of breeding birds occupying the alpine census plot ranged from 3.7 to 5.2 pairs over the 3-year period of study (Table 1). There were 37 to 52 individual breeding birds/km^2. Total standing crop biomass ranged from 7.8 to 10.2 g/ha. Only two species, both passerines, were breeding birds on the study plot. The most common of these was the Water Pipit (*Anthus spinoletta*), which I found generally throughout the plot. The Rock Wren (*Salpinctes obsoletus*) was less common and found only in more restricted habitats. Rosy Finches (*Leucosticte arctoa*), although frequent visitors to the plot, apparently nested off the area in nearby cliff habitats. The Rosy Finches were *L.a. atrata*, which breeds in alpine habitats from central Idaho, Montana, and Wyoming south to southeastern Oregon, east-central Nevada, and central Utah (American Ornithologists' Union 1983).

Other species, observed as occasional visitors to the alpine zone (less than 10 observations annually), included the Broad-tailed Hummingbird (*Selasphorus platycercus*), Clark's Nutcracker (*Nucifraga columbiana*), American Robin (*Turdus migratorius*), Townsend's Solitaire (*Myadestes townsendi*), Mountain Bluebird (*Sialia currucoides*), and Dark-eyed Junco (*Junco hyemalis*).

Less frequently observed birds (less than five observations annually) were the Northern Harrier (*Circus cyaneus*), Red-tailed Hawk (*Buteo jamaicensis*), Golden Eagle (*Aquila chrysaetos*), American Kestrel (*Falco sparverius*), Violet-green Swallow (*Tachycineta thalassina*), Common Raven (*Corvus corax*), Mountain Chickadee (*Parus gambeli*), and Cassin's Finch (*Carpodacus cassinii*). Most of the visitors observed in or flying above the alpine habitat were inhabitants of subalpine plant communities and visited the alpine only sporadically. Raptors occurred more commonly from mid-summer to late summer.

Water Pipit

The Water Pipit was the dominant breeding bird of the alpine zone in both numbers and standing crop biomass (Table 1). It was widely distributed on the study tract. Pipits established territories on a variety of topographies, but highest densitites were on the steep and relatively wind-sheltered, north-facing slope where territorial boundaries were contiguous and sometimes overlapping (Figure 1). Most of the breeding territories on the north-facing slope included parts of extensive snowfields that persisted summer-long on that aspect. The amount and distribution of snow in the spring are important in determining when and where birds breed in alpine habitats (Weeden 1960). Also, as noted by Pattie and Verbeek (1966), snowfields provide important habitats for the Water Pipit. Pipits on Bald Mountain often foraged for cold-numbed insects on the surface of the snow. Water from melting snowbanks contributed to a more mesic environment on the north-facing slope where grass and forb ground coverage was notably higher than on other aspects. I recorded Water Pipits least frequently on the windward side of the plot, where strong westerly winds were the rule and where vegetation was less abundant and boulderfields and talus more common.

I found two Water Pipit nests, one on 27 June that contained five eggs and the second on 6 July that contained four eggs. Incubating females were flushed from the nests when discovered. Nestlings were last observed on 20 July. Both Pipit nests were sunk in sloping ground and sheltered from above, one by an overhanging rock and the other by a thick mat of Alpine Avens. Nest locations fit Verbeek's (1970) descriptions as "rock nests" and "sod nests."

Table 1 Density, Standing Crop Biomass, and Other Attributes of Passerine Breeding Birds, Bald Mountain, Southern Snake Range, Nevada, 1981-1983

Species	Foraging category	Nesting substrate	Population density (pairs/20 ha)		
			1981	1982	1983
Water Pipit	Ground insectivore	Ground	3.5	3.7	3.7
Rock Wren	Ground insectivore	Rocks	1.7	+[b]	1.0
Rosy Finch	Ground omnivore	Cliffs	+	+	+
Number of breeding species			2	1	2
Total pairs/20 ha			5.2	3.7	4.7
Total individuals/km^2			52	37	47
Standing crop biomass (g/ha)[a]			10.2	7.8	9.4

[a]Species weights from Dunning (1984).

[b] + indicates that a species was only infrequently observed or that breeding territories could not be delineated.

Rock Wrens

Rock Wrens were irregular and relatively uncommon breeding birds on the alpine study plot (Table 1). I located all or parts of only five separate breeding territories within the boundaries of the 20-ha census plot during the 3-year

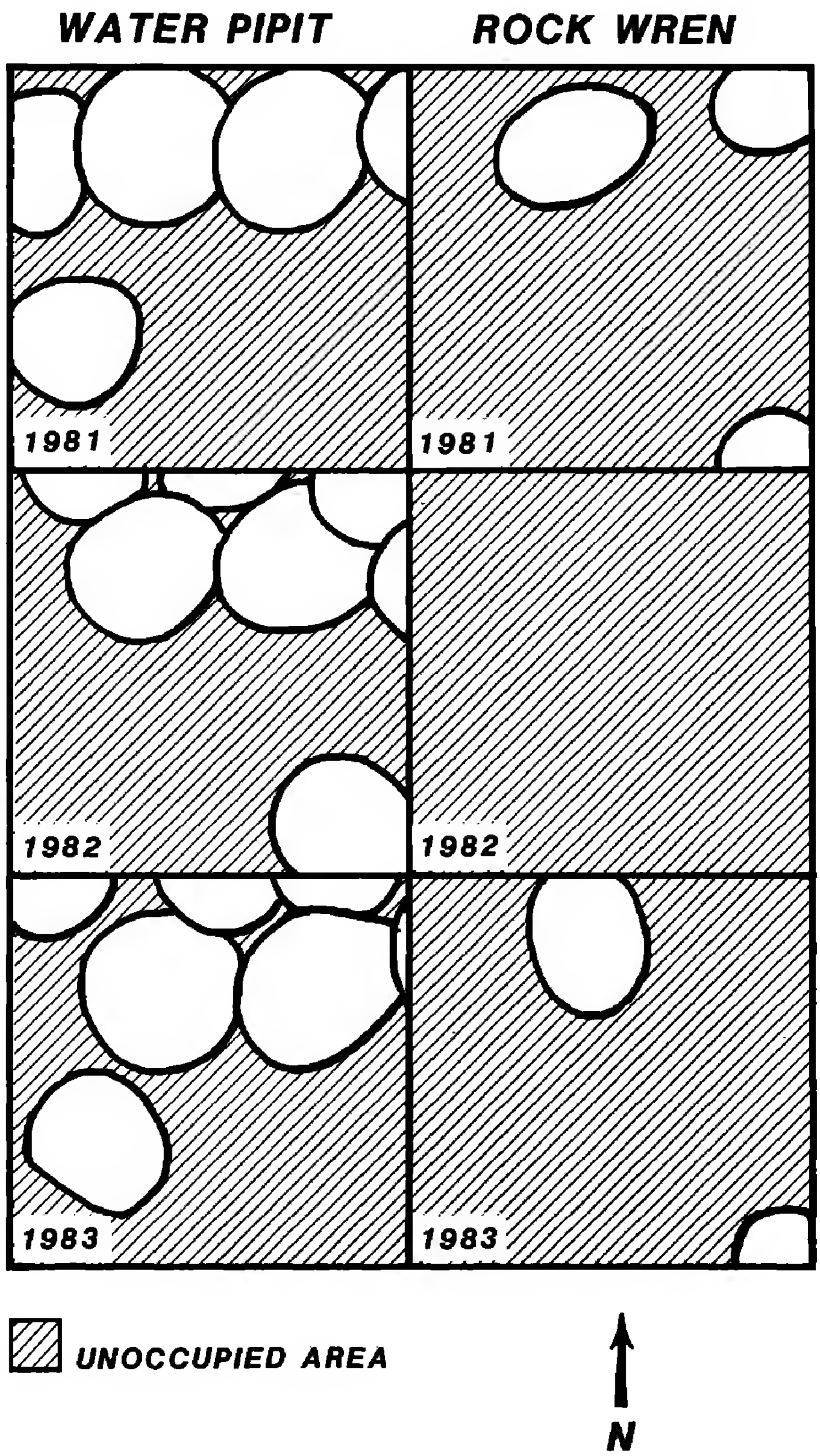

Figure 1. Annual dispersion patterns of Water Pipit and Rock Wren territories on the 20-ha alpine study plot.

study (Figure 1). These were centered on shattered outcroppings of exposed bedrock or, in one case, on a steep talus slope. Weather may have been a factor in the failure of the Rock Wren to establish breeding territories on the study plot in 1982. Spring was unusually late that year and alpine snowfields were larger and persisted longer. Snow still covered almost half the study plot in late June 1982.

I found no nests of the Rock Wren but observed territory establishment, singing, courtship, pairing, and other breeding activities. Later, I saw adult Rock Wrens carrying food items as they flew nearby.

Rosy Finches

I often saw Rosy Finches on the alpine zone of Bald Mountain both as single birds and in small groups of up to 10 or more. Paired birds or groups of three to five birds that included both males and females were most common. Finches were seldom seen below an elevation of about 3350 m.

Spot-mapping methods are inappropriate for censusing the Rosy Finch. The mapping method applies primarily to territorial and noncolonial passerines and other species of birds that have similar dispersion mechanisms and distribution patterns (International Bird Census Committee 1970). The "territory" of the Rosy Finch is centered around the female and varies in location and size with the movements of the female. It is the female rather than an area that is defended (French 1959). Thus, estimates of breeding densitities for the Rosy Finch are not listed in Table 1.

Rosy Finches did not nest on the Bald Mountain study plot. They apparently nested in the cirque headwalls, cliff faces, and talus slopes above treeline on nearby Wheeler Peak. Their flights to and from Bald Mountain were almost invariably in the direction of Wheeler Peak. French (1959) noted that nest sites of the Rosy Finch may be widely separated from feeding areas.

Rosy Finch activities on Bald Mountain were devoted largely to foraging. Most foraging took place on the surface of the snow, along the margins of receding snowbanks, or on snow-free areas adjacent to snowfields. Cold-numbed insects were apparently gleaned from the surface of the snow. Much of the food of Rosy Finches consists of seeds (French 1959), but insects can be a major food item, especially early in the breeding season (Twining 1940). I saw Rosy Finches most often on or near the snowfields that persisted on the north-facing aspect of Bald Mountain.

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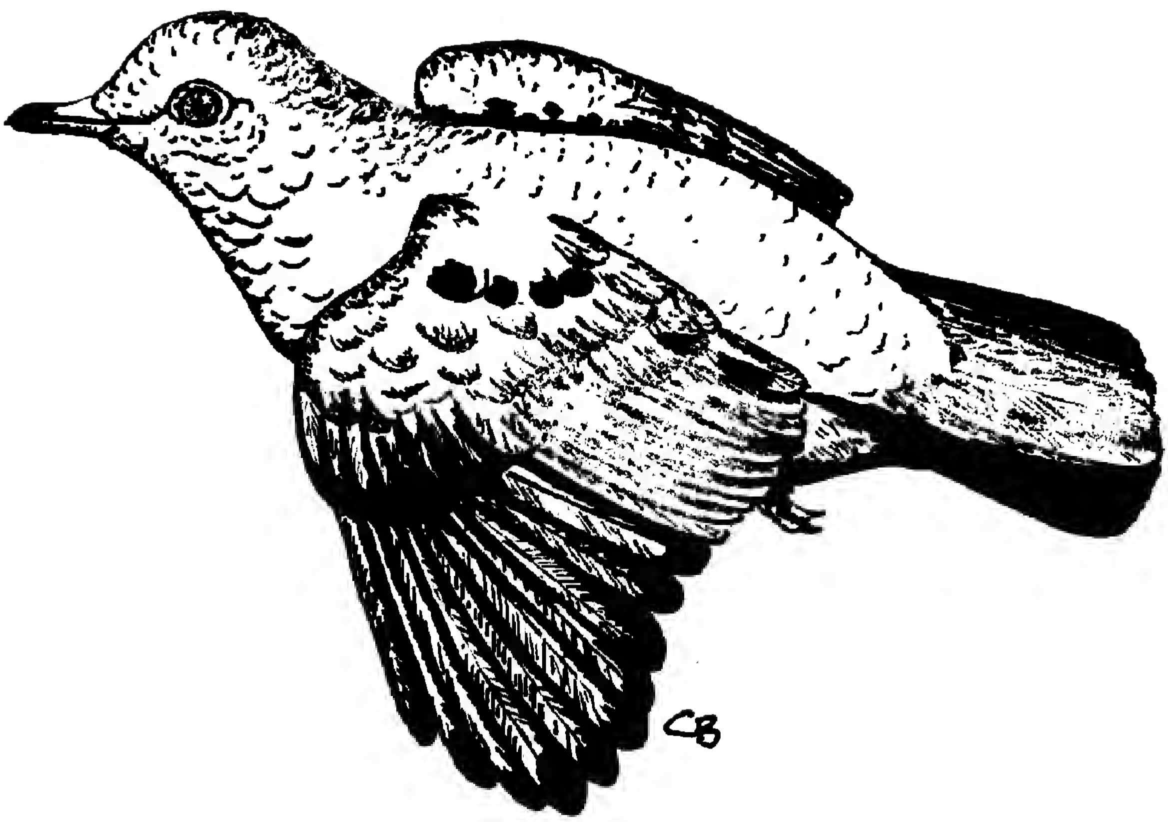
Water Pipit hatchling and egg. Frobisher Bay, Baffin Island, N.W.T., Canada.

Photo by Jeanne A. Conry



Common Ground-Dove *Sketch by Cameron Barrows*

NOTES

RANGE EXTENSION OF THE COMMON GROUND-DOVE INTO SANTA BARBARA AND VENTURA COUNTIES, CALIFORNIA

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Recent sightings of Common Ground-Doves (*Columbina passerina*) in Santa Barbara County and, especially, Ventura County, California, indicate that this dove is less rare in those counties than previously thought. This apparent change in status may not be due to inadequate coverage in the past, but rather may reflect a population increase due to relatively recent changes in agricultural practices and dramatic increases in avocado acreage in Ventura and southern Santa Barbara counties.

Webster et al. (1980) listed only three records of the Common Ground-Dove for this area: up to two seen near Santa Paula 20-21 August 1947, a single bird at McGrath State Beach on 13 September 1974, and another at Goleta on 2 October 1977. An additional record from Carpinteria, 25 August 1923 (Lehman 1982), was omitted by Webster et al. According to Garrett and Dunn (1981), the resident population closest to this area occurs in northeastern Orange County, including Garden Grove, Yorba Linda, and near Whittier. Recent records for Los Angeles County include at least five individuals near the Orange County line in Hawaiian Gardens, a residential area of northeastern Long Beach, since 1984 (McCaskie 1984c). Other reports come from the San Gabriel Valley; however, there is very little habitat suitable for ground doves in heavily urbanized lowland Los Angeles County.

In Santa Barbara County and, especially, Ventura County, ground doves have been recorded frequently since these publications. In the extreme southeastern corner of Santa Barbara County, the species has been recorded in small numbers on a number of occasions in the Carpinteria area, including three to four seen from 4 October 1984 to 23 November 1984 (McCaskie 1985a) and up to four seen from 30 November 1984 to 9 January 1985 (McCaskie 1985b). Goleta has had records of one or two individuals each fall from 1982 to 1985 (McCaskie 1983a, 1984a, 1985a, 1986). The foothills and canyons near Goleta represent the northernmost extension of significant commercial avocado and lemon orchards. Common Ground-Doves recorded in Ventura County include up to nine individuals seen throughout the winter of 1981-1982 near Camarillo, where they had been present at least the previous two years (McCaskie 1982), up to five near Oxnard during September and October 1982 (McCaskie 1983a), three in Santa Paula on 23 February 1983 (McCaskie 1983b), and one individual seen from 26 February to 11 March 1984 near Castaic Junction, where the Santa Clara Valley extends into Los Angeles County (McCaskie 1984b).

With access into private citrus and avocado groves in Ventura County in 1984 and 1985, I have found that the Common Ground-Dove is uncommon to fairly common in the Las Posas Valley (west of Moorpark) and in the El Rio area of the Oxnard floodplain. I have seen this species also on many occasions, but less commonly, throughout the Santa Clara Valley. Around the perimeter of roughly 40-acre parcels of avocado or lemon orchards in the Las Posas Valley and in the El Rio area I saw, on the average, three to five individuals, while in the Santa Clara Valley I found an

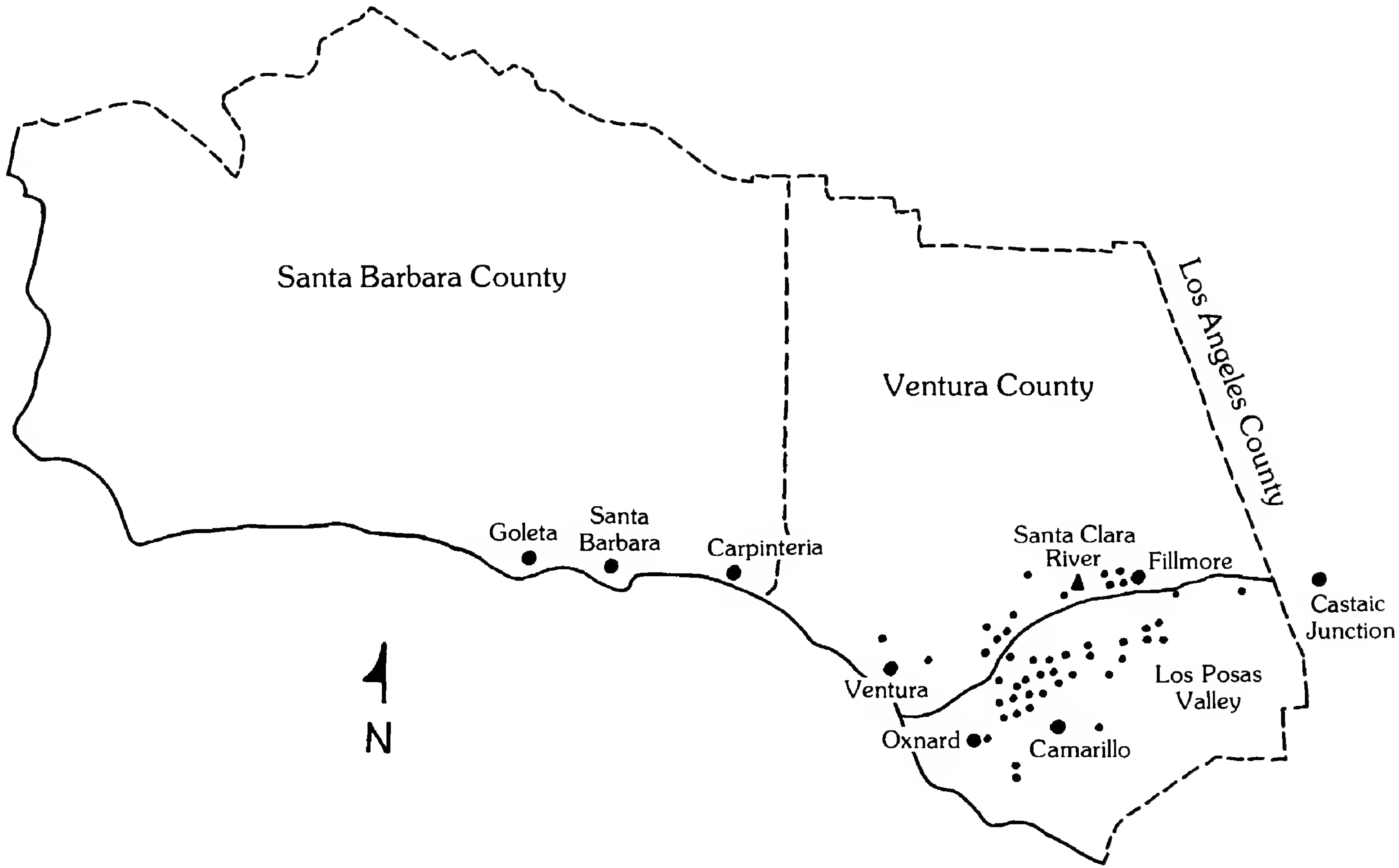

Figure 1. Recent sighting and nesting locations of the Common Ground-Dove in Santa Barbara and Ventura counties, California. ● Sight location; ▲, nesting location.

average of one to two individuals around parcels of the same size, if Common Ground-Doves were present. On 3 October 1984 I counted an unusually high number, 29 individuals, on a 100-acre ranch in the Las Posas Valley. My ground dove sightings during 1984 and 1985 were continuous through the year. I eventually observed Common Ground-Doves on all the properties I visited in the Las Posas Valley and in the El Rio area, whereas I observed them on about 10% of the properties I visited in the Santa Clara Valley. On 11 September 1985 I located a Common Ground-Dove nest, the first nesting record for Ventura County, in an orchard on Sycamore Road, four miles west of Fillmore.

Grinnell and Miller (1944) mentioned that the Common Ground-Dove seemed to increase and spread with the irrigation of low-lying desert lands. Over the past 15 years or so, as avocados have become more profitable, there has been a large increase in avocado acreage in both counties. There also has been a widespread conversion from furrow to drip and sprinkler irrigation systems, reducing the amount of ground disturbance through cultivation, and this change may also have been a factor in the Common Ground-Dove's expansion into this area. This conversion has been carried out most widely in lemon orchards. Most of my observations during 1984 and 1985 were in lemon and avocado orchards; a few were in orange groves. The doves were attracted especially to orchards that had eucalyptus windrows, where I have observed them on the roads below the trees, tipping the eucalyptus capsules for their seeds. They favored the younger avocado orchards where the trees had not closed their crowns, thus leaving more edge area. Unlike avocado trees, lemon trees are pruned regularly, keeping the tree's crown low and the orchard relatively open, so ground doves occurred in lemon orchards of all ages. All of my observations of ground doves outside orchards in this area have been in arroyos not far from an orchard and in association with eucalyptus, willow, and/or California (Peruvian) Pepper (*Schinus molle*).

Ventura County and, to a lesser extent, Santa Barbara County have large tracts of agricultural habitat suitable for ground doves, and, though urban development pressure is increasing, it will be several years before the existing orchards are seriously threatened.

I thank Kimball Garrett and Paul Lehman very much for their information, comments, and help on the manuscript.

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A RING-BILLED GULL ON THE GALÁPAGOS ISLANDS

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On 30 June 1983, on South Plaza Island, Galápagos Archipelago, we observed a gull obviously different from the resident Swallow-tailed (*Creagrus furcatus*) and Lava (*Larus fuliginosus*) gulls of the islands. We found the gull initially in one of the abundant tide pools along the island's rocky shore. From there it flew a short distance to a sea lion carcass, where it supplanted a Lava Gull and fed on the maggots covering the rotting carcass. The gull then flew a few hundred meters to a pool where several of our party took close-up photographs (e.g., Figure 1) that show the bird to have been a Ring-billed Gull (*Larus delawarensis*) in adult plumage.

The bird was aberrant in that it lacked white tips or mirrors on the outermost primaries. However, at least one published photograph of an adult-plumaged Ring-billed Gull shows a bird with all-black wing-tips (Weseloh and Blokpoel 1979). The bird we observed might have retained the outer primaries from the second-winter plumage, or else, less likely, wore off the white mirrors.

Our photographs document the first record of the Ring-billed Gull on the Galapágos Islands and in the Republic of Ecuador. According to the A.O.U. Check-List (1983), the wintering range of the species extends south normally to southern Mexico, casually to El Salvador and Costa Rica. Harrison (1983) mentions stragglers from Trinidad and Panamá, and Grant (1982) likewise marks Panamá as the approximate southern

Figure 1. Ring-billed Gull, South Plaza Island, Galápagos Archipelago, 30 June 1983.

Photo by Monica L. Udvardy

limit of the species' winter/nonbreeding range. Westward, stragglers have been noted on several of the Hawaiian Islands (Berger 1972 and M.D.F. Udvardy, unpublished records). Eastward, the Ring-billed Gull has been sighted as far as the coast of Sweden at the North Sea (Wallander and Mogren 1983). Thus it is not unexpected that a vagrant Ring-billed Gull should reach the Galápagos. Gulls are excellent travelers, many species covering much larger distances on regular seasonal migrations than between the Galápagos Archipelago and the nearest breeding colonies of this species in the Great Lakes area of North America. Actually, this distance is less than that between the Atlantic coastal North American breeding colonies and the British Isles, where the Ring-billed Gull is reported annually (Grant 1982), or between the Hawaiian Islands and the nearest colonies in the Pacific Northwest of North America.

Indeed, in view of the recent increase and expansion of the species' breeding colonies (Conover 1983), it is likely that vagrant Ring-billed Gulls will be reported even more widely.

C.V. Peterson, T. Säll, and M.L. Udvardy all furnished color slides, which helped greatly to verify the sighting on 30 June 1983. We also thank Dr. M. Harris (pers. comm., 1983), for corroborating the fact that, to his knowledge, no previous sighting of the Ring-billed Gull in Galápagos has been reported.

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Cover photo by Jules Evens, Point Reyes Station, California: Adult Long-tailed Jaeger (*Stercorarius longicaudus*), Meade River, Alaska, 20 June 1979.

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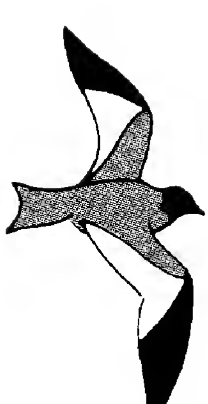

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WESTERN BIRDS

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THE BIRDS OF SAN ELIJO LAGOON, SAN DIEGO COUNTY, CALIFORNIA

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A group of volunteers conducted monthly bird surveys at San Elijo Lagoon, San Diego County, California, over the ten-year period from November 1973 to October 1983. This paper summarizes the data gathered on these surveys and includes noncount records from before, during, and after the survey period to give a comprehensive picture of the lagoon's avifauna through April 1987. The large number of surveys (120) on a regular basis makes possible a quantitative assessment of each species' status.

DESCRIPTION AND HISTORY OF THE SURVEY AREA

San Elijo Lagoon, one of eight coastal lagoons in northern San Diego County, is located at 33°00′ N, 117°20′ W, between the communities of Solana Beach to the south and Cardiff-by-the-Sea to the north, about 35 km north of the city of San Diego. The lagoon is shaped roughly like an hourglass, being between 0.3 and 1 km wide north-south and about 2 km long from the coast inland (east-west). State Road 21 and a railroad cross the lagoon near the beach, and the Interstate 5 freeway crosses in the center; all three run north-south.

The west basin (west of Interstate 5) has large areas of tidal mudflats, deep meandering channels, and emergent salt-marsh vegetation. The east basin is less saline and is filled largely with cattails (*Typha* sp.), one of the largest cattail stands in San Diego County. Bordering the lagoon on the north and south are alluvial slopes of unconsolidated material, covered mostly with scrub. In low areas where sand and silt have been deposited recently, a few dense stands of willows (*Salix* spp.) have grown up. A large stand of acacia, eucalyptus, and other nonnative trees occurs on the upper slope on the south side of the lagoon, just west of the freeway; a few scattered eucalyptus trees grow elsewhere on the upper slopes. Eroded sandstone cliffs rise above most of the alluvial slopes. Rather flat mesas extend back from the tops of the cliffs at elevations of 20 to 60 m. The survey area (Figure 1) includes the lagoon and the surrounding upland slopes but not the adjacent beach and ocean (nothing west of State Road 21) nor the mesa tops to the north and south.

The lagoon receives water intermittently from both the east and west. Two freshwater creeks feed the eastern end of the lagoon. At the beach, the tide flows into the lagoon only about half the time, when the mouth is not blocked by a sand berm. While the mouth is open, it tends to be closed gradually by waves, which wash sand into the inlet. The mouth remains closed until the lagoon water level rises (from freshwater runoff) high enough to overtop and wash out the berm. Then the lagoon drains rapidly and becomes tidal again. Typically, this cycle occurs a few times during the year, more frequently during the winter rainy season.

Several important man-made changes have altered San Elijo Lagoon. A railroad was first built across the lagoon in 1887, reducing water circulation. The coast road was built in 1932, the freeway in the 1960s. Between 1934 and 1973, sewage from several sources was discharged into the lagoon. Between 1937 and 1971, organized duck hunting took place, and several dikes and berms were constructed, many of which still remain.

Before and during the study period, the adjacent mesas were slowly converted from chaparral to housing tracts. Also, a section of the northeast alluvial slope was converted from chaparral to an agricultural field. In 1987, construction began on a community college on another portion of the northeast slope. These developments have led to an increase in human activity (jogging, birdwatching, motorcycling, walking of dogs, etc.) at the lagoon. Urbanization considerably increased the sedimentation rate into the lagoon (Barry et al. 1976), most noticeably in the northwest and southeast areas, where formerly wet areas are now sandy and being invaded by willows. Because of this, during the winter of 1981-1982 the San Diego County Department of Public Works carried out a scheme designed by the California Department of Fish and Game, clearing and dredging some of the east basin and creating a permanent water pool with two sandy islands to provide nesting habitat for Least Terns.

METHODS

Because of several development proposals, Allen and Karin Altman organized in November 1973 a group of volunteers to survey the lagoon's birdlife monthly. Subsequent count leaders were Bill Lenarz, then Mona Baumgartel and John DeBeer.

Counts were conducted usually on the first Sunday of each month by 8 to 15 people. Table 1 lists the count dates. The lagoon was divided into five areas, and count paths were established in each area (Figure 2). Participants assembled between 0730 and 0800 and divided into four groups. One group covered both the NE and NW areas (NE first); the other three groups each took one of the other three areas (W, SW, and SE). Each group consisted of two or more participants, at least one of whom was familiar with the local birds and the count path.

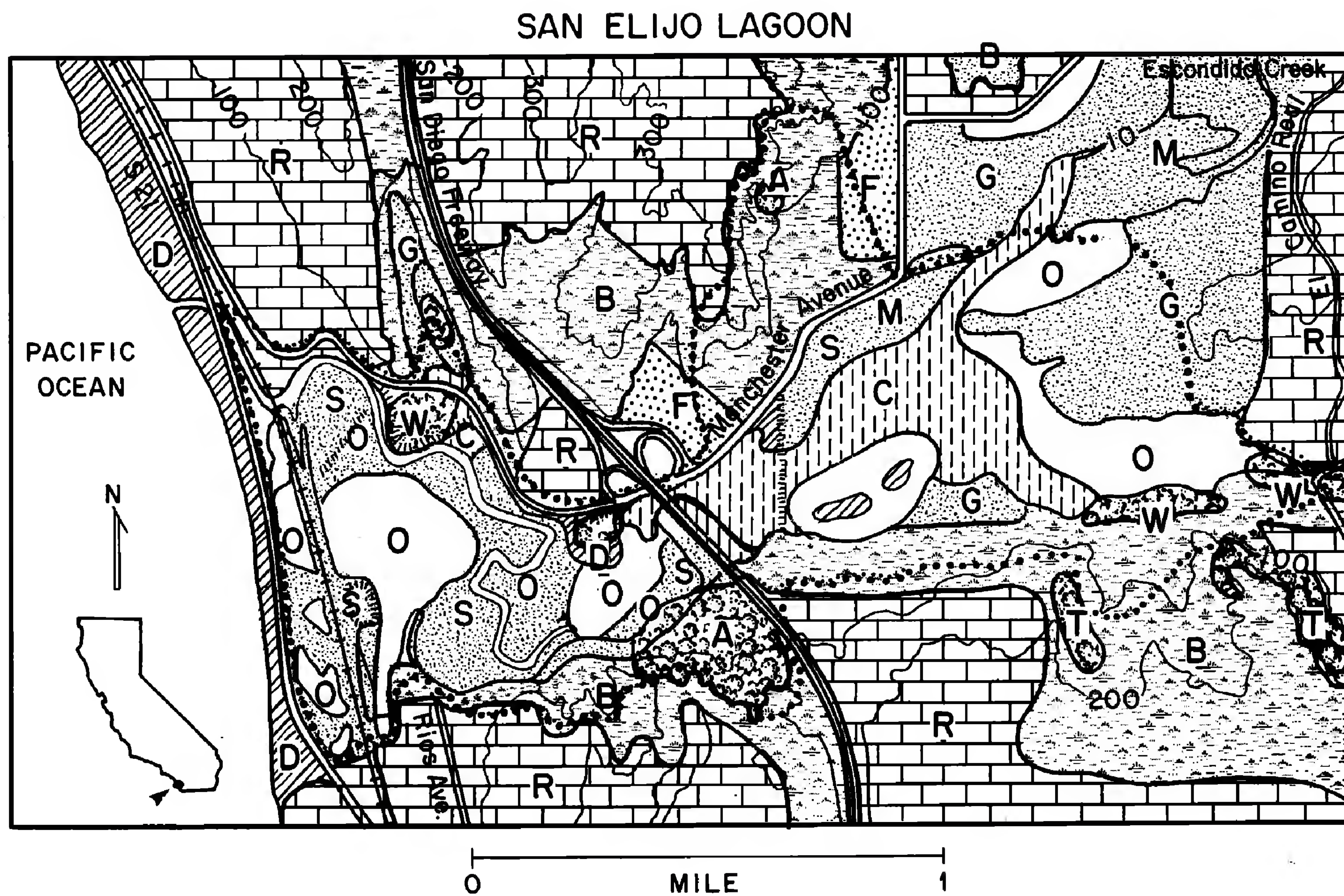

Figure 1. Vegetation of San Elijo Lagoon. The survey area is inside the dotted line. A, acacia and eucalyptus trees; B, brush (sage scrub and chaparral); C, cattail marsh; D, dry open sandy areas; F, agriculture, mostly vegetable farms; G, dry grass and pasture; M, wet grass meadow; O, open shallow water or mudflat; R, residential area; S, *Salicornia*, flooded during high water; T, oak grove; W, willow thicket. Unlabeled white areas are permanent water.

Table 1 Dates of Monthly San Elijo Lagoon Surveys

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973											4	2
1974	6	3	3	7	5	2	7	4	8	13	10	8
1975	5	16	9	6	4	1	6	3	7	5	9	7
1976	11	1	7	11	2	6	11	1	12	10	7	5
1977	9	6	13	3	1	5	10	7	4	2	6	4
1978	8	5	19	2	7	4	2	6	10	1	5	3
1979	7	4	4	1	6	3	8	5	9	14	4	2
1980	6	10	2	13	4	1	13	3	7	12	2	7
1981	11	1	8	5	3	7	12	2	6	4	1	6
1982	10	7	7	4	2	6	11	1	5	3	7	5
1983	9	6	6	10	1	5	3	7	4	2		
Average	8	6	8	6	4	4	9	4	8	8	6	5

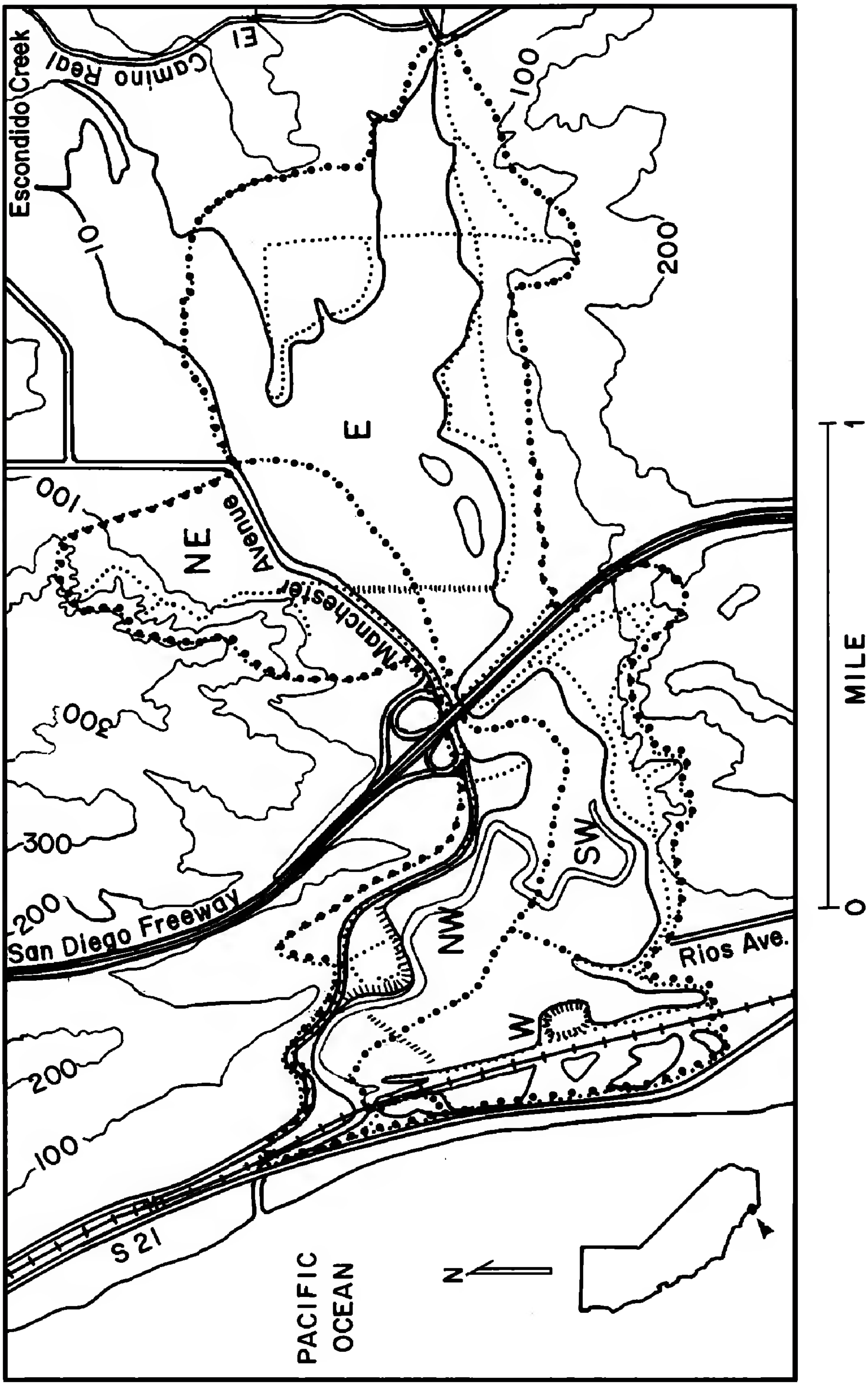

Figure 2. The five survey areas at San Elijo Lagoon. Heavy dots, survey area boundaries; light dots, trails.

Table 2 Area Surveyed, Time Spent, and Distance Traveled in Different Habitats during Each Monthly Survey[a]

Habitat	Area (ha)	Time (h)	Distance (km)
Woodland (acacia, eucalyptus, and willow)	20	2.5	1
Brush (sage scrub and chaparral)	90	7.0	7
Cattail marsh	180	3.0	2
Open water, mudflat, sand, wet grass, and *Salicornia*	60	10.5	8
Dry grass and pasture	20	1.0	1
Total	370	24.0	19

[a]Total times and distances are about 1.5 times the amount actually spent and traveled since frequently more than one type of habitat was being surveyed at a time.

Groups recorded all identified birds plus date, area, weather, water level, and observers on a field card. Table 2 shows the amount of time and the distances traveled in each type of habitat. Leaders had some flexibility in the amount of time spent at different locations, and groups frequently made a special effort to find birds known to be in their areas in low numbers. Nevertheless, each group covered its entire path and returned by noon for a compilation.

To produce this paper, we entered the count totals plus the data for each area into a computer and cross-checked them to eliminate errors. We then compared our data for each species with the information in Garrett and Dunn (1981) and Unitt (1984) and with our own knowledge of local bird distribution. We deleted or put into unidentified groups (e. g., *Empidonax* sp.), as appropriate, isolated unseasonal sightings and sightings of rare birds that were not verified independently. Two sightings of a Sandwich Tern (*Sterna sandvicensis*), 16 May 1982 (TM) and 24 Apr 1987 (SW), were deleted by the editor because they have not been evaluated by the California Bird Records Committtee. The number of changes was small; we changed fewer than 100 data points out of a total of over 51,000. Systematic variations from published information were rare and usually minor (e. g., Heermann's Gull). The data we present are based primarily on the 120 monthly surveys; all statistics were computed from the survey data only. For rare species, however, we attempted to compile all available records. We also cite noncount records for more common species if they are unseasonal or represent exceptionally high numbers for the lagoon. Noncount data from before 1960 are limited mostly to a few specimen records.

Breeding activity was not systematically sought or recorded on most surveys, so the breeding status of many species is not well known. To remedy this partially, we made a special effort during the spring and summer of 1982 and 1983 to note evidence of breeding on both count and noncount days.

The original data sheets, edited survey data on 5.25-inch floppy disks (ASCII files readable on a personal computer with an MS DOS operating system), computer printouts, and relevant reports have been archived in the library of the San Diego Natural History Museum under the title "San Elijo Lagoon Monthly Bird Survey."

DATA INTERPRETATION

For a few conspicuous species (e. g., Great Blue Heron), the number recorded on each count was probably close to the number actually present in the survey area. Most species, however, undoubtedly were systematically undercounted, a major unresolved problem with bird censuses (see Ralph and Scott 1981). The amount of undercounting varied not only between species but also with season, weather, and observer skill (see Dawson 1981a). A number of species were more vocal or conspicuous during the breeding season (e. g., Rufous-sided Towhee). Others (e. g., Blue-winged Teal) were in more easily identifiable plumage at certain times of the year. The weather during the counts was generally benign; however, occasional bad weather probably reduced numbers found (see Robbins 1981). Variability in the skills of individual observers had an unquantifiable, but surely major, effect on the number of birds recorded (see Faanes and Bystrak 1981). In the species accounts, the numbers given are the numbers recorded except for the few deletions described above. We made no other attempt to calibrate the data to account for these or other effects.

However, most of the variability from year to year in the number of birds recorded appeared to be due to true variability in the number of birds rather than to various forms of observer error just discussed. For instance, there was considerably less variation in territorial species than in gregarious species. Typical values of the coefficient of variation (the standard deviation divided by the average) ranged from around 0.5 for territorial birds (e. g., Northern Mockingbird) to 1.0 or higher for some gregarious birds (e. g., ducks). This variation, due to many factors, was large but is expected in biological data (see Cushing 1962).

For virtually every species, the distribution of numbers counted in any particular month was positively skewed. That is, there were a few values much higher than the average without corresponding values much lower than the average. (The data followed a Rayleigh rather than a Gaussian distribution.) This tendency, more evident in flocking than in territorial species, is an example of temporal patchiness, a common biological phenomenon (see Dawson 1981b). Because of this skewing, a few years' of data would not have given a reliable picture of the distribution of most species. Over 10 years, however, the fluctuations averaged out so that the plots of average numbers by month curved smoothly (for example, see Table 3).

In the species accounts, we give two measures of the central tendency, the average and the median. Someone interested in the long-term use of the

Table 3 Example of the Data: Numbers of Pied-billed Grebes Seen on Each of the Monthly Counts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973											67	30
1974	14	8	3	4	1	4	4	7	11	15	6	4
1975	4	4	4	3	1	0	1	1	2	2	5	1
1976	5	5	4	0	7	5	11	6	1	8	18	4
1977	4	1	4	0	2	16	2	4	4	9	1	10
1978	39	1	8	5	1	3	0	5	1	1	4	5
1979	1	5	9	5	0	2	3	20	23	16	25	7
1980	13	28	4	4	11	5	3	1	2	5	15	7
1981	7	19	4	12	13	10	10	9	17	16	7	16
1982	5	10	14	6	3	7	12	1	10	8	16	3
1983	8	17	9	2	15	10	19	30	46	26		
Average	10	10	6	4	5	6	7	8	12	11	16	9
Median	6	7	4	4	3	5	4	6	7	9	11	6

lagoon by a particular species might find the average value most useful, while someone visiting the lagoon for a day would probably be more interested in a median value. These two numbers also allow qualitative inferences about the variance and skewness. Because the data are skewed positively, the average values are greater than median values. If the average and median are relatively close, the variance and skewness are smaller than if the average is much greater than the median.

DISTRIBUTION OF SPECIES

Of the 281 species recorded at the lagoon, 46 are rare visitors not recorded on any monthly surveys. Another 70 species were recorded on ≤5% of the counts. Together, these 116 rare species constitute 41% of the species list for the lagoon. At the other extreme, 35 species were seen on 95% or more of the counts, including 17 species that were found on all counts.

The average numbers of water bird species, land bird species, and total species recorded per month (about 90) are shown in Figure 3. The highest number of species occurred during spring migration, largely a result of late-departing wintering birds overlapping with early-arriving summering birds, with water birds peaking in April and land birds peaking in May. The maximum number of species recorded on a count was 114 on 7 April 1974, and the minimum number was 68 on 12 July 1981.

Figure 4 shows the average number of birds of all species recorded per month. The average number of land birds (asterisks) remained fairly constant

Figure 3. Average number of species recorded at San Elijo Lagoon by month (solid line).

Figure 4. Average number of individual birds recorded at San Elijo Lagoon by month.

Solid line, number of total species; asterisks, number of land bird species (Falconiformes, Galliformes, Columbiformes, and all subsequent groups in the A. O. U. (1983) checklist). Thus the distance between the asterisks and solid line represents the number of water bird species.

throughout the year, while the average number of water birds decreased greatly from winter to summer.

While the numbers of species and of individual birds reported from San Elijo Lagoon are impressive, the area is not a "vagrant trap." San Elijo Lagoon is important to birds not so much because of the high number of species but because so many species use the area regularly. This is demonstrated by the large number of species, 131 (47% of total), that has been recorded on at least half the counts during at least one season of the year.

CHANGES IN THE LAGOON AVIFAUNA

One purpose of the 10-year survey was to determine whether and how the avifauna of the lagoon was changing. Figures 5 and 6 show the average number of species and birds, respectively, recorded at the lagoon on each monthly count by year. Clearly, the gross distribution of birds at the lagoon did not change significantly during the survey.

We then analyzed each species to determine which had increased or decreased during the count period. For each species, we plotted the total number seen per year versus year and used a two-tailed Student's t test to determine if a least mean square line through the plot had a significant nonzero slope. We combined the results of this (objective but simplistic) test with our understanding of each species' status (a subjective but more complex test) to determine which species were increasing or decreasing.

Numbers of only 25 species changed significantly during the survey. Twelve species increased: Brown Pelican, Double-crested Cormorant, Least Bittern, Great Egret, Mallard, Gadwall, American Wigeon, Red-shouldered Hawk,

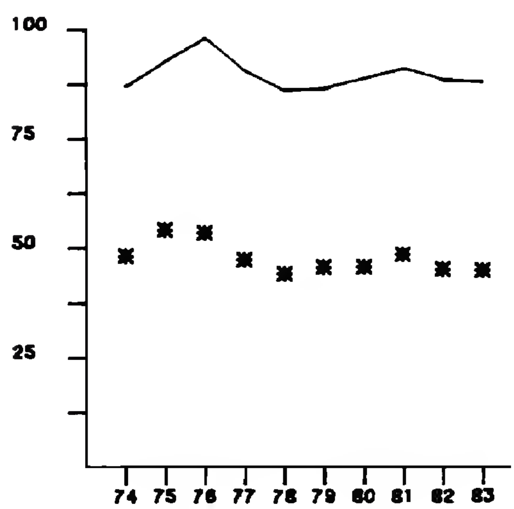

Figure 5. Average number of species recorded at San Elijo Lagoon in each month by year.

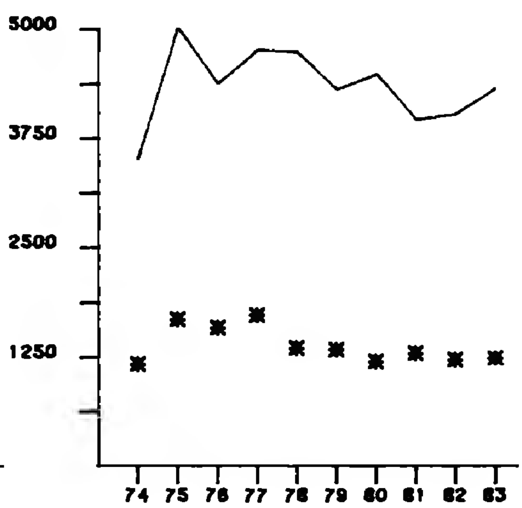

Figure 6. Average number of individual birds recorded at San Elijo Lagoon in each month by year.

Solid line, total species; asterisks, land bird species (see Figures 3 and 4). The year "74" corresponds to the twelve counts from November 1973 to October 1974, etc.

Anna's Hummingbird, Cassin's Kingbird, Black-tailed Gnatcatcher, and Hutton's Vireo. Thirteen decreased: Snow Goose, Canvasback, California Quail, Common Snipe, Greater Roadrunner, Horned Lark, Violet-green Swallow, Rough-winged Swallow, Cactus Wren, California Thrasher, Wilson's Warbler, Song Sparrow, and House Sparrow. More species than this probably changed their status at the lagoon, but these changes were masked by the variability in the data.

Although the reasons for many of these changes are unclear, a few associations suggest themselves. Five of the increasing species are herons and ducks whose primary habitats include shallow water or shorelines, whereas the one decreasing duck uses deep water, correlating with the lagoon's siltation. Very preliminary results of study by Michael Soule of the fauna of 37 canyons in San Diego isolated by housing subdivisions, reported in an interview (Stewart 1987), indicate that small, long-isolated canyons have lost the greatest number of chaparral-dependent birds. The California Quail, Greater Roadrunner, and California Thrasher were found to be the first species to disappear from these isolated canyons. Our results agree with these findings and show that the birds of San Elijo Lagoon are being affected by the adjacent suburban development.

We examined in detail changes in numbers of water birds in the east basin during the last two years of the survey because of the dredging and island construction done in 1981. Numbers of no species noticeably decreased in the east basin from 1981 to 1983. Pied-billed Grebes, Double-crested Cormorants, and Ruddy Ducks increased throughout the year, evidently as a result of the increase in the extent of deep water. Spotted Sandpipers increased during the summer, but this reflects their southward range expansion, not an effect of island creation. Least Terns increased in 1982, the first year they nested on the island, but decreased subsequently (see further information below under Status of Endangered Species).

STATUS OF ENDANGERED SPECIES

Of special interest are the population levels of endangered species. Eight species on California and/or Federal Threatened, Rare, or Endangered Species lists have been recorded at the lagoon; another 28 species are on the California "Species of Special Concern" list (Remsen 1979). Six of these 36 breed regularly at the lagoon: Least Bittern, Light-footed Clapper Rail, Snowy Plover, California Least Tern, California Black-tailed Gnatcatcher, and Belding's Savannah Sparrow.

The Least Bittern was observed regularly in summer in small numbers during the last six years of the count. It is unclear whether the paucity of records in the first four years (one sighting) was because the birds were absent or merely overlooked. Count participants made a greater attempt to locate this species in the latter years of the count when it came to be expected. Most sightings were in dense cattails east of the freeway.

In 1981, the Clapper Rail was discovered breeding at San Elijo Lagoon in an uncharacteristic habitat, the cattail marsh east of the freeway (R. L. Zembal in Unitt 1984). Clapper Rails were found that year in similar habitats at a number of other locations in southern California. It is unclear whether the rail was overlooked at these locations in the past, whether it had expanded (temporarily?) into a new habitat, or whether it was being driven into marginal habitat by deterioration of its preferred marshes. During 1984 and 1985 the populations of Clapper Rails crashed throughout southern California (McCaskie 1986). The fate of the San Elijo birds is not known for certain because no recent extensive searches have been made for them; however, no observers have reported them since 1983.

Snowy Plovers have nested at San Elijo Lagoon at several locations east of the freeway with varying success. Some of these nesting attempts were reported by Page and Stenzel (1981). Nesting success has been low primarily because of fluctuations in water level. In 1982, one pair bred successfully on the newly created islands in the east basin, and 10 to 15 pairs bred there in 1983. Their subsequent numbers and success there are unknown.

During the count period, the Least Tern has nested regularly at San Elijo Lagoon. Between 1974 and 1981, 2 to 20 pairs nested at various sandy spots around the lagoon without establishing a permanent colony site. Nests were usually in insecure locations and were subject to destruction by high water, predators, and motorcyclists. During the summer of 1982, approximately 35 pairs nested on the newly created islands east of the freeway. In subsequent years, however, the colony decreased, to about 25 pairs in 1983, 17-22 in 1984, 13 in 1985, 9 in 1986, and 13 in 1987. Their success has remained low (at most 10 fledglings in 1984, none in 1985, two in 1986, and four in 1987), as a result of continued predation (E. Copper pers. comm.).

The California Black-tailed Gnatcatcher is easily overlooked and confused with the Blue-gray Gnatcatcher by observers unfamiliar with its call. Therefore, its status at the lagoon is not entirely clear. This gnatcatcher was seldom recorded at the lagoon during the summer until 1980, after which a few were noted regularly. One nest with four young was found in the southeast area in June 1980. Therefore, it appears that in 1980 the Black-tailed Gnatcatcher colonized the lagoon or at least increased. This is a hopeful sign but does not negate the serious regional decline of this species shown by Atwood (1980).

The Belding's Savannah Sparrow is easy to recognize in the field and was recorded separately from migrant Savannah Sparrows. It is a common resident, recorded on all counts, but the data show a decline in the number of birds (6% per year) over the years of the count. This rate translates into about half as many birds at the end of the survey as at the beginning. While this decline is not pronounced enough to be unequivocal (because of scatter in the data), there is considerable cause for concern.

SUMMARY AND RECOMMENDATIONS

This study found that San Elijo Lagoon is an important location for birds for three reasons. First, it is a breeding locality for six rare or endangered species. Second, it is used by a large number of birds, most notably wintering water birds. Third, it is an area that is regularly used by a large number of species. The state and county have recognized the importance of San Elijo Lagoon by declaring it an ecological preserve. However, urbanization continues to degrade the habitat. Ideally, a buffer zone of open space should separate the lagoon from the surrounding development, and corridors of undeveloped, natural habitat should link the lagoon to other undeveloped areas. Residential and industrial developments should be planned to minimize erosion and the subsequent siltation of the lagoon basins. This study has shown serious cause for concern at San Elijo Lagoon for three endangered species: the Clapper Rail, the Least Tern, and the Belding's Savannah Sparrow. As these birds are also doing poorly throughout their southern California range, clearly much more effort must be directed toward their preservation. The nesting islands in the east basin do not appear to have been of lasting benefit to the Least Tern, possibly because predators have learned that the colony is an easy food source. Furthermore, creating sandy islands by removing cattails and *Salicornia* marsh entails a loss of habitat for Least Bittern, Clapper Rail, and Belding's Savannah Sparrow.

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SPECIES ACCOUNTS

The first of the two numbers following the scientific name of each species on this list is the total number of birds seen on all 120 monthly counts. The second is the total number of counts (out of 120) on which the bird was recorded. If both numbers are zero, the bird was recorded on noncount days only. Next is a qualitative assessment of the bird's abundance. Terms are defined as follows: abundant = average of >100 per count, very common = average of 30-100 per count, common = average of 10-30 per count, fairly common = average of 3-10 per count, uncommon = average of 1-3 per count, occasional = average of <1 per count, rare = found on 5 or fewer counts, exceptional = very few records for coastal southern California. If a species was recorded on five or fewer counts, all known occurrences (both count and noncount) are usually listed. Numbers in parentheses following dates refer to the number of birds seen on that date. If only one bird was seen, the number and parentheses are omitted. If a species was seen on more than five counts, the average and median in a given season are listed, separated by a slash. For example, "Ave 11/7 Sep-Feb" should be read as an average of 11 and a median of 7 birds seen on the monthly surveys from September to February. If the median is zero, it and the slash are omitted. No noncount data were used to compute averages or medians, which are rounded to two significant figures. Frequently, not all months are mentioned; statistics for unmentioned months are intermediate between those for mentioned months. Bear in mind that the surveys took place near the beginning of the month (average date the 6th; see Table 1).

Also included are any early, late, or unseasonal records, the maximum number of individuals reported for the lagoon, and the species' breeding status. These may be count or noncount data. "Common breeder" indicates that several pairs bred each year; "yearly breeder" indicates that one or a few pairs bred each year. In addition to the 280 main species on this list, several supplementary entries, enclosed in brackets, are included for any of the following reasons: (1) More than 5% of the individual birds of a group were not identified to species (e. g., dowitcher sp.). In these cases the data for the group as a whole are discussed before the individual species. (2) The species has been reported at the lagoon, we believe reliably, but without a specific date. (3) The species has occurred very near the lagoon and can reasonably be expected at the lagoon. Not included in this group are coastal or pelagic species which may be seen from shore. (4) All records are presumed or known to pertain to escaped captives or hybrids. We rarely kept records of exotic species.

Dated records cite the first published source unless a later source discusses the record more fully. AB refers to *American Birds*, AFN to *Audubon Field Notes*. Specimen and egg records are indicated by museum and number: SD refers to the San Diego Natural History Museum, SB to the San Bernardino County Museum, and WF to the Western Foundation for Vertebrate Zoology. Unpublished noncount records are indicated by the observer's initials (see acknowledgments); records without sources are from the monthly surveys. Some uncited records from the monthly surveys have been published previously by Unitt (1984).

Red-throated Loon *Gavia stellata*. 0, 0. Rare; 3 Dec 1972 (SS).

Pacific Loon *Gavia pacifica*. 1, 1. Rare; one in breeding plumage 27 Apr-4 May 1980 (TM).

Pied-billed Grebe *Podilymbus podiceps*. 1041, 115. Common in fall and winter, fairly common in spring and summer. Ave 11/7 Sep-Feb, falling to 5.7/4 Mar-Jul. Max 67 on 4 Nov 1973. Yearly breeder.

Horned Grebe *Podiceps auritus*. 10, 5. Rare winter visitor; 10 Oct 1976, 13 Oct 1974, 5-11 Jan 1975 (6) (SS), 8 Jan 1978, 9 Mar 1975.

Eared Grebe *Podiceps nigricollis*. 1669, 96. Common in winter, uncommon in summer. Ave 22/9 Oct-Apr, falling to 1.3 Jun-Sep. Max 250 on 6 Feb 1983. Bred in 1968 (AFN 22:647, 1968).

Western Grebe *Aechmophorus occidentalis*. 205, 47. Fairly common in winter, rare in summer. Ave 3.2/2 Nov-Apr. Jun-Sep records 7 Mar-1 Aug 1976 and 13 Jul 1980. Max 22 on 5 Dec 1976.

Clark's Grebe *Aechmophorus clarkii*. 1, 1. Not distinguished from Western Grebe during most of the count period. Identified on 8 Nov 1986 (RP) and 9 Jan 1983.

American White Pelican *Pelecanus erythrorhynchos*. 4, 2. Rare from fall through spring; 2 Nov 1985 (BF), 7 Nov 1971 (AF), 2-5 Dec 1973 (SS), 16 Jan 1982 (BM), 17 Mar 1970 (PMcB), 11 Apr 1976 (3), 29 May 1970 (AF).

Brown Pelican *Pelecanus occidentalis*. 335, 18. Increasing; 1980-1983, very common in fall and uncommon in winter. Ave. 1980-1983 61/40 Oct, 1.8 Nov-Feb, none Apr-Jun. Only one record, 11 Jul 1976 (2), 1973-1979. Max 160 on 4 Oct 1981.

Double-crested Cormorant *Phalacrocorax auritus*. 2956, 99. Very common in winter, fairly common in summer; increasing. Ave 34/32 Oct-Apr, falling to 4.6/1 Jun-Jul. Max 150 on 1 Feb 1981.

Magnificent Frigatebird *Fregata magnificens*. 0, 0. Rare summer visitor; 26 Jun 1976 (WTE), 6 Jul 1985 (JO).

American Bittern *Botaurus lentiginosus*. 73, 45. Occasional, mainly in winter. Ave 0.9/1 Nov-May, 0.2 Jun-Oct. Max 4 on 4 Nov 1973, 4 Mar 1979, and 1 Apr 1979.

Least Bittern *Ixobrychus exilis*. 27, 17. Uncommon in summer, rare in winter. Only one record, 7 Apr 1974, in first four years. Ave 1979-1983 1.0/1 Jun-Oct. One winter (Nov-Mar) record, 7-17 Jan 1979 (AB 33:312, 1979). Max 3 on 1 Jun 1980 and 7 Jun 1981. Bred in 1980 (TM) and 1982 (RW) (see also under Status of Endangered Species).

Great Blue Heron *Ardea herodias*. 1086, 120. Fairly common nonbreeding resident. Ave 9.8/8 Jun-Mar, 5.4/5 Apr-May. Max 31 on 7 Mar 1982.

Great Egret *Casmerodius albus*. 1147, 90. Common in winter, uncommon in summer; increasing. Ave 15/9 Oct-Apr, falling to 2.3/1 May-Sep. Max 98 on 4 Oct 1981.

Snowy Egret *Egretta thula*. 2393, 107. Very common in fall, common in winter, fairly common in summer. Ave 50/26 Sep-Oct, 18/14 Nov-Apr, 5.7/4 May-Jul. Max 280 on 4 Oct 1981.

Little Blue Heron *Egretta caerulea*. 0, 0. Rare; single adults on 20 May 1978 (TM) and 19 Jun 1977 (AB 31:1188, 1977).

Tricolored Heron *Egretta tricolor*. 2, 2. Rare; nine records 5 Oct-4 Mar; one 5 Jun 1977 (JDeB). Only three winter records since 1972: 16 Nov 1980 (TM), 3 Jan 1979 (MB), and 23 Feb-4 Mar 1979 (AB 33:312, 1979). Max 6 from 1 Nov to 23 Dec 1963 (McCaskie 1964).

Reddish Egret *Egretta rufescens*. 0, 0. Rare; 29 Sep 1968 (AFN 23:107, 1969), 13 Dec 1969 (PMcB). The bird seen 11-18 Sep 1962, ascribed by Unitt (1984) to San Elijo Lagoon, was actually at Batiquitos Lagoon, 8 km north of San Elijo (AFN 17:67, 1963).

Cattle Egret *Bubulcus ibis*. 6, 4. Rare in fall and winter; 15 Oct 1986 (J & DS), 3 Dec 1978 (2), 6 Dec 1981, 7 Dec 1980, 8 Jan 1978 (2).

Green-backed Heron *Butorides striatus*. 207, 83. Uncommon resident. Ave 2.3/2 Jul-Nov, falling to 1.3/1 Jan-Jun. Max 9 on 3 Apr 1977. Bred once in "mid 1970s" (JB).

Black-crowned Night-Heron *Nycticorax nycticorax*. 1267, 112. Common nonbreeding resident. Ave 11/8 throughout year. Max 200 on 11 Sep 1963 (GMcC).

Yellow-crowned Night-Heron *Nycticorax violaceus*. 5, 5. Exceptional. One probable immature 1-11 Nov 1963 (McCaskie 1964); one adult recorded intermittently 25 Oct 1981-21 Jun 1986 (Binford 1985, Morlan 1985, AB 40:1255, 1986), presumably the same bird found intermittently in a night-heron rookery at the Scripps Institution of Oceanography, La Jolla.

White-faced Ibis *Plegadis chihi*. 474, 37. Fairly common in winter, uncommon in summer; sporadic. Ave 5.9 Oct-Apr, 1.2 May-Sep. Max 60 on 2 Mar 1980, summer max 20 on 4 Aug 1974 and 3 Aug 1985 (DK).

Wood Stork *Mycteria americana*. 1, 1. Rare in summer; 25-26 May 1986 (AB 40:523, 1986), 30 Jul-3 Aug 1975 (AB 29:1030, 1975), 31 Jul-2 Aug 1964 (AFN 18:535, 1964), 6-10 Aug 1963 (AFN 18:73, 1964), 29 Aug 1961 (18) (AFN 15:492, 1961).

[Greater Flamingo *Phoenicopterus ruber*. 0, 0. Escapees have occurred on several occasions. Max 3 on 13 Dec 1969 (PMcB).]

[Fulvous Whistling-Duck *Dendrocygna bicolor*. 0, 0. Probable escapee recorded on 10 Sep 1972 (AB 27:120, 1973).]

Tundra Swan *Cygnus columbianus*. 0, 0. Rare; 19 Nov-11 Dec 1971 (AB 26:120, 1972), 6 Dec 1963 (2) (AFN 18:386, 1964).

[Bean Goose *Anser fabalis*. 1, 1. Escapee; 3 Oct 1982.]

Greater White-fronted Goose *Anser albifrons*. 3, 2. Rare; 4 Oct-1 Nov 1981 (2), 25-26 Oct 1986 (LS), 2 Nov 1969 (GMcC), 13 Dec 1969 (PMcB), 4 Dec 1970 (AF), 27 Dec 1986 (SK), 17 Mar 1970 (PMcB), 15 Apr 1987 (J & DS).

Snow Goose *Chen caerulescens*. 24, 11. Uncommon winter visitor; decreasing. Only one seen 1977-1983, 23 Nov-7 Dec 1980. Ave 1974-1976 2.0/2 Dec-Feb, none Apr-Oct. Max 6 on 13 Dec 1969 (PMcB).

Ross' Goose *Chen rossii*. 0, 0. Rare; 18 Dec 1982-30 Jan 1983 (3) (LS, DK), 20 Dec 1986 (LS).

Brant *Branta bernicla*. 65, 5. Rare in spring; 22 Feb 1984 (LS), 6 Mar 1983 (2), 13 Mar 1977 (60), 29 Mar-9 May 1981, 4 Apr 1982, and 27 Apr 1973 (SS).

Canada Goose *Branta canadensis*. 77, 4. Rare in winter; about 10 records between 16 Nov and 13 Mar. Max 400 on 21 Jan 1987 (BM).

[Common Shelduck *Tadorna tadorna*. 1, 1. Escapees; 1 Jun-6 Jul 1975 (2) (TM).]

Green-winged Teal *Anas crecca*. 11366, 89. Abundant in winter, occasional in summer. Ave 220/200 Dec-Mar, falling to four records Jun-Jul and none in Aug. Max 640 on 6 Feb 1977, summer max 5 on 3 Jul 1983. One male *A. c. crecca* 18-24 Mar 1973 (AB 27:662, 1973).

Mallard *Anas platyrhynchos*. 7557, 119. Abundant in summer, very common in winter; increasing. Ave 110/90 Jun-Sep, falling to 32/25 Oct-Apr. Max 510 on 4 Sep 1983. Common breeder. Small numbers of feral ducks were resident at the lagoon but not counted on the surveys.

Northern Pintail *Anas acuta*. 28768, 94. Abundant in winter, fairly common in summer. Ave 470/230 Sep-Feb, highest 1100/670 Dec, falling to 4.1 May-Aug. Max 5300 on 8 Dec 1974.

Blue-winged Teal *Anas discors*. 50, 25. Uncommon spring migrant, occasional otherwise. Ave 1.0 Mar-Jun, falling to 0.1 Aug-Jan. Max 8+ on 19 Oct 1985 (D & MH).

Cinnamon Teal *Anas cyanoptera*. 9576, 116. Abundant spring migrant, very common otherwise. Ave 180/130 Feb-Apr, falling to 42/21 Jun-Jan. Max 920 on 16 Feb 1975. Bred in 1967 (chick SD 36283).

Northern Shoveler *Anas clypeata*. 36389, 94. Abundant in winter, occasional in summer. Ave 300/240 Oct-Nov, 600/480 Dec-Apr, 7.6/2 May, 0.6 Jun-Aug. Max 2000 on 2 Apr 1978, summer max 6 on 6 Jul 1979.

Gadwall *Anas strepera*. 3401, 105. Very common in winter, fairly common in summer; increasing. Ave 42/20 Nov-Apr, falling to 8.8/2 Jul-Oct. Max 180 on 9 Jan 1983. Bred in 1975, 1978 (AF), and 1980.

Eurasian Wigeon *Anas penelope*. 6, 6. Occasional in winter since 1981. Ave 1981-1983 0.5 Nov-Mar. All records (7 Feb-19 Apr 1981 (AB 35:863, 1981), 12 Oct-13 Dec 1981 (AB 36:217, 1982), 24 Oct 1982-6 Feb 1983 (AB 37:223, 1983), 2 Oct 1983 (AB 38:246, 1984), and 29 Sep 1985 (AB 40:158, 1986)) may refer to the same male bird.

American Wigeon *Anas americana*. 6274, 70. Abundant late fall to early winter, very common late winter to early spring, rare in summer; increasing. Ave 150/95 Nov-Jan, 39/24 Feb-Apr. Late spring to early fall records include 3 May-7 Jun 1981 (15), 4 May 1980, 4 Aug 1974, 27 Aug 1985 (RW), and four early Sep records (max 12). Max 460 on 6 Dec 1981.

Canvasback *Aythya valisineria*. 147, 16. Decreasing; since 1979, a rare winter visitor. 85% of birds found the winter of 1973-1974; only two birds seen 1979-1983. Ave 1973-1975 49/19 Nov-Dec, 5/4 Jan-Apr. One summer (May-Sep) record, 3 Jul 1965 (AF). Max 59 on 4 Nov 1973.

Redhead *Aythya americana*. 1310, 58. Common in winter and spring, occasional in late summer. Ave 15/4 Nov-Jun, falling to 0.6 Aug-Sep. Max 420 on 5 Dec 1976. Bred in 1965 (AF).

Ring-necked Duck *Aythya collaris*. 0, 0. Rare; 26 Dec 1974-11 Jan 1975 (2) (SS).

[Tufted Duck × Greater Scaup *Aythya fuligula* × *marila*. 0, 0. Exceptional; 20 Feb-22 Mar 1987 (SR).]

Greater Scaup *Aythya marila*. 0, 0. Rare; 21 Dec 1986 (2) (LS), 26 Dec 1974 (SS).

Lesser Scaup *Aythya affinis*. 1193, 51. Common winter visitor. Ave 23/9 Dec-Apr, falling to none May-Sep. Max 200 on 6 Jan 1980.

Oldsquaw *Clangula hyemalis*. 0, 0. Rare; 4 Dec 1984 (BM).

Surf Scoter *Melanitta perspicillata*. 5, 4. Rare in winter and spring; 17 Dec 1986 (RP), 1 Feb 1981, 13 Apr-4 May 1980, 6 May 1979 (2). Common to abundant in winter in the surf seaward of the lagoon.

Common Goldeneye *Bucephala clangula*. 0, 0. Rare. One female from "Cardiff," 13 Jan 1958 (SD 30069), presumably was from San Elijo Lagoon.

Bufflehead *Bucephala albeola*. 939, 60. Common winter visitor. Ave 18/15 Dec-Apr, falling to none Jul-Sep. Four May records; one June record, 1 Jun 1980. One October record, 10 Oct 1976. Max 58 on 6 Mar 1983.

Hooded Merganser *Lophodytes cucullatus*. 0, 0. Rare; 21 Dec 1986 (LS).

Common Merganser *Mergus merganser*. 0, 0. Rare; one specimen from "Solana Beach" 18 Dec 1932 (SD 16152).

Red-breasted Merganser *Mergus serrator*. 181, 31. Fairly common in late winter, occasional at other times. Ave 3.6/2 Jan-Apr, 0.3 May-Nov. Max 20 on 1 Feb 1981.

Ruddy Duck *Oxyura jamaicensis*. 11136, 113. Abundant in winter, common in summer. Ave 160/80 Dec-Apr, falling to 23/12 Jun-Sep. Max 970 on 6 Apr 1975. Bred in 1964 (egg set WF 52570) and 1982.

Turkey Vulture *Cathartes aura*. 8, 6. Occasional from fall through spring. Ave 0.1 Oct-May, none in other months. Max 2 on 13 Mar 1977 and 2 Oct 1983.

Osprey *Pandion haliaetus*. 9, 8. Occasional from fall through spring. Ave 0.1 Sep-Apr, none in other months. Max 2 on 2 Nov 1980.

Black-shouldered Kite *Elanus caeruleus*. 199, 75. Uncommon in fall and winter, occasional in spring and summer. Ave 2.7/3 Sep-Jan, falling to 0.5 Mar-Jun. Max 7 on 4 Oct and 1 Nov 1981. Bred in 1982 (three young fledged) (TM).

Bald Eagle *Haliaeetus leucocephalus*. 1, 1. Rare; 8 Dec 1974.

Northern Harrier *Circus cyaneus*. 65, 42. Uncommon in winter, rare in summer. Ave 1.4/1 Nov-Jan. Summer (May-Aug) records 5 Jun 1977 and 13 Jul 1980. Max 3 on six dates. Bred in 1920 (egg set WF 52470).

[*Accipiter* spp. 134, 65. Includes 36% Sharp-shinned and 57% Cooper's Hawks plus 7% not identified to species. All unidentified were found Sep-Mar.]

Sharp-shinned Hawk *Accipiter striatus*. 48, 34. Occasional winter visitor. Ave 0.7 Nov-Apr, falling to none May-Aug. Max 4 on 7 Mar 1976.

Cooper's Hawk *Accipiter cooperii*. 77, 52. Uncommon in winter, occasional in summer. Ave 1.5/1 Nov-Jan, falling to 0.2 Apr-Sep. Max 3 on five Dec and Jan dates.

Red-shouldered Hawk *Buteo lineatus*. 84, 51. Uncommon in fall and winter, occasional in spring and summer; increasing. Ave 1.1/1 Oct-Jan, falling to 0.4 Mar-Jul. Max 5 on 10 Jan 1982.

Red-tailed Hawk *Buteo jamaicensis*. 689, 120. Fairly common in winter, uncommon in summer. Ave 10/9 Dec-Feb, falling to 2.9/3 May-Sep. Max 19 on 5 Jan 1975. Yearly breeder near, but not at, lagoon.

Ferruginous Hawk *Buteo regalis*. 0, 0. Rare; fall 1986-7 Jan 1987 (RP, LS, SW).

Rough-legged Hawk *Buteo lagopus*. 1, 1. Rare; 4 Dec 1977.

Golden Eagle *Aquila chrysaetos*. 1, 1. Rare; 4 Oct 1981, 7 Apr 1979 (2) (DA). Dixon (1937) included San Elijo Lagoon within the territory of a pair that nested at Olivenhain, 1.5 miles northeast of the lagoon, until the 1950s (RQ, fide TS). Urbanization has eliminated this territory (Unitt 1984).

American Kestrel *Falco sparverius*. 640, 118. Fairly common resident. Ave 6.9/6 Sep-Jan, 3.9/4 Mar-Jul. Max 16 on 2 Dec 1979. Probably breeds occasionally; bred in 1919 in "San Elijo Canyon" (egg set WF 55068), which may or may not be San Elijo Lagoon.

Merlin *Falco columbarius*. 1, 1. Rare in fall and winter; 11 Oct 1963 (GMcC), 12 Oct 1985 (CE), 18 Oct 1980 (TM), 22 Oct 1978 (TM), 18 Dec 1985 (BM), 9 Jan 1983, 20 Mar 1980 (CD).

Peregrine Falcon *Falco peregrinus*. 2, 2. Rare; 3 Oct 1982, 5 May 1974.

Prairie Falcon *Falco mexicanus*. 2, 2. Rare winter visitor; 7 Nov 1976, 5-11 Jan 1975 (SS).

Ring-necked Pheasant *Phasianus colchicus*. 2, 2. Rare; 27 Sep-25 Oct 1981 (2) (TM), 10 Oct 1976, Mar 1985 (BM).

[Common Peafowl *Pavo cristatus*. 0, 0. Feral birds have been seen on several occasions east of the freeway.]

California Quail *Callipepla californica*. 12197, 120. Abundant resident, decreasing. Ave 100/88 throughout the year. Max 340 on 5 Jan 1975. Common breeder.

Black Rail *Laterallus jamaicensis*. 0, 0. Rare in winter; 28 Oct 1973 (AF), 11 Nov 1963 (AFN 18:73, 1964), 15 Nov 1969 (AF), 17 Jan 1964 (Unitt 1984), 21 Feb 1983 (AB 37:338, 1983). A specimen from "Encinitas" 8 Dec 1886 (SD 148) Unitt (1984) suggested was from either San Elijo or Batiquitos lagoons.

Clapper Rail *Rallus longirostris*. 27, 11. Uncommon resident from 1981 through at least 1983. The only records between 1947 (Wilbur 1974) and 1981 were in 1972 (3) (Wilbur et al. 1979) and on 21 Sep 1977 (RC). In Jun 1981, at least 10 birds were found east of the freeway (Unitt 1984). One to three birds were occasionally recorded through 1983, but none has been reported since then. Presumably bred 1981-1983 (PJ). (See also under Status of Endangered Species.)

Virginia Rail *Rallus limicola*. 220, 71. Fairly common in winter, occasional in summer. Ave 3.3/2 Oct-Jan, falling to 0.4 Jun-Jul. Max 17 on 4 Nov 1973. Yearly breeder.

Sora *Porzana carolina*. 708, 90. Fairly common in fall and winter, common in spring, rare in summer. Ave 5.8/6 Sep-Jan, 13/11 Mar-Apr. The only Jun-Jul records are 6 Jun 1982, 8 Jul 1979, and 11 Jul 1976. Max 38 on 9 Mar 1975.

Common Moorhen *Gallinula chloropus*. 45, 25. Occasional. Ave 0.5 Oct-May, falling to 0.2 Jun-Sep. Max 6 on 5 Dec 1976. Bred (adults with chicks as late as 7 Aug) in 1983.

American Coot *Fulica americana*. 59348, 120. Abundant in winter, very common in summer. Ave 1000/860 Nov-Jan, 66/17 Jun-Sep. Max 2000 on 4 Dec 1977. Common breeder.

Black-bellied Plover *Pluvialis squatarola*. 2665, 106. Very common in fall, common in winter and early spring, fairly common in late spring and summer. Ave 47/38 Aug-Sep, 25/20 Oct-Mar, 6.2/5 Apr-Jul. Max 120 on 5 Sep 1982.

Lesser Golden Plover *Pluvialis dominica*. 0, 0. Rare fall migrant; 1-9 Aug 1964 (AFN 18:535, 1964), 16 Aug 1981 (MB), 22 Aug 1968 (AFN 23:108, 1969), 19 Sep 1967 (AFN 22:89, 1968), 12 Oct 1981 (SS).

Snowy Plover *Charadrius alexandrinus*. 888, 63. Common in fall, fairly common otherwise. Ave 16/7 Jul-Sep, falling to 4.6 Oct-Jun. Max 74 on 5 Dec 1982. Yearly breeder (see also under Status of Endangered Species).

Semipalmated Plover *Charadrius semipalmatus*. 2774, 93. Very common in fall, common in winter and spring, fairly common in summer. Ave 53/28 Aug-Oct, 15/6 Nov-May, 5.9/1 Jun-Jul. Max 330 on 1 Oct 1978.

Killdeer *Charadrius vociferus*. 5692, 120. Very common resident. Ave 62/60 Jul-Aug, 45/40 Sep-Jun, min 32/29 Apr-May. Max 160 on 7 Nov 1976. Common breeder.

Black-necked Stilt *Himantopus mexicanus*. 8756, 119. Abundant in summer, very common otherwise. Ave 110/97 Jun-Sep, falling to 46/41 Nov-Mar. Max 280 on 11 Jul 1976. Common breeder.

American Avocet *Recurvirostra americana*. 11657, 114. Abundant in spring, very common otherwise. Ave 220/200 Mar-Apr, 56/25 Aug-Jan. Max 780 on 7 Dec 1980. Common breeder.

Greater Yellowlegs *Tringa melanoleuca*. 706, 90. Common in fall, fairly common in winter and spring, rare in summer. Ave 15/14 Aug-Sep, 4.3/3 Nov-Apr. The only May and June records are 1 May 1983 (late spring migrant), 1 Jun 1975 (2), 5 Jun 1977 (4) (summering?), and 27 Jun 1976 (Unitt 1984) (early fall migrant). Max 33 on 1 Aug 1976.

Lesser Yellowlegs *Tringa flavipes*. 480, 70. Fairly common spring and fall migrant, uncommon in winter. Ave 1.4/1 Jul, 10/8 Aug-Sep, 1.8/1 Nov-Feb, 7.5/4 Mar-Apr, none in Jun. Late spring records 2 May 1982 (2) and 4 May 1975. Fall max 44 on 12 Sep 1976, winter max 10 on 6 Dec 1982, spring max 37 on 1 Apr 1979.

Solitary Sandpiper *Tringa solitaria*. 1, 1 (12 Sep 1976). Rare in fall; nine records 16 Aug (1981, TM) to 21 Sep (1962, AFN 17:68, 1963). One spring record, 12 Apr 1975 (AB 29:908, 1975). Max 2 on 3 Sep 1968 (GMcC).

Willet *Catoptrophorus semipalmatus*. 2654, 111. Very common in fall migration, common in winter and spring migration, fairly common in late spring and summer. Ave 55/45 Aug-Sep, 14/13 Nov-Apr, 5.9/4 May-Jun. Max 400 + on 2 Sep 1969 (AF).

Wandering Tattler *Heteroscelus incanus*. 3, 3. Rare in spring; 5 Apr 1981, 2 May-6 Jun 1982.

Spotted Sandpiper *Actitis macularia*. 493, 105. Fairly common from fall to spring; recently a few birds have summered. Ave 7.4/7 Sep, 4.3/4 Oct-Apr, 5.5/5 May, 0.8 Jun-Jul. Max 17 on 10 Sep 1978. Bred in 1982 (AB 36:1016, 1982), 1983 (AB 37:1027, 1983), and 1984 (DK).

Whimbrel *Numenius phaeopus*. 848, 55. Very common in fall, occasional in winter, uncommon otherwise. Ave 36/18 Jul-Aug, 0.3 Nov-Jan, 1.4 Feb-Jun. Max 230 on 6 Aug 1978.

Long-billed Curlew *Numenius americanus*. 19, 10. Occasional in fall and winter. Ave 0.1 Jul-Oct, 0.4 Nov-Feb. One spring record, 7 May 1978. Max 5 on 1 Feb 1981.

Marbled Godwit *Limosa fedoa*. 1072, 90. Common in summer, fairly common in winter. Ave 14/13 Jun-Sep, 3.4/1 Nov-Jan, 16/13 Mar, 4.9/3 Apr-May. Max 180 on 3 Aug 1985 (DK). These data differ from Garrett and Dunn (1981) and Unitt (1984), who indicate that in southern California generally this species is more common in winter.

Ruddy Turnstone *Arenaria interpres*. 78, 35. Uncommon in spring and fall, occasional in summer and winter. Ave 1.5/1 Apr, 0.4 May-Aug, 1.3 Sep-Oct, 0.2 Dec-Jan. Max 8 on 12 Oct 1980.

Black Turnstone *Arenaria melanocephala*. 47, 23. Uncommon in spring, rare in summer, occasional in fall and winter. Ave 0.2 Sep-Jan, 1.2 Mar-Apr. Summer (May-Aug) records 5 May-2 Jun 1974, 3 Jul 1977 (Unitt 1984), and 4 Aug 1974. Max 7 on 2 Mar 1980.

Surfbird *Aphriza virgata*. 0, 0. Rare; 3 Jan 1964 (Unitt 1984).

Red Knot *Calidris canutus*. 97, 15. Fairly common in fall. Ave 7.4/1 Sep, none Nov-Apr. One spring record, 7 May 1978 (2); one summer record (early fall migrants?), 13 Jul 1980 (3). Max 41 on 10 Sep 1978.

Sanderling *Calidris alba*. 5814, 77. Abundant in fall, very common in winter and spring, occasional in summer. Ave 100/55 Sep, 57/21 Oct-May, falling to none in Jun, 0.4 in Jul. Max 590 on 7 Sep 1980.

[Peeps *Calidris* spp. 40328, 110. Includes, Semipalmated, 53% Western, 13% Least, and Baird's Sandpipers plus 34% not identified to species. Max 4000 on 14 Oct 1979.]

Semipalmated Sandpiper *Calidris pusilla*. 1, 1. Rare fall migrant; 20 Aug 1980 (DK), 7 Sep 1980.

Western Sandpiper *Calidris mauri*. 21453, 98. Abundant in fall and spring, very common in winter, rare in summer. Ave 400/150 Sep-Nov, 95/25 Jan-Mar, 220/110 Apr. Only June records 1 Jun 1975, 12 Jun 1983 (DK). Max 2500 on 14 Oct 1979.

Least Sandpiper *Calidris minutilla*. 5288, 96. Very common in fall and winter, fairly common in spring, occasional in summer. Ave 65/41 Aug-Feb, falling to 8.8/1 Apr-May. One June record, 1 Jun 1980. Max 680 on 12 Oct 1980.

Baird's Sandpiper *Calidris bairdii*. 5, 3. Rare fall migrant. Thirteen records in 1960s of about 25 birds between 14 Aug and 21 Sep. Max 5 on 15 Aug 1965 (Unitt 1984). More recent records 6 Aug 1978 (2), 27 Aug 1985 (2) (RW), 30 Aug 1981 (TM), 7 Sep 1975, 8 Sep 1985 (3) (JD), 10 Sep 1972 (SS), 17 Sep 1986 (3) (J & DS), 23 Sep 1984 (2) (RW), 5 Oct 1975 (2).

Pectoral Sandpiper *Calidris melanotos*. 8, 5. Rare fall migrant. About 20 records during 1960s of about 90 birds between 8 Aug and 18 Oct. Max 20 on 10 Oct 1965 and 11 Oct 1963 (Unitt 1984). More recent records 29 Jun 1977 (exceptionally early) (AB 31:1190, 1977), 6-7 Sep 1981 (TM), 8 Sep 1985 (JD), 17-18 Sep 1972 (SS), 1-8 Oct 1978 (2) (TM), 2 Oct 1983 (3), 5 Oct 1975 (2), 10 Oct 1976.

Dunlin *Calidris alpina*. 970, 55. Common winter visitor. Ave 13/4 Oct-Apr, falling to none Jun-Aug. Four early fall (Sep) records, earliest 4 Sep 1977 (2). Max 340 on 10 Nov 1974.

Curlew Sandpiper *Calidris ferruginea*. 0, 0. Exceptional. One adult 4 Jul 1981 (Binford 1985), the only record for San Diego County.

Stilt Sandpiper *Calidris himantopus*. 0, 0. Rare in fall, exceptional in winter; 2 Sep 1985 (4) (AB 40:158, 1986), 13-25 Sep 1964 (AFN 19:79, 1965), 16 Sep 1967 (GMcC), 21 Sep 1962 (AFN 17:68, 1963), 29 Sep-8 Oct 1984 (3) (AB 39:103, 1985), 21 Oct 1962 (AFN 17:68, 1963), and 21-22 Feb 1982 (AB 36:331, 1982), the only winter record for San Diego County.

Ruff *Philomachus pugnax*. 0, 0. Rare; 21-23 Sep 1962 (McCaskie 1963).

[Dowitchers *Limnodromus* spp. 19675, 114. Includes 4% Short-billed and 28% Long-billed Dowitchers plus 68% not identified to species. Abundant in winter, common in summer. Ave 200/150 Sep-May, falling to 42/21 Jun-Jul. Max 705 on 9 Sep 1979.]

Short-billed Dowitcher *Limnodromus griseus*. 747, 51. Common in fall, fairly common in winter, uncommon in spring. Ave 18/12 Sep-Oct, 3.7 Nov-Apr, 1.1 May-Jun. Max 100 on 3 Jul 1977 (Unitt 1984).

Long-billed Dowitcher *Limnodromus scolopaceus*. 5506, 85. Very common from fall through spring, uncommon in summer. Ave 55/18 Aug-May, 1.2 Jun-Jul. Max 390 on 9 Sep 1979.

Common Snipe *Gallinago gallinago*. 44, 21. Uncommon winter visitor; decreasing. Only four records 1978-1983. Ave 1974-1977 1.6/2 Nov-Apr, none Jun-Aug. Late spring record 4 May 1975. Max 5 on 9 Nov 1975.

Wilson's Phalarope *Phalaropus tricolor*. 1419, 30. Very common in fall, exceptional in winter, fairly common in spring, rare in summer. Ave 13/1 Jul, 99/27 Aug, 22/9 Sep, none Nov-Mar except 5 Jan 1964 (AFN 18:387, 1964), 4.4 May, and Jun records 2 Jun 1974 and 7 Jun 1981. Max 360 on 5 Aug 1979.

Red-necked Phalarope *Phalaropus lobatus*. 5654, 35. Abundant in fall, occasional in spring. Ave 250/140 Sep-Oct, none Dec-Apr, 0.4 May, none Jun-Jul. Max 1400 on 4 Sep 1977.

Red Phalarope *Phalaropus fulicaria*. 220, 4. Rare in winter and spring; 1-9 Nov 1963 (100) (SD 30725), 7 Nov-5 Dec 1982 (30), 28 Nov 1969 (AS), 5 Dec 1976-9 Jan 1977 (170), 18 May 1978 (PU), 24-25 May 1980 (10) (TM).

Pomarine Jaeger *Stercorarius pomarinus*. 0, 0. Rare; 6 Mar 1964 (GMcC).

Parasitic Jaeger *Stercorarius parasiticus*. 0, 0. Rare; 15 Jul 1984 (GMcC), east of the freeway.

Franklin's Gull *Larus pipixcan*. 0, 0. Rare in fall; 11 Oct-7 Nov 1964 (5) (McCaskie and Cardiff 1965), 25-29 Oct 1969 (2) (AFN 24:100a, 1970), 20 Nov 1971 (AB 26:121, 1972).

Bonaparte's Gull *Larus philadelphia*. 2884, 74. Very common in winter, fairly common in summer. Ave 52/21 Nov-Mar, falling to 3.1 May-Oct. Max 350 on 9 Jan 1977, summer max 41 on 10 Jul 1977.

Heermann's Gull *Larus heermanni*. 394, 30. Common in fall, occasional otherwise. Ave 12/5 Jul-Sep, falling to 0.2 Nov-Jun. Max 69 on 10 Jul 1977. Although this species is common along the coast of southern California Jul-Feb (Garrett and Dunn 1981), apparently it uses brackish lagoons commonly during its northbound (fall) migration only.

[Large gulls *Larus* spp. 25977, 120. Includes 38% Ring-billed, 10% California, 10% Western, and 1% Mew, Herring, Thayer's, and Glaucous-winged Gulls, plus 41% not identified to species. Abundant in fall and winter, very common in summer. Ave 470/270 Dec-Mar, 59/26 May-Jul, 120/87 Sep-Nov. Max 1980 on 16 Feb 1975.]

Mew Gull *Larus canus*. 1, 1. Rare; 10 Oct 1976.

Ring-billed Gull *Larus delawarensis*. 9991, 117. Abundant in winter, common in summer. Ave 190/120 Feb-Mar, 21/9 May-Jul, 110/87 Nov-Jan. Max 830 on 7 Mar 1976, summer max 230 on 5 Jun 1977.

California Gull *Larus californicus*. 2647, 62. Uncommon in fall, very common in winter, rare in summer. Ave 2.4 Aug-Oct, 68/23 Jan-Mar. The only Jun-Jul records are 4-5 Jun 1977 (3), 27 Jun 1976 (Unitt 1984), and 29 Jun 1977 (Unitt 1984) Max 340 on 6 Feb 1977.

Herring Gull *Larus argentatus*. 69, 22. Uncommon winter visitor. Ave 1.3 Dec-Apr, falling to none Jun-Oct. Late spring records 1 May 1977 and 2 May 1976. Max 10 on 9 Mar 1975 and 7 Mar 1976.

Thayer's Gull *Larus thayeri*. 4, 4. Rare winter visitor; 7 Dec 1975, 8 Jan 1978, 11 Jan 1976, 7 Mar 1976.

Western Gull *Larus occidentalis*. 2603, 114. Very common in summer, common in fall and winter, fairly common in spring. Ave 40/13 Jun-Aug, 18/11 Sep-Mar, 8.1/5 Apr-May. Max 350 on 2 Jul 1978.

Glaucous-winged Gull *Larus glaucescens*. 1, 1. Rare; 27 Nov 1981 (TM), 31 Dec 1972 (SS), 4 Apr 1982, 22 Apr 1968 (AF).

[Glaucous Gull *Larus hyperboreus*. 0, 0. One on the beach 100 meters north of the lagoon on 7 Mar 1982 (TM).]

Black-legged Kittiwake *Rissa tridactyla*. 2, 2. Rare in spring; 7 Mar 1976, 3 Apr 1977 (both dead birds), 22 Apr 1968 (AF).

Caspian Tern *Sterna caspia*. 1359, 79. Very common in spring, common in summer and fall, occasional in winter. Ave 38/30 Apr, 15/11 May-Jun, 26/11 Jul-Aug, 0.5 Oct-Jan. Max 140 on 7 Aug 1983.

Royal Tern *Sterna maxima*. 623, 79. Fairly common in spring and fall, uncommon in summer and winter. Ave 8.3/4 Apr-May, 2.8 Jun-Jul, 8.1/4 Sep-Oct, 1.9/1 Dec-Jan. Max 45 on 6 May 1979.

Elegant Tern *Sterna elegans*. 8398, 69. Very common in spring, abundant in late summer. Ave 45/17 Apr, 12/4 May-Jun, 250/67 Jul-Sep, falling to none Jan-Feb. Early spring record 13 Mar 1977, late fall records 2 Dec 1973 and 7 Dec 1980 (5). Max 2000 on 4 Aug 1974.

[Common/Forster's Tern *Sterna* spp. 10605, 115. Includes 8% Common and 81% Forster's Terns plus 11% not identified to species. Max 550 on 12 Jul 1980.]

Common Tern *Sterna hirundo*. 809, 31. Very common in fall, rare in spring and summer. Ave 34/2 Aug-Sep, falling to none Nov-Mar. Spring and summer (Apr-Jun) records include 12 Apr 1969 (Unitt 1984), 4 May 1980, 4 Jun 1978, 5 Jun 1977 (11), and 7 Jun 1981. Max 240 on 7 Sep 1980.

Forster's Tern *Sterna forsteri*. 8600, 115. Abundant in late summer, very common otherwise. Ave 120/76 Jul-Sep, 46/32 Oct-Jan, 86/56 Feb-Mar, 50/38 Apr-Jun. Max 370 on 10 Jul 1977.

Least Tern *Sterna antillarum*. 1088, 45. Common in summer. Ave 10/7 May, 20/21 Jun, 38/34 Jul-Aug, falling to none Oct-Mar. Extreme dates 6 Apr 1970 (AF) and 13 Apr 1980 in spring, 23 Sep 1969 (AF) in fall. Max 66 on 2 Aug 1981. For data on breeding, see under Status of Endangered Species.

Black Tern *Chlidonias niger*. 13, 8. Occasional in fall, rare in winter and spring. Ave 0.4 Aug-Oct. Nov-Jun records 8-11 Nov 1963 (AFN 18:74, 1964), 11 Feb-9 Mar 1968 (AFN 22:478, 1968), 2 May 1982, 11 May 1980 (TM). Max 3 on 4 Aug 1974.

Black Skimmer *Rynchops niger*. 0, 0. Rare; records during the study period are 6 Aug 1983 (WJ), 28 Sep 1982 (3) (SW), 12 Oct 1981 (SS). There are several subsequent records for this species, which is expanding its range. Max 10 from 27 Oct to 19 Nov 1984 (BM).

Common Murre *Uria aalge*. 0, 0. Rare. A sick bird found east of the freeway on dried mud on 15 Jun 1982 had died by the next day (DK). A specimen from "Cardiff" on 4 Feb 1942 (SD 18950) was probably found on the beach near the lagoon.

Rock Dove *Columba livia*. 6774, 115. Abundant in winter, very common otherwise. Ave 110/85 Dec-Feb, 31/24 Mar-Aug, 56/44 Sep-Nov. Max 380 on 6 Jan 1980. Common breeder.

Band-tailed Pigeon *Columba fasciata*. 0, 0. Rare in spring; 5 Apr 1974 (SS), 26 Apr 1981 (2) (TM).

Spotted Dove *Streptopelia chinensis*. 23, 18. Occasional. Ave 0.2 throughout the year. Max 2 on five dates.

White-winged Dove *Zenaida asiatica*. 1, 1. Rare migrant; 4 Sep 1978 (RAE), 20 Sep 1964 (GMcC), 22 Sep 1962 (AFN 17:69, 1963), 3 May 1981.

Mourning Dove *Zenaida macroura*. 8744, 120. Very common resident. Ave 100/97 Jun-Sep, falling to 55/42 Nov-Apr. Max 220 on 6 Feb 1983. Common breeder.

Greater Roadrunner *Geococcyx californianus*. 57, 42. Occasional; decreasing. Ave 0.5 throughout the year. Max 4 on 5 Apr 1981. Probable yearly breeder.

Common Barn-Owl *Tyto alba*. 17, 11. Occasional. 1-3 seen each month Apr-Sep 1974, 6 scattered records later. All but 1 found along cliffs on N side of lagoon E of freeway. Whitewashed rocks in this habitat suggest this species is regular. Five egg sets (WF) were collected near Cardiff and Solana Beach from 1922 to 1939.

Great Horned Owl *Bubo virginianus*. 3, 3. Rare; 4 Sep 1977, 12 Sep 1976, 23 Nov 1980 (TM), 28 Feb 1982 (TM), 6 May 1976. Egg set from "east of Solana Beach" on 10 Mar 1936 (WF 4514).

Burrowing Owl *Athene cunicularia*. 4, 4. Rare winter visitor; 2 Nov 1980, 7 Dec 1975-1 Feb 1976.

[Long-eared Owl *Asio otus*. 0, 0. Listed as a rare winter visitor by Summers (1975), but we know of no specific occurrences.]

Short-eared Owl *Asio flammeus*. 0, 0. Rare winter visitor; 19 Oct 1980 (TM), 27 Nov 1981 (TM), 30 Dec 1984 (LS), winter 1969-1970 (TM), 7 Mar 1965 (GMcC).

Lesser Nighthawk *Chordeiles acutipennis*. 0, 0. Rare; 23 May 1976 (TM).

[Common Poorwill *Phalaenoptilus nuttallii*. 0, 0. Specimen from "Cardiff" 21 Nov 1915 (SD 31452).]

[Swifts. 767, 65. Include Black, Chimney, 26% Vaux's, and 65% White-throated Swifts plus 9% not identified to species.]

Black Swift *Cypseloides niger*. 0, 0. Rare; 19 May 1981 (AB 35:864, 1981).

Chimney Swift *Chaetura pelagica*. 0, 0. Rare; 29 Jun-22 Aug 1968 (5) (AFN 22:649, 1968; SD 36690).

Vaux's Swift *Chaetura vauxi*. 202, 11. Common in spring, uncommon in fall. Ave 19/2 May, none Jun-Aug, 1.3 Oct. Early fall record 7 Sep 1975 (2). Winter (Nov-Mar) records 6 and 22 Mar 1964 (AFN 18:388, 1964). Max 160 on 5 May 1974.

White-throated Swift *Aeronautes saxatalis*. 498, 62. Fairly common in spring, uncommon otherwise. Ave 9.7/8 Feb-Apr, falling to 1.1 Aug-Dec. Max 200 on 6 Mar 1964 (Unitt 1984). Probable common breeder in cliffs in northeast area.

Black-chinned Hummingbird *Archilochus alexandri*. 20, 10. Occasional migrant. Ave 0.3 Apr, 0.6 Jul-Sep, none in other months. Max 6 on 7 Aug 1977.

Anna's Hummingbird *Calypte anna*. 2851, 120. Common resident; increasing. Ave 27/26 Aug-Apr, 12/12 Jun-Jul. Max 56 on 12 Oct 1980. Common breeder.

Costa's Hummingbird *Calypte costae*. 19, 15. Occasional. Ave 0.5 Apr-May, 0.1 Jun-Aug, 0.2 Sep-Oct, 0.1 Nov-Mar. Max 3 on 6 Apr 1975.

[Rufous/Allen's Hummingbird *Selasphorus* spp. 404, 42. Includes 32% Rufous and 8% Allen's Hummingbirds plus 59% not identified to species. Fairly common in spring, common in fall, rare in winter. Ave 3.9/2 Apr, none Jun, 12/6 Jul-Sep. Oct-Jan records of unidentified birds on 2 Oct 1977, 4 Nov 1979 (3), and 3 Dec 1978. Max 110 on 11 Jul 1976.]

Rufous Hummingbird *Selasphorus rufus*. 130, 20. Fairly common in fall, uncommon in spring. Ave 5.2 Jul-Aug, none Sep-Jan, 0.2 Feb-Mar, 2.1/1 Apr, and none Jun. Early and late spring dates 4 Feb 1979 and 4 May 1980. Max 74 on 11 Jul 1976.

Allen's Hummingbird *Selasphorus sasin*. 32, 7. Uncommon in fall, rare in spring. Ave 1.6 Jul-Aug. One record Sep-Jun, 3 Apr 1977. Max 10 on 12 Jul 1981.

Belted Kingfisher *Ceryle alcyon*. 214, 86. Uncommon from fall through spring. Ave 2.6/2 Sep-Mar, falling to none Jun. Late spring record 1 May 1977. Max 6 on 4 Aug 1974 and 1 Nov 1981. One summer record after the study period of one 7 Jun 1984 carrying food, presumably to nestlings.

Red-naped Sapsucker *Sphyrapicus nuchalis*. 3, 2. Rare fall migrant; 18 Oct 1981 (TM), 9 Nov 1975, 10 Nov 1974 (2).

Red-breasted Sapsucker *Sphyrapicus ruber*. 4, 4. Rare fall migrant and winter visitor; 1 Oct 1978, 6 Nov 1977, 2 Dec 1973, 6 Feb 1977.

Nuttall's Woodpecker *Picoides nuttallii*. 304, 109. Uncommon resident. Ave 2.5/2 throughout the year. Max 7 on 2 Aug 1981. Yearly breeder.

Downy Woodpecker *Picoides pubescens*. 3, 3. Rare in late summer; 8 Jul 1979, 3 Aug 1980, 6 Sep 1981.

Hairy Woodpecker *Picoides villosus*. 3, 3. Rare in fall through spring; 20 Sep-12 Oct 1975 (AB 30:127, 1976), 3 Oct 1982, 7 Dec 1975, 2 May 1976.

Common Flicker *Colaptes auratus*. 538, 109. Fairly common in winter, uncommon in summer. Ave 8.2/8 Nov-Jan, falling to 1.9/2 Apr-Sep. Max 20 on 9 Nov 1975. Probable yearly breeder. Apparent Yellow-shafted Flickers (*C. a. luteus*) were recorded 1 Nov 1986 (LS), 9 Nov-7 Dec 1975, 8 Dec 1974, and 3 Feb 1974.

Olive-sided Flycatcher *Contopus borealis*. 23, 13. Uncommon in spring, exceptional in summer, rare in fall. Ave 1.7/1 May, 0.4 Jun, none Jul-Aug except for single record of breeding, 8 Sep 1974, none Oct-Mar. Max 6 on 1 May 1977. Exceptional breeding record 2 May-5 Jul 1982 (TM, DK) of a pair raising one young in a nonnative cypress (not a eucalyptus as reported AB 36:1017, 1982).

Western Wood-Pewee *Contopus sordidulus*. 69, 19. Fairly common spring migrant, occasional fall migrant. Ave 3.0/1 May-Jun, none Jul, 0.7 Sep, none Nov-Apr. Max 20 on 1 Jun 1975.

[*Empidonax* spp. 129, 36. Includes 3% Willow, 3% Hammond's, and 60% Western Flycatchers plus 33% not identified to species. Fairly common in spring, uncommon in fall. Ave 7.6/4 May, none Jul, 1.3/1 Sep-Oct, none Nov-Mar. Max 35 on 4 May 1975.]

Willow Flycatcher *Empidonax traillii*. 4, 3. Rare migrant; 21 May 1985 (RW), 1 Jun 1975, 5 Jun 1977, 12 Sep 1976 (2).

Hammond's Flycatcher *Empidonax hammondii*. 5, 3. Rare in spring; 11 Apr 1976, 17 Apr 1973 (SS), 2 May 1982, 5 May 1974 (3).

Western Flycatcher *Empidonax difficilis*. 78, 30. Fairly common in spring, uncommon in fall. Ave 3.8/2 May, none Jul, 1.1/1 Sep-Oct, none Nov-Mar. Max 20 on 4 May 1975.

Black Phoebe *Sayornis nigricans*. 785, 118. Fairly common. Ave 8.4/8 Jul-Jan, falling to 3.5/3 Mar-Jun. Max 33 on 7 Aug 1983. Probable occasional breeder.

Eastern Phoebe *Sayornis phoebe*. 2, 2. Rare winter visitor; 5 Dec 1976-6 Feb 1977 (AB 31:374 1977).

Say's Phoebe *Sayornis saya*. 315, 62. Fairly common in winter, rare in summer. Ave 6.6/6 Oct-Jan. The only records May-Aug are of a bird that summered in 1980. Early fall dates 5 Sep 1982 (2) and 6 Sep 1981; late spring dates 4 Apr 1982 and 7 Apr 1974. Max 14 on 6 Jan 1980.

Vermilion Flycatcher *Pyrocephalus rubinus*. 0, 0. Rare; 20 Sep 1964 (AFN 19:80, 1965).

Ash-throated Flycatcher *Myiarchus cinerascens*. 114, 35. Uncommon in summer. Ave 2.3/1 May-Sep, none Oct-Mar. Max 14 on 3 Aug 1975. Probable yearly breeder.

Tropical Kingbird *Tyrannus melancholicus*. 0, 0. Rare in fall; 20 Sep 1963 (McCaskie et al. 1967a; SD 30768), 22 Sep 1964 (AFN 19:80, 1965), 28 Sep 1967 (AFN 22:90, 1968), 5 Dec 1965 (AFN 460, 1966).

Cassin's Kingbird *Tyrannus vociferans*. 468, 89. Fairly common in fall, uncommon otherwise; increasing. Ave 8.3/4 Sep-Oct, falling to 2.3/2 Dec-Jun. Max 50 on 6 Sep 1981. Yearly breeder.

Western Kingbird *Tyrannus verticalis*. 124, 35. Fairly common in spring, uncommon in summer. Ave 3.9/2 Apr-May, 1.1 Jun-Sep, none Nov-Mar. Max 25 on 5 Apr 1981.

Eastern Kingbird *Tyrannus tyrannus*. 1, 1. Rare fall migrant; 6 Aug 1978, 27 Aug 1964 (McCaskie et al. 1967a), 25 Sep-2 Oct 1964 (McCaskie et al. 1967a), 28 Sep 1963 (McCaskie et al. 1967a; SD 30767), 28 Sep-1 Oct 1986 (AB 41:145, 1987).

Scissor-tailed Flycatcher *Tyrannus forficatus*. 1, 1. Rare in fall; 8-10 Nov 1974 (AB 29:122, 1975), 22 Nov 1963 (McCaskie et al. 1967a; SD 30769).

Horned Lark *Eremophila alpestris*. 134, 22. Fairly common in spring, occasional in winter; decreasing. Only 8 birds seen 1978-1979 and none 1980-1983. Ave 1974-1977 5.8/3 Mar-Jul, none Aug-Sep, 0.5 Oct-Feb. Max 20 on 3 Apr 1977, 5 May 1974, and 1 Jun 1975. Probably bred formerly; egg set from "near Olivenhain" (1.5 miles northeast of the lagoon) on 23 May 1922 (WF 5123).

Purple Martin *Progne subis*. 1, 1. Rare; 22 Mar 1964 (2) (Unitt 1984), 6 Apr 1975, 10 Sep 1972 (SS).

Tree Swallow *Tachycineta bicolor*. 2674, 37. Very common in winter and abundant in spring but sporadic; rare otherwise. Ave 7.0 Nov-Dec, 41/1 Jan-Feb, 160/18 Mar. Late spring to early fall (May-Sep) records 2 May 1982 (10), 7 May 1978 (10), 6 Jun 1976 (3), 3 Jul 1983 (8), 4 Aug 1974 (2), 7 Sep 1980. Max 760 on 9 Mar 1975 and 750 on 16 Feb 1987 (JK).

Violet-green Swallow *Tachycineta thalassina*. 156, 13. Common but irregular in spring; decreasing. Ave 11/1 Mar, 2.0 Apr-May, none Jul-Feb. Late spring records 1 Jun 1980 (2) and 5 Jun 1983. Max 65 on 3 Mar 1974.

Northern Rough-winged Swallow *Stelgidopteryx serripennis*. 2265, 70. Very common in spring and summer, fairly common in fall, rare in winter; decreasing. Ave 22/21 Mar, 60/43 Apr-May, 33/21 Jun-Jul, 5.8/2 Aug-Oct. Nov-Feb records 5 Dec 1976 (3), 5 Jan 1975, 16 Feb 1975 (2). Max 220 on 11 Jul 1976. Yearly breeder.

Bank Swallow *Riparia riparia*. 0, 0. Rare; 11 Apr 1975 (Unitt 1984), 4 Jun 1984 (JO), 19 Aug 1973 (SS), 13 Sep 1981 (TM), 21 Sep 1980 (2) (TM).

Cliff Swallow *Hirundo pyrrhonota*. 10400, 64. Abundant in summer. Ave 230/190 Apr-Jul, falling to none Nov-Jan. Early record 16 Feb 1975, late record 4 Oct 1981 (8). Max 620 on 3 Jun 1979. Common breeder; main nesting area is under freeway bridge.

Barn Swallow *Hirundo rustica*. 316, 42. Fairly common spring and fall migrant, occasional in summer. Ave 1.4 Mar-Apr, 6.4/5 May, 0.3 Jun-Aug, 7.2/3 Sep-Nov. Dec-Feb records 9 Jan 1977 and 16 Feb 1987 (3) (DK). Max 46 on 4 Oct 1981. Probable occasional breeder; egg set from "Solana Beach" 16 May 1933 (WF 6578).

Scrub Jay *Aphelocoma coerulescens*. 1069, 119. Common in fall, fairly common otherwise. Ave 19/18 Sep, 6.9/7 Nov-May, 10/10 Jul-Aug. Max 32 on 6 Sep 1981. Yearly breeder.

American Crow *Corvus brachyrhynchos*. 63, 29. Occasional in winter. Ave 0.8 Oct-Apr, 0.1 May-Sep. Max 10 on 4 Oct 1981.

Common Raven *Corvus corax*. 267, 87. Fairly common in spring, occasional in summer, uncommon in fall and winter. Ave 3.8/2 Mar-Jun, 0.5 Aug-Sep, 1.9/2 Oct-Feb. Max 16 on 6 Jun 1976. Occasional breeder; egg set from "Solana Beach" on 30 Apr 1966 (SB 19352).

Verdin *Auriparus flaviceps*. 1, 1. Exceptional; 9 Jan-17 Feb 1975 (AB 29:743, 1975).

Bushtit *Psaltriparus minimus*. 14636, 120. Abundant in fall and winter, very common in spring and summer. Ave 160/150 Sep-Feb, falling to 88/78 Mar-Aug. Max 430 on 6 Nov 1977. Common breeder.

[Red-breasted Nuthatch *Sitta canadensis*. 0, 0. Listed as a rare fall migrant by Summers (1975), but we know of no specific occurrences.]

Cactus Wren *Campylorhynchus brunneicapillus*. 74, 47. Previously an uncommon resident, now extirpated. No records after 6 Sep 1981 when the habitat was converted to farmland. Ave 1973-1981 0.9 throughout the year. All records were from *Opuntia* patch on slopes of northeast area. Max 6 on 9 Mar 1975. Formerly, probable yearly breeder.

Rock Wren *Salpinctes obsoletus*. 2, 2. Rare; 13 Oct 1974, 10 Apr 1983.

Bewick's Wren *Thryomanes bewickii*. 733, 114. Fairly common resident. Ave 6.1/5 throughout the year. Max 28 on 8 Jan 1978. Common breeder.

House Wren *Troglodytes aedon*. 320, 93. Fairly common in fall, uncommon otherwise. Ave 4.9/4 Sep-Dec, falling to 1.4/1 Mar-Aug. Max 15 on 7 Sep 1980.

Marsh Wren *Cistothorus palustris*. 2432, 119. Common in winter, fairly common in summer. Ave 29/25 Jan-Jun, 7.3/6 Jul-Sep, 15/16 Oct-Dec. Max 96 on 1 Jun 1975. Common breeder.

Golden-crowned Kinglet *Regulus satrapa*. 1, 1. Rare; 10 Nov 1976.

Ruby-crowned Kinglet *Regulus calendula*. 428, 60. Fairly common winter visitor. Ave 8.0/8 Nov-Mar, none Jun-Sep. Late spring (May) records 2 May 1976, 3 May 1981 (2), and 6 May 1979. Max 26 on 1 Nov 1981.

[Gnatcatchers *Polioptila* spp. 299, 73. Includes 48% Blue-gray and 37% Black-tailed Gnatcatchers plus 14% not identified to species. Max 14 on 11 Jan 1981.]

Blue-gray Gnatcatcher *Polioptila caerulea*. 145, 46. Uncommon winter visitor. Ave 2.1/1 Sep-Mar, none Apr-Aug. Max 9 on 2 Nov 1980.

Black-tailed Gnatcatcher *Polioptila melanura*. 112, 38. Uncommon resident; increasing. Only records 1974-1978 were 7 Dec 1975-7 Mar 1976 (max 3). Ave 1979-1983 1.4/1 throughout the year. Max 9 on 5 Dec 1982. Bred in 1980. (See also under Status of Endangered Species.)

Western Bluebird *Sialia mexicana*. 56, 8. Uncommon winter visitor. Ave 1.4 Nov-Feb, none in other months. Max 20 on 6 Feb 1983.

Townsend's Solitaire *Myadestes townsendi*. 1, 1. Rare; 1 Feb 1976.

Swainson's Thrush *Catharus ustulatus*. 5, 4. Rare; five records 4 May-2 June, 20 Jun 1982 (heard singing in willows, TM), 9 Sep 1979. Max 3 from 4 to 13 May 1975 (TM).

Hermit Thrush *Catharus guttatus*. 189, 38. Fairly common winter visitor. Ave 3.5/2 Nov-Mar, falling to none May-Sep. Max 20 on 9 Nov 1975.

American Robin *Turdus migratorius*. 5, 3. Rare winter visitor; 25 Oct 1981 (TM), 17 Dec 1974 (SS), 8 Jan 1978, 19 Mar-2 Apr 1978 (2).

Varied Thrush *Ixoreus naevius*. 0, 0. Rare; 8 Jan 1982 (RWa). Another 16 Jan 1973 (AF) at nearby Glen Park in Cardiff.

Wrentit *Chamaea fasciata*. 2229, 120. Common resident. Ave 19/19 throughout the year. Max 34 on 11 Jul 1976. Probable common breeder.

Northern Mockingbird *Mimus polyglottos*. 1946, 120. Common resident. Ave 22/22 Jun-Oct, falling to 11/10 Nov-Apr. Max 53 on 3 Aug 1975. Common breeder.

Sage Thrasher *Oreoscoptes montanus*. 1, 1. Rare; 6 Feb 1977.

Bendire's Thrasher *Toxostoma bendirei*. 0, 0. Rare; 27 Aug 1964 (McCaskie et al. 1967b).

California Thrasher *Toxostoma redivivum*. 852, 116. Fairly common resident; decreasing. Ave 7.1/6 throughout the year. Max 21 on 8 Sep 1974. Common breeder.

Water Pipit *Anthus spinoletta*. 879, 44. Common winter visitor. Ave 15/2 Nov-Apr, falling to none May-Sep. Max 100 on 7 Feb 1982.

Cedar Waxwing *Bombycilla cedrorum*. 218, 9. Fairly common but very sporadic winter visitor. Ave 8.5 Jan-Feb. Single records in Nov, Mar, May, and on 6 Jul 1975 (25). Max 70 on 10 Feb 1980.

Phainopepla *Phainopepla nitens*. 14, 7. Occasional in summer. Ave 0.4 Jun-Aug, none Oct-May. Max 4 on 5 Jun 1983 and 7 Aug 1977.

Loggerhead Shrike *Lanius ludovicianus*. 942, 119. Fairly common resident. Ave 7.8/8 throughout the year. Max 19 on 10 Sep 1978. Yearly breeder.

European Starling *Sturnus vulgaris*. 6626, 120. Very common resident. Ave 66/54 Jul-Feb, falling to 31/22 Mar-May. Max 230 on 7 Nov 1976. Common breeder; first known to breed in 1964 (egg set WF 75235).

Bell's Vireo *Vireo bellii*. 0, 0. Rare; 20 May 1986 (AW), 21 May 1985 (CE).

Solitary Vireo *Vireo solitarius*. 5, 3. Rare migrant; 6 Apr 1975 (2), 19 Apr 1987 (SW), 4 May 1975 (2), 5 May 1974, 14 Sep 1980 (TM).

Hutton's Vireo *Vireo huttoni*. 13, 9. Occasional after 1980; possibly overlooked previously. Ave 1981-1983 0.4 throughout the year. Max 3 on 2 May 1982. Bred in 1981 and 1982 in thicket of nonnative acacia.

Warbling Vireo *Vireo gilvus*. 136, 27. Common spring migrant, uncommon fall migrant. Ave 11/7 May, none Jul, 1.0/1 Sep, and none Nov-Mar. Early fall migrant 1 Aug 1976. Max 30 on 4 May 1980.

Tennessee Warbler *Vermivora peregrina*. 1, 1. Rare fall migrant; 19 Sep 1962 (AFN 17:70, 1963), 28 Sep 1962 (AFN 17:70, 1963), 13 Oct 1974, 30 Oct 1964 (AFN 19:81, 1965).

Orange-crowned Warbler *Vermivora celata*. 251, 66. Fairly common in spring, uncommon in fall, occasional otherwise. Ave 5.3/2 Mar-May, 0.5 Jun-Aug, 2.6/2 Sep-Oct, 0.6 Nov-Feb. Max 43 on 6 Apr 1975.

Nashville Warbler *Vermivora ruficapilla*. 42, 15. Uncommon in spring, occasional in fall. Ave 1.5 Apr-May, none Jun-Aug, 0.5 Sep-Oct, none Dec-Mar. Max 21 on 4 May 1975.

Virginia's Warbler *Vermivora virginiae*. 0, 0. Rare; 8 Sep 1966 (GMcC), 11-13 Sep 1964 (AFN 19:81, 1965), 12 Oct 1962 (GMcC).

Northern Parula *Parula americana*. 1, 1. Exceptional in winter; female 8 Mar 1981 (AB 35:864, 1981).

Yellow Warbler *Dendroica petchia*. 45, 21. Uncommon migrant. Ave 1.7/1 May, none Jul-Aug, 1.1 Sep-Oct. One Dec-Mar record, 5 Jan 1975. Fall records 12 Aug 1967 (Unitt 1984) to 11 Nov 1964 (AFN 19:80, 1965). Max 5 on two May, one Sep dates.

Yellow-rumped Warbler *Dendroica coronata*. 7862, 75. Abundant winter visitor. Ave 130/120 Nov-Apr, falling to none Jun-Sep. Max 280 on 8 Jan 1978. Myrtle Warblers identified 6 Apr 1975, 16 Apr 1978 (TM).

Black-throated Gray Warbler *Dendroica nigrescens*. 58, 16. Uncommon in spring, occasional in fall. Ave 2.8/1 Apr-May, none Jun-Aug, 0.1 Sep, none Oct-Mar. Max 21 on 4 May 1975.

Townsend's Warbler *Dendroica townsendi*. 75, 13. Fairly common in spring, occasional in fall. Ave 6.9/5 May, none Jul-Aug, 0.2 Sep-Oct, none Nov-Mar. Early spring record 10 Apr 1983 (2). Max 21 on 4 May 1975.

Hermit Warbler *Dendroica occidentalis*. 26, 8. Uncommon spring migrant. Ave 2.6/1 May, none in other months. Max 10 on 5 May 1976.

Prairie Warbler *Dendroica discolor*. 0, 0. Rare; 17 Oct 1964 (2) (AFN 19:81, 1965), 19-28 Oct 1962 (McCaskie and Banks 1964).

Palm Warbler *Dendroica palmarum*. 0, 0. Rare; 12 Oct 1962 (McCaskie and Banks 1964).

Blackpoll Warbler *Dendroica striata*. 0, 0. Rare; 30 Sep 1967 (AFN 22:91, 1968).

Black-and-white Warbler *Mniotilta varia*. 2, 2. Rare in spring; 2 May 1982, 5 May 1976.

American Redstart *Setophaga ruticilla*. 3, 3. Rare; 13 Sep 1981 (TM), 3 Oct 1982, 2-7 Dec 1973 (SS), 7 Jun 1981.

Northern Waterthrush *Seiurus noveboracensis*. 2, 2. Rare; 2 Sep 1965 (AFN 20:92, 1966), 8 Sep 1985 (JL), 5 Oct 1975, 18 Dec 1974 (AB 29:744, 1975), 5-7 Apr 1974 (AB 28:854, 1974).

MacGillivray's Warbler *Oporornis tolmiei*. 10, 7. Occasional migrant. Ave 0.3 Sep-Oct, 0.2 Apr-May, none in other months. Max 2 on three dates.

Common Yellowthroat *Geothlypis trichas*. 2056, 120. Common resident. Ave 27/22 May-Jun, 13/12 Aug-Dec, 18/17 Jan-Apr. Max 70 on 2 May 1982. Common breeder.

Wilson's Warbler *Wilsonia pusilla*. 341, 37. Common in spring, occasional in fall; decreasing. Ave 4.6/3 Apr, 27/21 May, none Jul, 0.8/1 Sep-Oct, none Dec-Mar. Max 74 on 4 May 1975.

Yellow-breasted Chat *Icteria virens*. 1, 1. Rare; 20 May 1978 (TM), 8 Sep 1974.

Summer Tanager *Piranga rubra*. 1, 1. Rare; 5 Sep 1982.

Western Tanager *Piranga ludoviciana*. 52, 14. Fairly common spring migrant, occasional fall migrant. Ave 4.0/2 May, none Jul, 0.5 Aug-Sep, none Oct-Apr. Max 21 on 4 May 1975.

Black-headed Grosbeak *Pheucticus melanocephalus*. 167, 37. Fairly common in summer. Ave 4.0/3 Apr-Aug, falling to none Nov-Mar. Max 20 on 3 Aug 1980. Yearly breeder in willows.

Blue Grosbeak *Guiraca caerulea*. 0, 0. Exceptional in winter, rare in spring; 22 Feb-13 Mar 1964 (McCaskie et al. 1967c), 23 Apr 1973 (SS), 28 Apr 1984 (BM).

Lazuli Bunting *Passerina amoena*. 5, 2. Rare spring and fall migrant; 18 Apr 1982 (TM), 26 Apr 1981 (2) (TM), 3 May 1981, 4 May 1975 (4), 10 Sep 1972 (SS).

Green-tailed Towhee *Pipilo chlorurus*. 0, 0. Rare; 6 Dec 1973 (SS).

Rufous-sided Towhee *Pipilo erythrophthalmus*. 413, 94. Fairly common in spring, uncommon otherwise. Ave 8.3/8 May-Jun, falling to 2.0/2 Aug-Mar. Max 17 on 4 May 1975. Common breeder.

Brown Tohwee *Pipilo fuscus*. 4358, 120. Very common resident. Ave 36/35 throughout the year. Max 74 on 5 Jan 1975. Common breeder.

Rufous-crowned Sparrow *Aimophila ruficeps*. 14, 8. Occasional. Ave 0.1 throughout the year. Max 5 on 12 Jul 1980.

Chipping Sparrow *Spizella passerina*. 5, 4. Rare migrant; 5 Apr 1981, 2 May 1976 (2), 4 May 1975, 10 Sep 1972 (SS), 5 Oct 1975.

Vesper Sparrow *Pooecetes gramineus*. 9, 5. Rare in fall and winter; 4 Oct 1981, 5 Oct 1975, 1 Nov 1981 (3), 6 Jan-2 Mar 1980 (2).

Lark Sparrow *Chondestes grammacus*. 1, 1. Rare; 8 Dec 1974.

[Savannah Sparrow *Passerculus sandwichensis*. 4736, 120. The resident race was recorded separately from migrants.]

Belding's Savannah Sparrow *P. s. beldingi*. 4233, 120. Very common resident; decreasing. Ave 35/32 throughout the year. Max 120 on 1 May 1977. Common breeder; see also under Status of Endangered Species.

Migrant Savannah Sparrows. 503, 44. Fairly common in winter. Ave 7.1/1 Oct-Apr, none Jun-Aug. Late spring records 1 May 1977 (2), 2 May 1976. Max 60 on 2 Dec 1979. Large-billed Sparrow (*P. s. rostratus*) identified fall 1981 (TM).

Grasshopper Sparrow *Ammodramus savannarum*. 0, 0. Rare; 11 Apr 1982 (TM).

Fox Sparrow *Passerella iliaca*. 9, 8. Occasional winter visitor. Ave 0.2 Oct-Feb. None in other months.

Song Sparrow *Melospiza melodia*. 7819, 120. Very common resident; decreasing. Ave 89/82 Jan-Jun, falling to 39/31 Jul-Nov. Max 200 on 5 Jan 1975. Common breeder.

Lincoln's Sparrow *Melospiza lincolnii*. 73, 36. Uncommon winter visitor. Ave 1.0 Oct-Apr, falling to none Jun-Aug. Early record 7 Sep 1975, late record 6 May 1979. Max 7 on 6 Apr 1975.

Swamp Sparrow *Melospiza georgiana*. 4, 4. Rare winter visitor; 2-9 Nov 1980 (TM), 10 Dec 1976 (AB 31:375, 1977), 21 Dec 1986 (LS), 9 Jan-6 Mar 1983.

White-throated Sparrow *Zonotrichia albicollis*. 4, 2. Rare winter visitor; 8 Jan 1978 (2), 9 Jan 1983 (2).

Golden-crowned Sparrow *Zonotrichia atricapilla*. 134, 40. Uncommon in winter, fairly common in spring. Ave 1.8/1 Nov-Mar, 5/3 Apr, none Jun-Oct. Max 18 on 3 Apr 1977.

White-crowned Sparrow *Zonotrichia leucophrys*. 7262, 75. Abundant winter visitor. Ave 130/99 Nov-Mar, falling to none Jun-Aug. Early record 10 Sep 1978. Max 500 on 11 Jan 1976.

Dark-eyed Junco *Junco hyemalis*. 6, 3. Rare winter visitor; 13 Oct 1974, 4 Nov-2 Dec 1973 (4), 13 Jan 1973 (SS).

Bobolink *Dolichonyx oryzivorus*. 0, 0. Rare fall migrant; 30 Sep 1967 (SS).

Red-winged Blackbird *Agelaius phoeniceus*. 8828, 118. Very common resident. Ave 100/83 Mar-Jun, falling to 60/35 Jul-Feb. Max 440 on 1 May 1977. Common breeder.

Tricolored Blackbird *Agelaius tricolor*. 27, 3. Rare and sporadic from fall through spring; 25 Jul-10 Sep 1972 (35) (SS), 24 Oct 1981 (BM), 6 Nov 1977 (25), 6 Feb 1977, 1 May 1977, 11 May 1982 (BM), 27 May 1981 (BM).

Western Meadowlark *Sturnella neglecta*. 2657, 120. Very common in winter, common in summer. Ave 32/25 Nov-Apr, falling to 13/10 May-Oct. Max 88 on 1 Feb 1981. Common breeder.

Yellow-headed Blackbird *Xanthocephalus xanthocephalus*. 2, 2. Rare from fall to spring; 18 Oct 1981 (4) (TM), 7 Nov 1982, 4 Feb 1970 (2) (AF), 1-17 May 1983 (4) (BM), 20 May 1979 (TM).

Brewer's Blackbird *Euphagus cyanocephalus*. 2530, 113. Very common in winter, common otherwise. Ave 44/35 Jan-Feb, 12/9 Apr-Aug, 21/17 Sep-Dec. Max 150 on 1 Feb 1981. Yearly breeder.

Great-tailed Grackle *Quiscalus mexicanus*. 0, 0. Rare; 10-11 Feb 1987 (RP).

Brown-headed Cowbird *Molothrus ater*. 152, 36. Fairly common summer visitor. Ave 3.3/2 Apr-Jul, falling to none Dec-Feb. Max 17 on 7 Apr 1974. Yearly breeder; in 1982, seen parasitizing Common Yellowthroat (TM).

Orchard Oriole *Icterus spurius*. 0, 0. Rare; 26-28 Oct 1962 (AFN 17:71, 1963), 27 Oct-3 Nov 1973 (AB 28:110, 1974).

Hooded Oriole *Icterus cucullatus*. 159, 40. Fairly common in summer. Ave 3.1/3 Apr-Aug, falling to none Nov-Mar. Max 11 on 4 May 1975. Yearly breeder.

Northern Oriole *Icterus galbula*. 334, 50. Fairly common in summer. Ave 7.8/7 Apr-Jul, falling to none Oct-Feb. Early record 3 Mar 1974. Max 23 on 2 Jun 1974. Yearly breeder. Baltimore Orioles *I. g. galbula* recorded 2 Jan 1973 (AB 27:665, 1973), 25-29 Sep 1973 (AB 28:110, 1974).

Scott's Oriole *Icterus parisorum*. 0, 0. Rare; 11 May 1980 (TM).

Purple Finch *Carpodacus purpureus*. 3, 1. Rare; 11 Apr 1976 (3).

House Finch *Carpodacus mexicanus*. 25177, 120. Abundant resident. Ave 280/250 Aug-Dec, falling to 110/95 Mar-May. Max 540 on 12 Oct 1980. Common breeder.

Pine Siskin *Carduelis pinus*. 3, 1. Rare; 7 Dec 1975 (3).

Lesser Goldfinch *Carduelis psaltria*. 2556, 114. Common resident. Ave 21/17 throughout the year. Max 100 on 7 Dec 1980. Common breeder.

Lawrence's Goldfinch *Carduelis lawrencei*. 212, 20. Sporadic; fairly common in spring, uncommon in fall. Ave 4.3 Mar-Jun, none Jul, 1.2 Aug-Oct, none Nov-Jan. Half of the individuals were found in 1975. Max 50 on 9 Mar 1975.

American Goldfinch *Carduelis tristis*. 303, 51. Uncommon resident. Ave 2.5 throughout the year. Max 38 on 11 Jan 1976. Probable occasional breeder.

House Sparrow *Passer domesticus*. 340, 61. Uncommon resident; decreasing. Ave 2.8/1 throughout the year. Max 37 on 5 Jan 1975.

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Green-backed Heron *Sketch by Eric Lichtwardt*

CHARACTERISTICS OF LEWIS' WOODPECKER HABITAT ON THE MODOC PLATEAU, CALIFORNIA

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The Lewis' Woodpecker (*Melanerpes lewis*) breeds throughout western North America in open Ponderosa Pine (*Pinus ponderosa*) forests, logged or burned coniferous forests, open riparian woodlands, and oak (*Quercus spp.*) woodlands (Bent 1939, Snow 1940, Bock 1970, Jackman 1974). Features of each habitat include an open tree canopy, snags, and a shrub understory (Bock 1970, Jackman 1974, Sousa 1983).

The nomadic habits of the Lewis' Woodpecker make quantitative study of its habitat difficult. A population of this species may occur at a location during one breeding season, then disappear from the same location during subsequent years. Bock (1970) attributed this irregular pattern of habitat occupancy to fluctuations in food supply. In this paper we present quantitative descriptions of Lewis' Woodpecker habitat in northeastern California.

STUDY AREA AND METHODS

Our study took place on the Modoc Plateau region of the Modoc National Forest approximately 32 km northwest of Adin, Modoc County, California. The habitat structure of the study area was heterogeneous because a 47,000-ha fire in 1976 had eliminated much of the tree canopy and shrub understory in some areas while leaving other areas undisturbed. Unburned portions of the study area consisted of an open-canopied forest of Jeffrey Pine (*Pinus jeffreyi*), Douglas-fir (*Pseudotsuga menziesii*), and Incense Cedar (*Calocedrus decurrens*) with an understory of Curl-leaf Mountain-mahogany (*Cercocarpus ledifolius*), Green-leaf Manzanita (*Arctostaphylos patula*), Big Sagebrush (*Artemisia tridentata*), Bitterbrush (*Purshia tridentata*), Choke Cherry (*Prunus virginiana*), Bitter Cherry (*P. emarginata*), and Golden Currant (*Ribes aureum*). The fire altered the habitat by replacing the tree canopy with numerous charred snags and removing most of the understory. By 1982 a shrub layer consisting of Green-leaf Manzanita, Choke Cherry, Golden Currant, and *Ceanothus* species was present in burned areas.

Our study site encompassed approximately 2100 ha and included both burned (900 ha) and unburned (1200 ha) habitat. We used a systematic-random sampling scheme (Cochran 1977) to place six 1000-m-long transects in each habitat. Transects were spaced 200 m apart and sampled the entire habitat. We conducted 25 surveys (11 in burned and 14 in unburned habitats) from June through August in both 1982 and 1983 to note the presence of Lewis' Woodpeckers. A chi-square test was used to determine whether the species used both habitats equally (Sokal and Rohlf 1969).

To describe the habitat used by Lewis' Woodpeckers, we randomly selected 25 sampling points each in the burned and unburned habitats. Sampling points were systematically placed along the existing survey transects. At each sampling point we used the point-center quarter method to estimate density, basal area, and average height of snags and live trees (Cottam and Curtis 1956). Total and relative cover by shrub species were estimated along a 15-m line intercept. Average shrub height was calculated as the mean height of five systematically sampled shrubs along the line intercept. We recorded the number of shrub species within a 7.5-m radius of the sampling point.

One-way analysis of variance was used to test for differences between burned and unburned habitats (Sokal and Rohlf 1969). A Spearman rank-order correlation coefficient (r_s) was calculated to compare relative frequencies of shrub species occurrences between habitats (Conover 1971).

RESULTS

Lewis' Woodpeckers used burned habitat more frequently than unburned habitat during the period 1 June through 15 July, but showed no significant preference for habitat during the period 16 July through 31 August (Table 1). Burned habitat contained significantly more but smaller snags than did unburned habitat (Table 2). The density of live trees was significantly greater on unburned than on burned habitat. Although the number of shrub species and the amount of shrub cover in the two habitats differed only slightly, the unburned habitat had taller shrubs than the burned habitat (Table 2). The relative frequencies of shrub species were independent of whether or not the area had burned ($r_s = 0.46$; df = 20; $P < 0.05$).

DISCUSSION

Lewis' Woodpeckers on the Modoc Plateau used burned habitat with greater frequency than unburned habitat (Table 1). Although they occupied burned habitat throughout our sampling period, they were observed in unburned areas no earlier than August of either year. Furthermore, by locating three nests and observing fledged young, we verified that woodpeckers bred in the burned habitat, but we observed no breeding activity in the unburned habitat. Therefore we conclude that Lewis' Woodpeckers used burned habitat for breeding and after nesting expanded their habitat to include unburned areas.

Table 1 Numbers of Surveys on Which Lewis' Woodpeckers Were Observed in Burned and Unburned habitats on the Modoc Plateau, 1982 and 1983

	Burned habitat[1]		Unburned habitat		
Dates	Present	Absent	Present	Absent	$\chi^{2\,a}$
1 June-15 July	4	1	0	7	5.58*
16 July-31 August	5	1	3	4	0.86
1 June-31 August	9	2	3	14	4.68*

[a]Chi-squared test for goodness of fit: df = 1; *, significant ($P < 0.05$) χ^2 value.

Table 2 Comparisons of Burned and Unburned Habitats Used by Lewis' Woodpeckers on the Modoc Plateau [a]

	Burned habitat		Unburned habitat	
Variable	Mean	SE[b]	Mean	SE
Shrub cover (%)	13.4	3.2	26.5	3.7*
Average shrub height (m)	0.6	0.1	0.9	0.1**
Number of shrub species	4.5	0.3	5.6	0.4*
Snag basal area (m^2/ha)	11.8	3.0	1.9	0.9**
Tree basal area (m^2/ha)	3.8	1.9	31.7	3.6***
Snag density (snags/ha)	471.5	115.2	99.1	19.6**
Tree density (trees/ha)	203.2	38.6	912.7	104.4***
Average snag height (m)	8.3	0.7	16.1	1.2***
Average tree height (m)	12.2	0.9	10.7	1.0

[a]Sample size is 25 for each group. One-way analysis of variance; df = 1,48. Significance levels: *, $P < 0.05$. **, $P < 0.01$. ***, $P < 0.001$.

[b]SE, standard error.

Results of our habitat analysis are not in total agreement with the conclusions of previous studies. Bock (1970) suggested that Lewis' Woodpecker habitat is characterized by snags, an extensive shrub layer, and an open tree canopy. Sousa (1983) stated that optimal breeding habitat should have at least 50% shrub cover and 2.5 snags/ha. In our study area, both the burned and unburned habitats had open tree canopies and sufficient numbers of snags, but neither had an extensive shrub layer. Thus, we suggest that additional factors play major roles in attracting nesting Lewis' Woodpeckers.

SUMMARY

We studied Lewis' Woodpecker habitat in burned and unburned areas of the Modoc Plateau, California. Although both habitats appeared suitable, the species was observed more frequently in burned habitats. We verified that the woodpecker nested on burned habitat, but we observed no nesting activities on unburned habitat. We suggest that factors other than habitat structure alone predispose Lewis' Woodpeckers to use an area.

ACKNOWLEDGMENT

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Lewis' Woodpecker *Sketch by Narca Moore-Craig*

NOTES

A SPECIMEN RECORD OF THE ANCIENT MURRELET FROM NEW MEXICO

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The Ancient Murrelet (*Synthliborhamphus antiquus*) occurs casually in interior western North America, with records as far inland as the upper Midwest and Great Lakes region (A.O.U. 1983). There are no previous records of this species from New Mexico (Hubbard 1978; New Mexico Ornithol. Soc. 1962-1985); however, the eventual occurrence of *S. antiquus* in New Mexico might have been expected in view of the proximity of specimen and sight records of this species in Colorado (Bailey and Niedrach 1967), Utah (Behle and Perry 1975), and Nevada (Monson and Phillips 1981). This note presents data on the first specimen of *S. antiquus* found in New Mexico.

On 6 November 1985, 4 km north of Santa Fe on U.S. Highway 84-285 near its junction with Tano Road, elevation 2195 m, Santa Fe Co., Miller found a live Ancient Murrelet sitting on U.S. Highway 285. The Ancient Murrelet made no apparent attempts to escape capture when he approached it. The specimen was taken to a local pet shop, where it was kept in an aquarium until its death the following day. When dissected, the specimen showed no apparent wounds nor did it appear emaciated. It was prepared as a skin and trunk skeleton and is now 600008 in the United States National Museum, Washington, D.C. We recorded the following data while preparing the specimen: testes Flesh Color, left 1 × 4 mm, right 1 × 3 mm; weight 172.6 g; no fat; skull less than 10% ossified; immature plumage; no body molt; total length 238 mm; maxilla Pale Neutral Gray with tip, culmen, and basal 5-6 mm Blackish Neutral Gray; mandible Pale Neutral Gray with angle of gonys, tip, and basal 5-7 mm Blackish Neutral Gray; tarsi Pale Neutral Gray with Blackish Neutral Gray line along entire length of posterior; webs, bottoms of feet, and dorsal toe joints Blackish Neutral Gray; toes Pale Neutral Gray; irides Vandyke Brown. Names of colors of soft parts are from Smithe (1975, 1981). The specimen's stomach contained small bones of fish, at least part of which the bird obtained while it was in the aquarium.

Weather conditions in western North America between 28 October and 6 November 1985 were characterized, to some degree, by west to northwest winds from the northwestern United States and adjacent Canada (N.O.A.A. 1985). The direction and high velocity of winds both at the surface and at the 500-millibar height contour may explain, at least in part, this extralimital record in New Mexico of this pelagic species.

Although an Ancient Murrelet in New Mexico is an extreme extralimital and new state record, it does conform to a temporal pattern of distribution summarized by Munyer (1965) and Verbeek (1966) that most inland records of this species are in the fall (November). This species has been recorded in several of the interior western and northern United States (DeSante and Pyle 1986), but a record of this species in the Southwest is a noteworthy deviation from previously described geographic distributions of inland records of Ancient Murrelets.

We thank John P. Hubbard, Robert Andrews, and an anonymous reviewer for comments and suggestions on this note.

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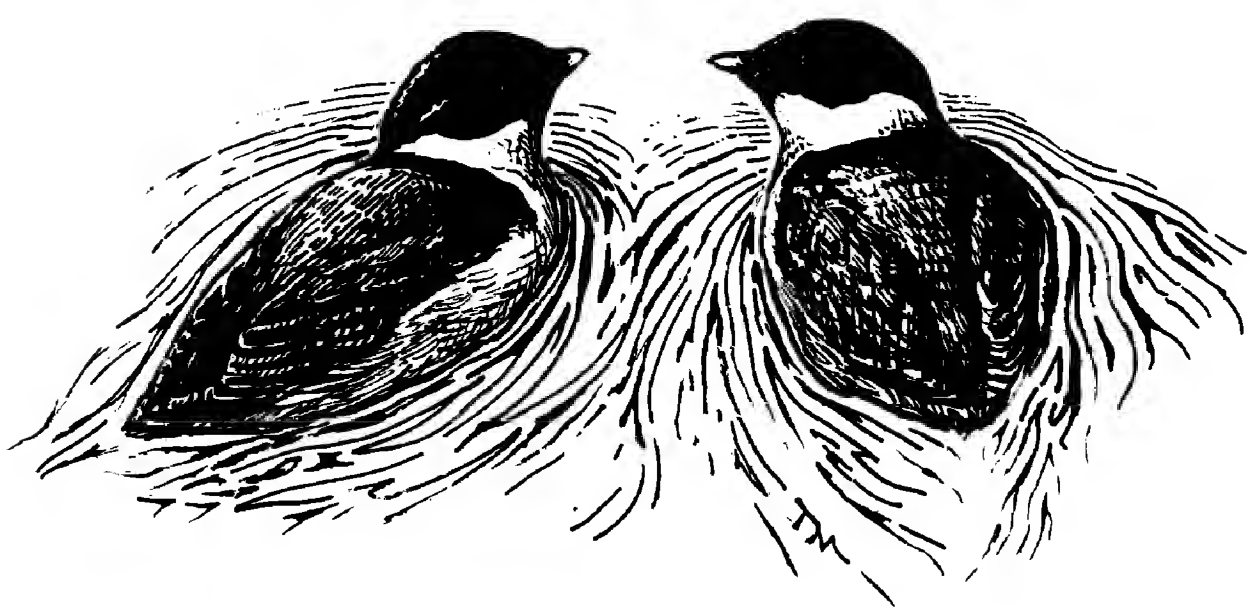

Ancient Murrelets *Sketch by Tim Manolis*

AN AMERICAN OYSTERCATCHER IN IDAHO

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The American Oystercatcher (*Haematopus palliatus*) breeds along the American Atlantic coast from Massachusetts south to Argentina and along the Pacific coast from central Baja California south to Chile (A.O.U. 1983). Although generally a sedentary coastal species, it wanders occasionally (Hayman et al. 1986). Vagrants have been recorded as far north as Labrador on the Atlantic coast and San Luis Obispo Co., California, on the Pacific coast (two records from northern California are unsubstantiated, Roberson 1986). In the west, inland records exist for California, three individuals together, Salton Sea, 14-30 August 1977 (Luther 1980); New Mexico, one individual, Hidalgo Co., 10 August 1976 (Huntington and Huntington 1983, John P. Hubbard pers. comm.); and Idaho, one individual, Payette Co., 19 April 1981 (Rogers 1981). This note presents detailed documentation of the Idaho record and discusses this unusual occurrence.

We observed a black and white oystercatcher with a brown back 3.3 miles south of Fruitland (along Whitley Drive), Payette Co., Idaho, between the hours of 1910 and 1945 on 19 April 1981. Rogers (1981) stated "north of Fruitland" and "18 April," both of which are mistakes. The American Oystercatcher is the only black and white oystercatcher recorded in North America (A.O.U. 1983), and all other black and white oystercatchers are black rather than brown above (Hayman et al. 1986). The oystercatcher was in the south section of a several-hundred-acre pond/marsh area about 1 mile east of the Snake River. It was wading along the edge of a small island in a shallow 8- to- 10-acre alkali pond. The banks of the pond were covered with grasses, predominantly salt grass (*Distichlis stricta*). We studied the oystercatcher through a 32 × spotting scope at a distance of about 35 meters and drew a sketch and took careful notes while observing it. The sky was overcast.

The following detailed description of the bird's plumage and soft parts may shed light on its age and subspecies (words in quotes are directly from field notes; all others are from the field sketch): (1) legs "pinkish-gray"; (2) proximal half of bill "pale orange" and distal half "dark"; (3) "iris pale brown"; (4) scapulars and lesser/median wing coverts "brown" with some pale fringes; (5) upper tail coverts barred with black; (6) border between black breast and white belly not clearly defined, but black spots not noted near the border or on the belly. We did not hear any vocalizations or see the bird fly, but it momentarily extended its wings, allowing a view of its upper tail coverts.

Retention of some pale-fringed scapulars and lesser/median wing coverts from its juvenile plumage, dark-tipped bill, and pale brown iris establish the bird as one year old (Prater et al. 1977, Hayman et al. 1986). Only two subspecies of American Oystercatcher have flecking or barring on their upper tail coverts: *frazari* and *galapagensis* (Hayman et al. 1986). The subspecies *frazari* breeds along the west coast of Mexico and is therefore the subspecies occurring closest to Idaho; *galapagensis* is endemic to the Galapagos Islands.

The oystercatcher we observed was closely associated with four Black-necked Stilts (*Himantopus mexicanus*). It appeared nervous and followed the stilts as they fed but showed little interest in feeding, although it probed into the shallow water four or five times. After nearly 30 minutes it followed two stilts onto the small island and lay down. We returned the next day to attempt to photograph the oystercatcher but it was not there, although the Black-necked Stilts were still in the same area. Neither species was present at this location during the mid-afternoon on 18 April.

It does not seem likely that this was a weather-induced vagrancy since storm systems in west-central Idaho usually come from the west and American Oystercatchers occur along the Gulf of California, far south of Idaho. Mid-April weather charts obtained from the National Climatic Data Center show a low-pressure area over the central part of the Gulf of

California on 17 April 1981. The charts show no fronts moving between the Gulf of California and Idaho in mid-April.

No clear pattern of seasonal occurrence exists for the American Oystercatcher in the western U.S. In addition to the inland records for the west mentioned above (one spring, two summer), five records exist for the California coast, including up to three individuals present year-round for at least 18 years in Santa Barbara Co. (Roberson 1986). West Mexican populations are apparently nonmigratory, and immature Eurasian Oystercatchers (*Haematopus ostralegus*) remain on their wintering grounds all year (Hayman et al. 1986), making this extralimital record difficult to explain.

We thank Dennis Paulson for his valuable comments on several drafts of this note. We also thank Jon Dunn, Robert Humphrey, Tim Reynolds, John Pitcher, and Chris Chappell for their comments.

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BARRED OWL SPECIMEN RECORDS FOR MONTANA

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Taylor and Forsman (1976) reported recent range extensions of the Barred Owl (*Strix varia*) in western North America. Boxall and Stepney (1982) described the species' distribution and status in Alberta. Shea (1974) summarized sightings, a photographic record, and several vocalization records of Barred Owls in western Montana but collected no specimens. Although published nesting records are not available, D. Flath (pers. comm.) stated that breeding is occasionally reported for the Blackfoot, Bitterroot, and Fisher river valleys (see also Skaar et al. 1985). Marks et al. (1984) reported prey identified from 37 Barred Owl pellets from western Montana. Saunders (1921) reported that Thomas collected three Barred Owls near Billings, but the specimens have never been located and Skaar (1975 and pers. comm.) questioned their authenticity. Here we report the first extant Barred Owl specimens for Montana and a range extension east across the continental divide.

During 1974 three Barred Owls were found dead in Montana. The first specimen (Univ. Montana No. 15710), a road kill, was found by Ellis and Gus Wolfe on 13 April on Highway 200 1.6 km west of the junction of highways 200 and 287 in Lewis and Clark County, east of the continental divide. The location is on the open prairie about 30 km east of the forested foothills of the Rocky Mountains. On 26 April Peter Widener IV and Ellis located the remains of a second Barred Owl in Powell County about 0.5 km south of the north fork of the Blackfoot River and approximately 73 km southwest of the first specimen. The scattered remains of this owl (Univ. Montana No. 15709) suggested that it had been plucked by an avian predator perched ca.5 m up on a horizontal limb in a mature stand of Ponderosa Pine (*Pinus ponderosa*). The third bird, an adult female (Univ. Montana No. 15807), was picked up (finder unknown) dead near Patomac, Missoula County, in September 1974.

Two other records are well substantiated and deserve mention. An injured bird, recovered 21 December 1976, was rehabilitated by the John Craighead family and released 6 February 1977 on the Lee Metcalf National Wildlife Refuge, Ravalli County. Finally, a road-killed female was found 4 October 1981, 1.6 km west of Patomac Bar, Highway 200, Missoula County, by Lynne Meggs and delivered to the University (Univ. Montana No. 17145).

In the years following collection of the 1974 specimens, occasional sightings and vocalization records were reported in issues of American Birds. These, the unpublished references to nesting, the food habits report (Marks et al. 1984), and the two additional specimen records all suggest that the Barred Owl has become increasingly common in Montana since the early 1970s.

P.D. Skaar provided information on early literature and kindly read a previous version of this manuscript. Ellis' travels were financed by the Montana Department of Fish, Wildlife and Parks.

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Barred Owl *Sketch by Cameron Barrows*

OCCURRENCE OF BIRD NESTS ON JUMPING CHOLLA CACTI

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To study the use of Jumping Cholla cacti (*Opuntia fulgida*) by birds for nesting, I searched a 200-sq-m area at Organ Pipe Cactus National Monument, Arizona, in April 1987. It was also my aim to find out if nesting birds select particular heights of cacti. Sixty-three bird species breed in Organ Pipe Cactus National Monument (Huey 1942, Groschupf et al. 1987).

I classified cacti into three height categories: <1 m, 1-2 m, and >2 m tall; broken cacti and half-built nests were excluded. I found nests of only two bird species, the Cactus Wren (*Campylorhynchus brunneicapillus*) and Curve-billed Thrasher (*Toxostoma curvirostre*). It is possible that one or two older thrasher nests may have been of the Bendire's Thrasher (*T. bendirei*), which also occurs in the study area. Out of 128 cacti, 23 (18.0%) had nests, of which three were active at that time (two of the Cactus Wren and one of the Curve-billed Thrasher). No nests were in cacti <1 m tall, while 31.3 and 68.7% of cacti that were, respectively, 1-2 m and >2 m tall had nests. Previous observations on the Cactus Wren and Curve-billed Thrasher showed that they seldom nest lower than 1 m from the ground (Bent 1948).

Out of all nests, 13 (56.6%) were of the Cactus Wren and 10 (43.4%) were of the Curve-billed Thrasher. The mean height of the Cactus Wrens' nests was 1.51 ± 0.38 m, of the Curve-billed Thrashers', 1.14 ± 0.28 m. This nest height difference between these two species is statistically significant ($p < 0.05$, Mann-Whitney *U* test).

Of Cactus Wren nests, 30.7, 30.7, 30.7, and 7.9% had nest entrance east, north, south, and west, respectively. The Cactus Wrens may select nest entrances to avoid winds during cooler early parts of the breeding season and face them during hot parts of the season (Ricklefs and Hainsworth 1969), or nest orientation may be selected at random (Anderson and Anderson 1973).

I thank Dr. Lynn W. Oliphant for his help and comments on the manuscript.

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PRESIDENT'S MESSAGE

Have you noticed you've been getting issues of *Western Birds* more frequently than usual in recent months? Editor Philip Unitt has done an excellent job of speeding up the rate of publication in order to get the journal back on schedule.

There is perhaps one disconcerting aspect of this, however. Renewal notices come enclosed with issue number four of each volume, because WFO memberships are due by the *volume*, not by the *year*. Under ideal circumstances, of course, each volume matches a given year, and the reason we are speeding publication is to catch up to a point where this match occurs. Our goal is to be back on schedule by the end of 1989. Until then, we ask your indulgence if we seem constantly to be asking for renewals. You will be getting a full set of four issues—and good value for your money—each time you renew, regardless of how frequently that may seem to be!

One exciting development of which you have already been apprised is our arrangement with *British Birds*, arguably the best journal of its kind in the world and the model for *Western Birds*, whereby WFO members may claim a 25% discount on a subscription to the British journal (the discount applies annually as long as you maintain your subscription to *Western Birds*). Our thanks to the publishers of *British Birds* for allowing us to offer this service to you.

Presentation of the first Alan M. Craig Award to Alan M. Craig (second from left) at the 1987 WFO meeting in Bellingham, Washington. Shown with Alan are, from left, WFO President Tim Manolis, Vice-President Narca Moore-Craig, and Board Member and Past President Guy McCaskie.

Photo by Bruce Webb

NEW TREASURER/MEMBERSHIP SECRETARY FOR WFO. After a brief, but much appreciated, stint as WFO treasurer and membership secretary, Art Cupples informed the WFO Board of Directors he would be unable to continue in the position. Our thanks to Art for his contributions to WFO in a difficult job. We have been fortunate in having quickly found a replacement. Howard L. Cogswell, an eminent western field ornithologist in the definitive sense, has volunteered to serve in this capacity. Howard's years of experience in various official capacities for many ornithological societies will certainly be of great benefit to WFO, and we are happy to welcome him aboard.

WFO'S 12TH ANNUAL MEETING. The 12th Annual Meeting of Western Field Ornithologists was held at Western Washington University, Bellingham, Washington, from 21 to 23 August 1987.

Attending the meeting were 130 members, family, and friends, including 48 new members. All were treated to warm, sunny weather, good birding, and stimulating speakers. A special highlight was presentation of the first Alan M. Craig Award to Alan himself (see below). Special credit goes to Terry Wahl and his local committee for organizing a very successful convention where, as Terry put it, "a whole new population of bird people was exposed to the organization."

THE ALAN M. CRAIG AWARD. Special tribute was paid at the Bellingham meeting to Alan M. Craig's long years of service as editor of *Western Birds*. At the annual banquet, Alan was the surprised recipient of a special WFO award named in his honor. The first Alan M. Craig Award—a painted bronze statuette of the WFO logo, a flying Sabine's Gull—was presented by WFO's first president, Guy McCaskie. Befitting the magnitude of Alan's contribution to WFO, future Alan M. Craig Awards will be made only on an irregular basis for exceptional service to the organization.

Tim Manolis, WFO President

WESTERN BIRDS, INDEX, VOLUME 18, 1987

Compiled by Mildred Comar

Volume 18, Number 4, 1987

Cover photo by Darrell Gulin (*Nature's Images*, Seattle, Washington): Cinnamon Teal (*Anas cyanoptera*), Malheur National Wildlife Refuge, Harney County, Oregon, June 1985.

Western Birds solicits papers that are both useful to and understandable by amateur field ornithologists and also contribute significantly to scientific literature. The journal welcomes contributions from both professionals and amateurs. Appropriate topics include distribution, migration, status, identification, geographic variation, conservation, behavior, ecology, population dynamics, habitat requirements, the effects of pollution, and techniques for censusing, sound recording, and photographing birds in the field. Papers of general interest will be considered regardless of their geographic origin, but particularly desired are reports of studies done in or bearing on the Rocky Mountain and Pacific states and provinces, including Alaska and Hawaii, western Texas, northwestern Mexico, and the northeastern Pacific Ocean.

Send manuscripts to Philip Unitt, 3411 Felton Street, San Diego, CA 92104. For matter of style consult the *Suggestions to Contributors to Western Birds* (8 pages available at no cost from the editor) and the *Council of Biology Editors Style Manual* (available for $24 from the Council of Biology Editors, Inc., 9650 Rockville Pike, Bethesda, MD 20814.

Reprints can be ordered at author's expense from the Editor when proof is returned or earlier.

Good photographs of rare and unusual birds, unaccompanied by an article but with caption including species, date, locality and other pertinent information, are wanted for publication in *Western Birds*. Submit photos and captions to Photo Editor.