

ENDANGERED HABITATS VERSUS ENDANGERED SPECIES: A MANAGEMENT CHALLENGE

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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 et 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 contribute 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 hydriparian (accompanying peren-

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nial 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

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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*

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 Nighthjar
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 Sandpiper	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	
Osprey*	Belted Kingfisher*	Gila Woodpecker	Nonriparian (32 spp. = 20%)
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		LeComte'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

*Excludes accidental nesters. Modified from Johnson et al. 1977.

*Extripated 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

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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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