

STATUS CHANGES OF BIRD SPECIES USING REVEGETATED RIPARIAN HABITATS ON THE LOWER COLORADO RIVER FROM 1977 TO 1984¹

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*Abstract: Two dredge-spoil sites were revegetated on the lower Colorado River with native riparian trees. Another site was cleared of exotic saltcedar (*Tamarix chinensis*) and revegetated with native shrubs. Sites were censused for birds through all phases of revegetation. Bird species were grouped by natural-history characteristics to determine changes in the types of species occurring during the development of revegetation sites. Most species responded positively within 2 years after planting, including some sensitive species. This study is the first of its kind to document changes in bird use of artificially established native riparian habitats.*

Revegetation with native riparian species is often suggested in mitigation proposals to offset expected losses to riparian habitats in the southwestern U.S. Despite the continuing need for large-scale revegetation efforts, there are few success stories and even fewer detailed assessments of wildlife responses to these measures. In an effort to address this deficiency, we summarize the response among birds species in developing riparian habitats on three revegetation sites along the lower Colorado River from 1977-1984.

Documentation for overall increases in birds on these three revegetation sites has been provided elsewhere (Anderson and Ohmart 1982). In this paper, we examine natural-history characteristics of responding species, how they respond (positively, negative, or not at all), and when they respond (before, during, or after development of the habitat) to revegetation. This data provides an opportunity to predict how particular species, or groups of species, are attracted to revegetation sites, given that the intensity and duration of the effort is adequate to attract the bird species of interest.

Methods

Revegetation techniques are detailed elsewhere (Anderson and others 1978, Anderson and Ohmart 1982, Anderson and others 1984, Disano and others 1984, Anderson and Ohmart 1985). Three sites were selected for revegetation with native riparian trees and shrubs in 1977. Two sites were on dredge spoil devoid of vegetation since the 1950's. These sites were planted

with native Fremont cottonwoods (*Populus fremontii*), Goodding willows (*Salix gooddingii*), honey mesquite (*Prosopis glandulosa*), and palo verde (*Cercidium floridum*) in January 1979. The third site was a mixed-species stand dominated by saltcedar (*Tamarix chinensis*) and a few decadent Goodding willow; saltcedar was completely cleared, root-ripped, and the site leveled between July 1978 and April 1979. Shrubs were established on this third site by March 1980 and native trees were planted July 1980.

Development of vegetation on each site was evaluated by comparing each of nine variables describing vegetation structure and numbers of trees and shrubs, with the average and standard deviation for all native and non-native riparian vegetation types along the lower Colorado River during the years 1975-1979. Techniques for collecting and analyzing vegetation data on the lower Colorado River are treated elsewhere (Anderson and others 1983, Anderson and Ohmart 1986). Values obtained for the revegetation sites were standardized as:

$$\text{Value}_{\text{reveg}} - \text{Mean}_{\text{rip}} / \text{SD}_{\text{rip}} = \text{standardized value}$$

where $\text{Value}_{\text{reveg}}$ is a quantified variable on a revegetation site, Mean_{rip} is the same variable from all riparian vegetation, and SD_{rip} is one standard deviation of the mean from all riparian vegetation. In this way it was possible to tell where the value for any variable on any site fell with respect to the lower Colorado River average.

Determining when vegetation on each site began to exceed the lower Colorado River average was defined by taking an average of the standardized values for all variables at each measuring period (two per year). Then we determined when the average changed from negative to positive. In this way, we could determine how long it took a bird species' status to change relative to the change in vegetation.

Status changes among bird species, within each site, were determined by pinpointing the first season that there was a noticeable and consistent change in densities from prior seasons or years. Each of the three sites was surveyed six to nine times each season of each year using a modified Emlen variable-distance transect (Emlen 1971, Anderson and others 1977).

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Five seasons were defined as winter (December-February), spring (March-April), summer (May-July), late summer (August-September), and fall (October-November). In addition to pinpointing the first season of change, the number of seasons before and after vegetation change was determined (adjusted for species that were summer or winter visitors), as well as the direction of change.

Species were then grouped by generalized foraging guilds (insectivores, omnivores, granivores, frugivores/nectivores, gamebirds, and raptors), residency (permanent resident, summer visitor, winter visitor), breeding phonology (early [March to mid-April], medium [mid-April to mid-May], late [mid-May to late July]), typical foraging height (ground, understory, midstory, canopy), and typical foraging technique (scratch, glean, aerial). Change in status, direction of change, and first season of change were assessed by the number of species within guilds among sites. Magnitude of changes within groups were assessed by total individuals recorded before and after change in vegetation at each site.

Results

Vegetation

The two dredge-spoil sites were transformed in 1.5 to 2 years from being barren of vegetation to supporting higher than average number of cottonwoods, willows, and shrubs, as well as higher than average horizontal patchiness and foliage height diversity (table 1; Anderson and Ohmart 1982). The cleared Cibola Refuge site was transformed in 0.5 year from a saltcedar-dominated habitat to a habitat supporting high numbers of native shrubs (principally, quail bush *Atriplex lentiformis* and

inkweed *Suaeda torreyana*). The Cibola Refuge site also changed to having higher than average foliage density in the shrub layer and patchiness in the shrub and midstory layers.

Birds

A total of 96 species were found on at least one of the three sites during the study. Of these 96, 57 species occurred regularly on at least two sites to be considered in this paper. Data for these 57 species are assessed in their responses to revegetation in the figures below by grouping them by natural-history characteristics. Data for individual species are omitted here due to length constraints, but are available upon request.

Most permanent resident species responded quickly to changes in vegetation; many within three seasons (< 1 year) before or after vegetation change on each site (fig. 1). Although many visiting species responded within three seasons, density changes were often not evident within the same year as change in vegetation. This disparity was because of the fewer seasons visiting species occurred each year along the lower Colorado River relative to permanent residents (table 1).

Revegetation primarily benefited insectivorous species (fig. 2A). Granivorous species, the other major trophic group, were about evenly split in status change. Reorganizing species by residency status indicated that most permanent residents and summer visitors increased among revegetation sites, except for permanent residents on the Cibola National Wildlife Refuge site, where they were nearly evenly split among status change categories (fig. 2B). Winter visitors were split among status change categories, but with a simple majority of species increasing on each site. Combining trophic and residency groups indicated that declining species were mostly wintering granivores on dredge-spoil sites.

Table 1 – Revegetation site development from planting to change in vegetation structure with respect to the lower Colorado River average (Anderson and Ohmart 1982). Also noted are the number of seasons from initiation of study through season of vegetational change which serve as base points for comparing changes in bird densities within each residency group.

Site/study Initiation	Season/year trees planted	Vegetation change	Number of seasons between change in vegetation and initiation of study			Season/year of
			Permanent resident	Summer visitor	Winter visitor	
East dredge spoil	Winter 1978-79	Summer 1980	15	9	12	Summer 1977
West dredge spoil	Winter 1978-79	Fall 1980	15	9	12	Fall 1977
Cibola Refuge	Summer 1980	Fall 1980	11	7	9	Late summer 1978

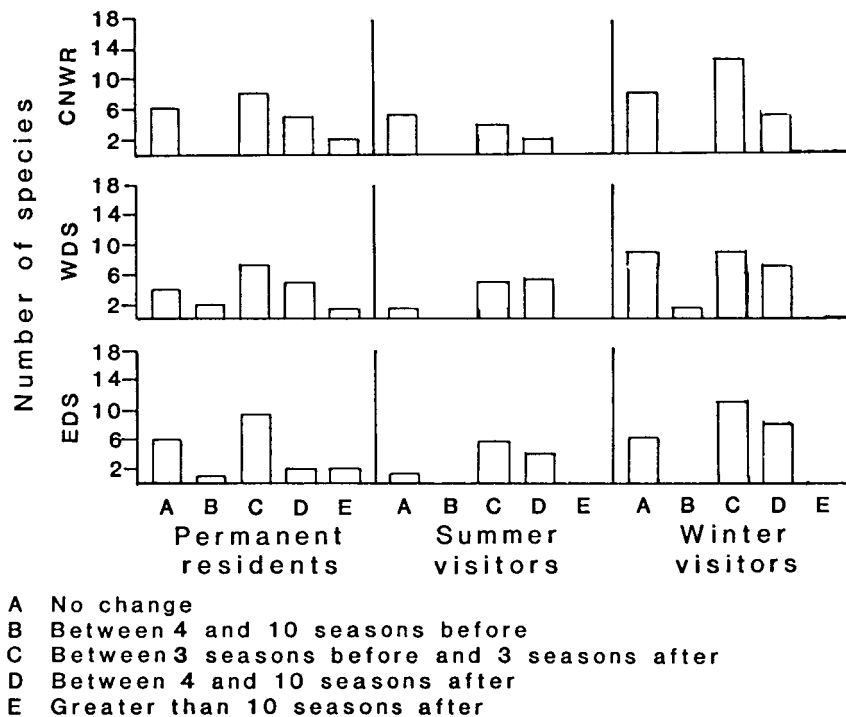


Figure 1 – Number of seasons before or after vegetation change that each bird species (grouped by seasonal residency) changed. See table 1 for base points of season of vegetation change relative to initiation of the study for each residency group at each site. CNWR = Cibola National Wildlife Refuge, WDS = west dredge spoil, EDS = east dredge spoil.

Noticeable and lasting changes for permanent residents typically occurred during their postbreeding seasons (summer, late summer, and fall) (fig. 3). Usually, after an additional year had passed, noticeable changes for permanent residents occurred during every season. Season of first noticeable change for visiting species showed no clear pattern except that many of these species usually responded 1 year or more after permanent residents for both summering and wintering species (figs. 2, 3).

Quantified comparisons of insectivorous, omnivorous, and granivorous individuals during summer indicated, within natural-history groupings, that early breeders, scratchers and gleaners, insectivores, and omnivores benefited the most from revegetation (fig. 4A). Late breeders, aerial foragers, and granivores benefited the least. During winter, species that benefited most from revegetation were midstory and canopy foragers, gleaners, permanent residents, and insectivores (fig. 4B). Individuals that were ground and understory foragers, scratchers, winter visitors, and granivores benefited greatly on the Cibola National Refuge site where shrub cover was extensive, but these types of birds declined on dredge-spoil sites.

Discussion

The very rapid development of revegetation sites, in comparison with natural riparian vegetation, was very encouraging but should be kept in perspective. Native riparian plant species are fast growing when planted under optimal conditions, however, relatively few areas remain on the lower Colorado River where revegetation would be successful (Anderson, unpubl. data). Thus, interpreting growth rates and overall site development requires assuming optimal conditions. Also, revegetation sites quickly surpassed the average for nine vegetation variables (Anderson, unpubl. data), largely because of the overall decadent condition of lower Colorado River habitats, most of which are dominated by exotic saltcedar.

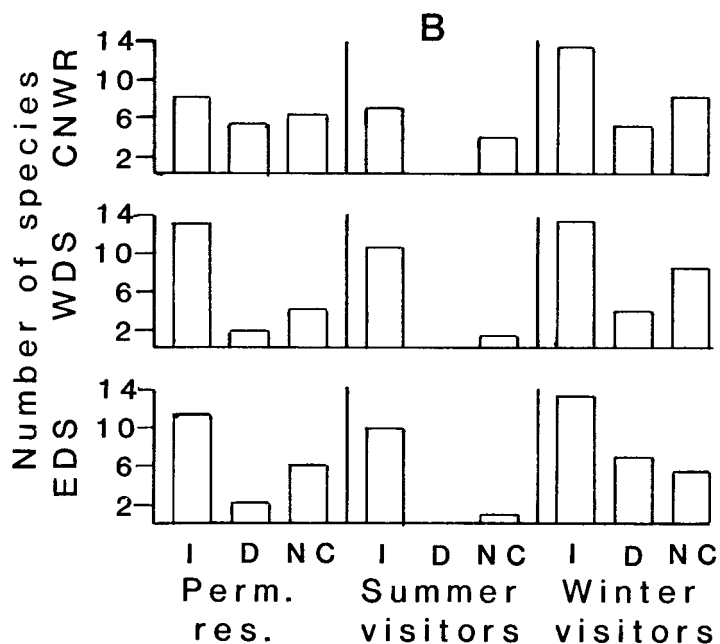
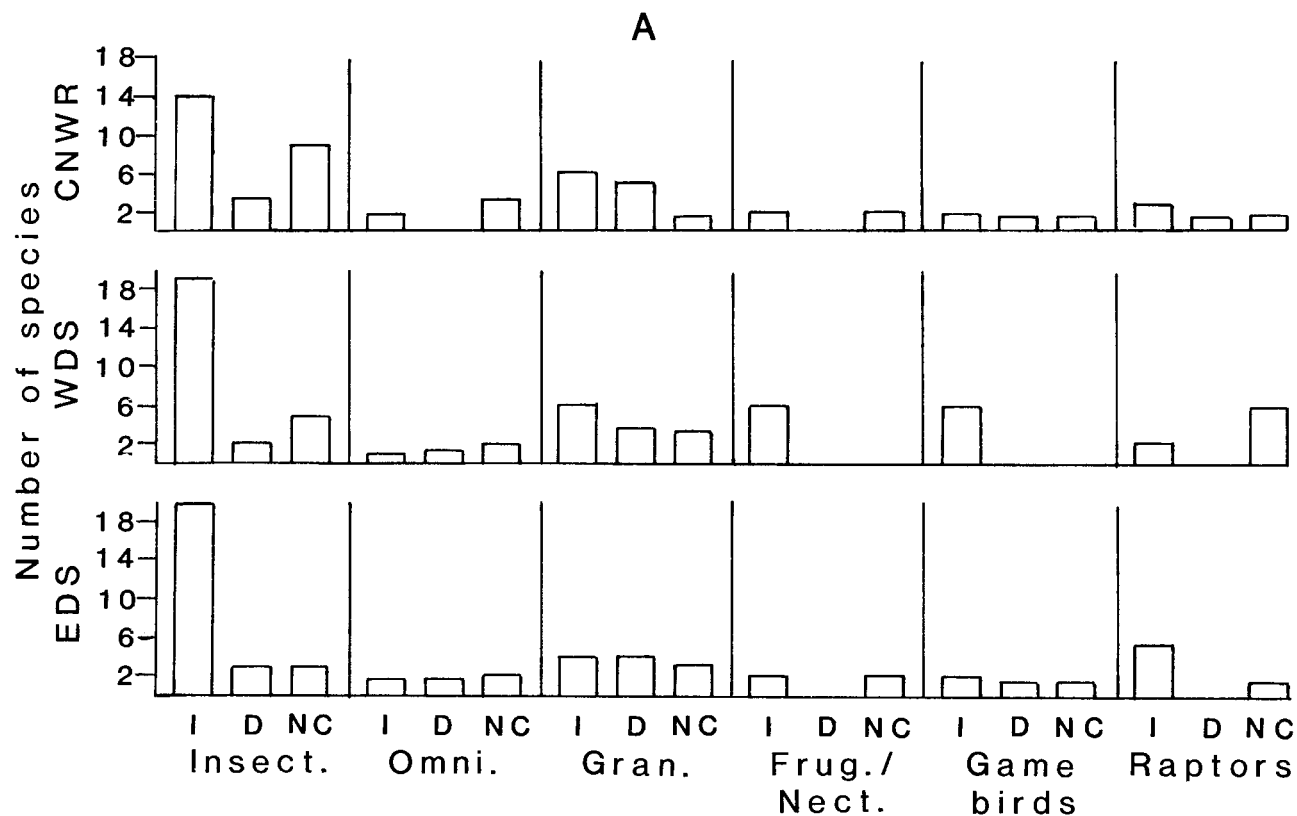


Figure 2 - Direction of status change among birds, if any, after vegetation change. Species grouped by foraging guild (A) and by residency status (B). I = increase, D = decrease, NC = no change, Insect. = insectivore, Omni. = omnivore, Gran. = granivore, Frug./Nect. = frugivore/nectivore. Site abbreviations as in figure 1.

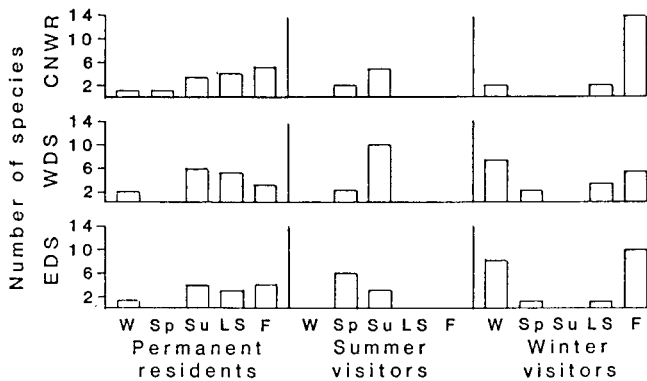


Figure 3 – Season of first noticeable and permanent change in abundance among birds grouped by residency status. W = winter, Sp = spring, Su = summer, LS = late summer, F = fall, site abbreviations as in figure 1.

Before assessing the relative overall success of these revegetation efforts it is important to address species that would be potentially targeted in future efforts. On the lower Colorado River, these species fall into three main groups: (1) late-breeding insectivores, (2) cavity nesters, and (3) large raptors (Hunter 1984, Hunter and others 1987b). Only a few representative species from these groups were found to use any of the three revegetation sites extensively during our study.

The rarest species to breed successfully was the yellow-billed cuckoo (*Coccyzus americanus*), with up to three pairs present on the two dredge-spoil sites in 1981 (2 years after planting) and 1982. Although cuckoos raised young during both years they have since disappeared from these sites, as well as from most of the lower Colorado River (Laymon and Halterman 1986); perhaps, these efforts were "too little, too late" in maintaining population levels of this species for the entire river. Other late-breeding insectivorous species such as Bell's vireo (*Vireo bellii*), yellow warbler (*Dendroica petechia*), and summer tanager (*Piranga rubra*) have been found only sporadically on these sites; this may have more to do with their very low population levels than with the attractiveness of the revegetated habitat.

Cavity-nesting species, especially larger ones, were not expected to rapidly move onto the dredge-spoil sites, as there were few snags. Censusing through to 1984 confirmed this prediction, although we did find increasing numbers of smaller cavity-nesting species, such as ladder-backed woodpeckers (*Picoides scalaris*), ash-throated flycatcher (*Myiarchus cinerascens*), and Lucy's warbler (*Vermivora luciae*). Limbs of some trees were girdled in November 1981 to attract species such as elf owl (*Micrathene whitneyi*), Gila woodpecker (*Melanerpes uropygialis*), gilded flicker (*Colaptes auratus mearnsi*), and brown-crested flycatcher (*Myiarchus*

tyrannulus), all of which are considered sensitive or State-listed cavity-nesting species in California. We found breeding Gila woodpeckers and brown-crested flycatchers on the dredge-spoil sites on surveys after 1984.

Large raptors, many of which are obligated to broad-leaf riparian habitats, are now very rare on the lower Colorado River. Raptors occurring within the riparian zone require large trees for nest platforms; cottonwood is one of the most important tree species for this purpose. Although we found an increasing frequency of raptors using the sites during winter, we found no nesting activity throughout the study. There are ongoing attempts to reintroduce Harris' hawks (*Parabuteo unicinctus*) to the lower Colorado River, and we suspect the dredge-spoil sites may eventually support a nesting pair.

Assessing natural-history characteristics and response to revegetation by these species provides some qualitative predictions as to which species are likely to respond and to what extent. Permanent residents were not initially attracted to developing revegetation sites for breeding. Eventually, however, many of these species were found to increase during winter and spring, the latter season represents the peak breeding season for most permanent residents. A similar sequence of events may occur for visiting species with the first individuals occurring only after all other natural and preferred habitats become saturated, thus possibly explaining the delay of a year or more for some species in responding to revegetation sites when compared to permanent residents. For all species, breeding and/or overwintering success should increase as vegetation continues to develop, resulting in greater use of these sites through time. Revegetation sites may be treated initially by most species as secondary "sink" habitats for dispersing young or nonbreeding adults. Only later will species respond to these habitats as primary "source" habitats that are important for increasing overall population stability. The time span for the transition from "sink" to "source" is dependent, at least partially, on how rapidly the habitat attains a high-quality level and how well the bird populations can produce "excess" individuals.

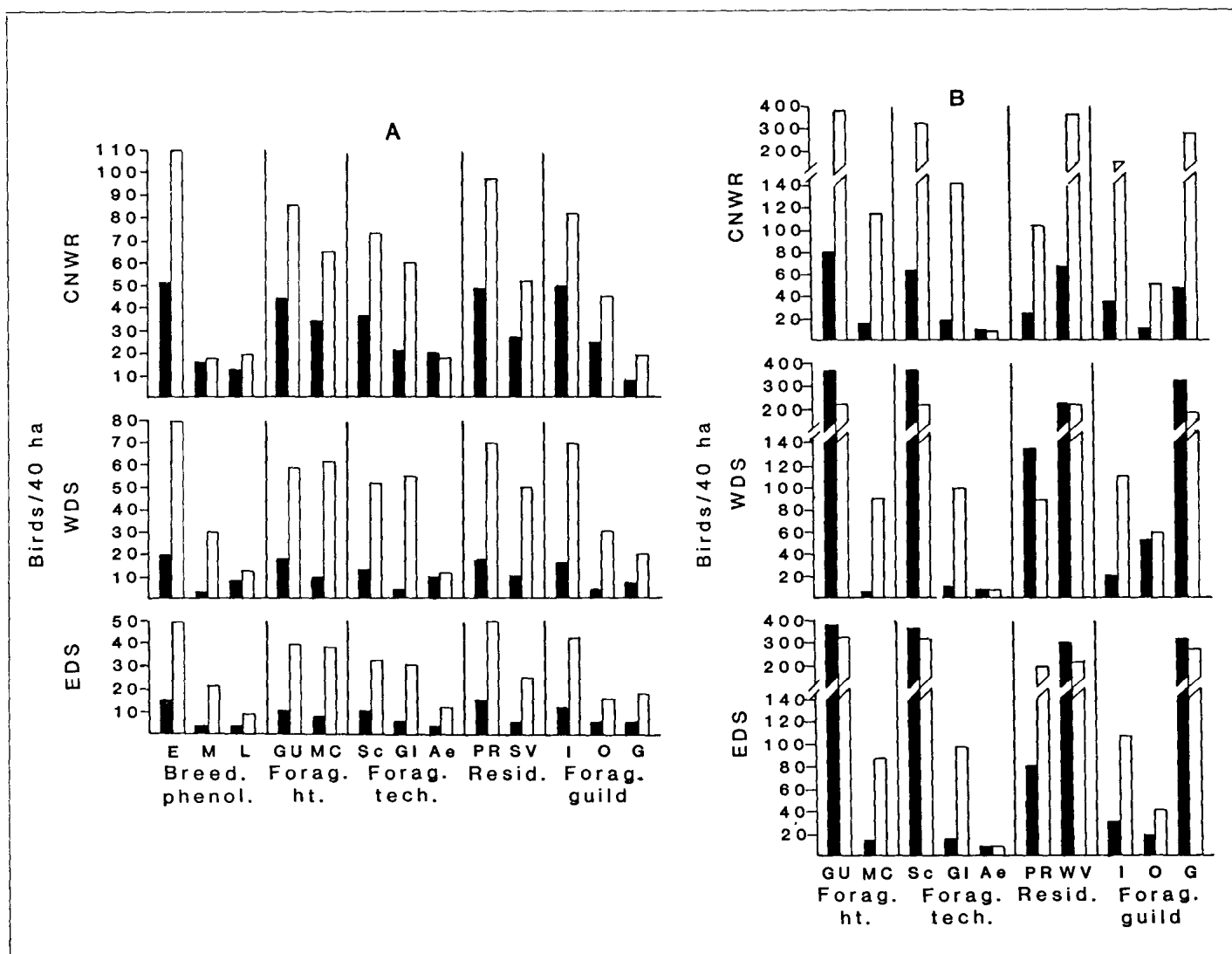


Figure 4 – (A) Spring-summer-late summer summary of numbers of individuals in response to revegetation (before = solid; after = open) within natural-history groups among study sites. Breeding phenology: E = early, M = middle, L = late; Foraging height: G = ground forager, U = understory, M = midstory, C = canopy; Foraging technique: Sc = scratch, Gl = glean, A = aerial; Residency: PR = permanent resident, SV = summer visitor; Foraging guild: I = insectivore, O = omnivore, G = granivore, site abbreviations as in figure 1. (B) Fall-winter-spring of numbers of individuals in response to revegetation within groups among study sites. WV = winter visitor, other abbreviations as in figure 4A.

There are many different approaches being used in revegetation, but to our knowledge few, if any, other efforts have documented success in attracting and increasing any bird populations. The total area (54 ha) revegetated in our efforts is still insignificant relative to loss of native riparian habitat on the lower Colorado River (Yunker and Andersen 1986); although, we did document increasing bird populations for many species. The lack of response, however, by many sensitive species targeted in these efforts supports the need for even greater commitment to revegetation as a mitigation pro-

cedure. Sadly, the dredge-spoil sites (30 ha) now support the largest remaining stands of mature cottonwood-dominated habitat along the entire 450 km of the lower Colorado River (Hunter and others 1987a).

There are a few organizations that have demonstrated a strong commitment to revegetation. The Nature Conservancy of California and the California Department of Fish and Game have adopted both an experimental approach to revegetation and one of annually revegetating adjacent to original sites or healthy natural stands when possible. Both of these approaches are positive and these

organizations should be commended. Such approaches allow for additional knowledge in developing the most cost-effective revegetation techniques that will benefit a diversity of wildlife species.

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