

IS THE CALIFORNIA GNATCATCHER AN INDICATOR OF BIRD-SPECIES RICHNESS IN COASTAL SAGE SCRUB?

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In southern California, the California Gnatcatcher (*Polioptila californica*) is a resident year round in coastal sage scrub (Atwood 1993). This habitat, reduced to 10 to 30% of its former extent by conversion to human use, supports approximately 100 other animal and plant species considered rare, sensitive, threatened, or endangered by California or federal wildlife agencies (Atwood 1993, McCaull 1994). The legal protection given to the California Gnatcatcher has been important in driving efforts to protect coastal sage scrub from human development. The relative wealth of ecological information available for the California Gnatcatcher (Atwood 1993) makes this species attractive as a potential indicator of biodiversity in coastal sage scrub.

An indicator species has been defined as "an organism whose characteristics (e.g., presence or absence, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure" (Landres et al. 1988). However, the use of an individual species as an indicator of biodiversity requires that there be a predictable relationship between the indicator and some attribute of biodiversity (Landres et al. 1988, Noss 1990). To begin to evaluate the California Gnatcatcher as a biodiversity indicator in coastal sage scrub habitat, we asked the question, are California Gnatcatchers found in areas of coastal sage scrub with high bird-species richness?

METHODS

As part of a larger project to explore the habitat associations of coastal sage scrub birds, in 1995 and 1996 we conducted point counts at 17 sites in San Diego, Orange, and Riverside counties (Figure 1). Within each site 4–20 points were located in coastal sage scrub, at least 50 meters from the nearest road or the edge of another habitat type, and with at least 150 meters between points. Birds were sampled by means of 5-minute unlimited-radius point counts (Ralph et al. 1995) conducted between sunrise and 10:00. In 1995, 128 points were sampled at 11 sites. Each point was visited once between 11 April and 10 May and again between 16 May and 16 June. In 1996, 155 points were sampled at 16 sites. One site, Dawson Canyon, was sampled in 1995 but not in 1996 because it had burned. First visits were conducted between 19 March and 1 May, second visits between 3 May and 25 May.

Our sampling was designed as an extensive survey of biodiversity across a large area rather than as an intensive effort to locate rare species. Therefore, our survey methods did not meet the specifications developed for intensive inventories of the California Gnatcatcher (Calif. Dept. Fish & Game 1993).

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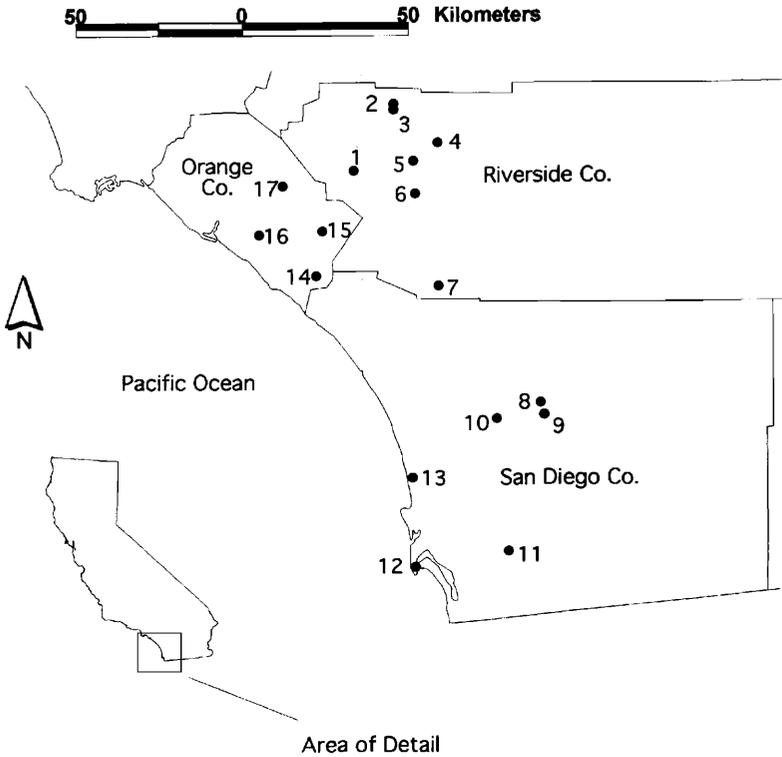


Figure 1. Locations of point counts in southern California. 1, Dawson Canyon; 2, University of California, Riverside campus; 3, Sycamore Canyon Park; 4, Lake Perris State Recreation Area; 5, Motte Rimrock Reserve; 6, Kabian Park; 7, Santa Margarita Ecological Reserve; 8, Pamo Valley; 9, Black Canyon; 10, Wild Animal Park; 11, Sweetwater River; 12, Point Loma; 13, Torrey Pines State Reserve; 14, Rancho Mission Viejo; 15, Starr Ranch; 16, Sycamore Hills; 17, Limestone Canyon.

However, we feel our methods were appropriate for evaluating the suitability of the gnatcatcher as an indicator because a species that is very difficult to detect in an extensive survey of biodiversity is by definition less useful as an indicator. Furthermore, on the basis of personal communication with land managers, we are confident that we detected gnatcatchers at all study sites where they had been found with more intensive survey methods.

For all analyses the California Gnatcatcher was removed from the species list used to estimate species richness. Wide-ranging species, such as raptors, were not included in the analyses because their presence was rarely associated with individual points. We compared the number of species detected per point at two spatial scales, among sampling points and among sites, using data from two visits to all the points.

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We used sampled randomization tests (Sokal and Rohlf 1995) to compare species richness at points where California Gnatcatchers were detected to the species richness expected at a random sample of points. We used this as an alternative to a parametric test because the number of points at which gnatcatchers were found was much smaller than the number of points at which they were not found. To compare the mean species richness among sites with and without gnatcatchers, we used a hierarchical analysis of variance with gnatcatcher presence/absence as one class variable and site (nested within gnatcatcher) as a second class variable. We conducted all site-level analyses using the average number of species detected per point to avoid making inappropriate comparisons of total species richness among sites containing different numbers of sampling points.

RESULTS

Point Scale

In 1995, California Gnatcatchers were detected at 18 of 128 points. The mean number of other bird species detected at points with gnatcatchers was 11.7, and this value was significantly higher than expected at a random sample of 18 points (mean 10.6, $P < 0.05$, one-tailed test). In 1996, gnatcatchers were detected at 19 of 155 points. The mean number of bird species detected at points with gnatcatchers, however, was 11.0, which did not differ significantly from the expected value (mean 11.8, $P > 0.1$).

The 10 species most frequently detected at sampling points were the California Towhee (*Pipilo crissalis*), Spotted Towhee (*Pipilo maculatus*), Bewick's Wren (*Thryomanes bewickii*), Wrentit (*Chamaea fasciata*), Costa's Hummingbird (*Calypte costae*), Bushtit (*Psaltriparus minimus*), Rufous-crowned Sparrow (*Aimophila ruficeps*), Mourning Dove (*Zenaida macroura*), California Quail (*Callipepla californica*), and California Thrasher (*Toxostoma redivivum*). These species were detected at over 50% of the sampling points in 1996.

Site Scale

In 1995, significantly more bird species were detected at points located within sites where gnatcatchers had been detected than at points in sites without gnatcatchers ($F = 14.89$, $P < 0.001$). However, the difference in richness was small: the mean number of species at points with gnatcatchers was 11.0, at sites without gnatcatchers 9.5. This difference was significant even when significant differences in species richness among sites were accounted for ($F = 3.26$, $P < 0.001$; Figure 2). In 1996, there was no significant difference between mean species richness at sites with or without gnatcatchers (12.0 vs. 11.6; Figure 3).

DISCUSSION

Our results suggest that the California Gnatcatcher is not a particularly good indicator of bird-species richness in coastal sage scrub. Although gnatcatchers were found at points and sites with greater-than-expected

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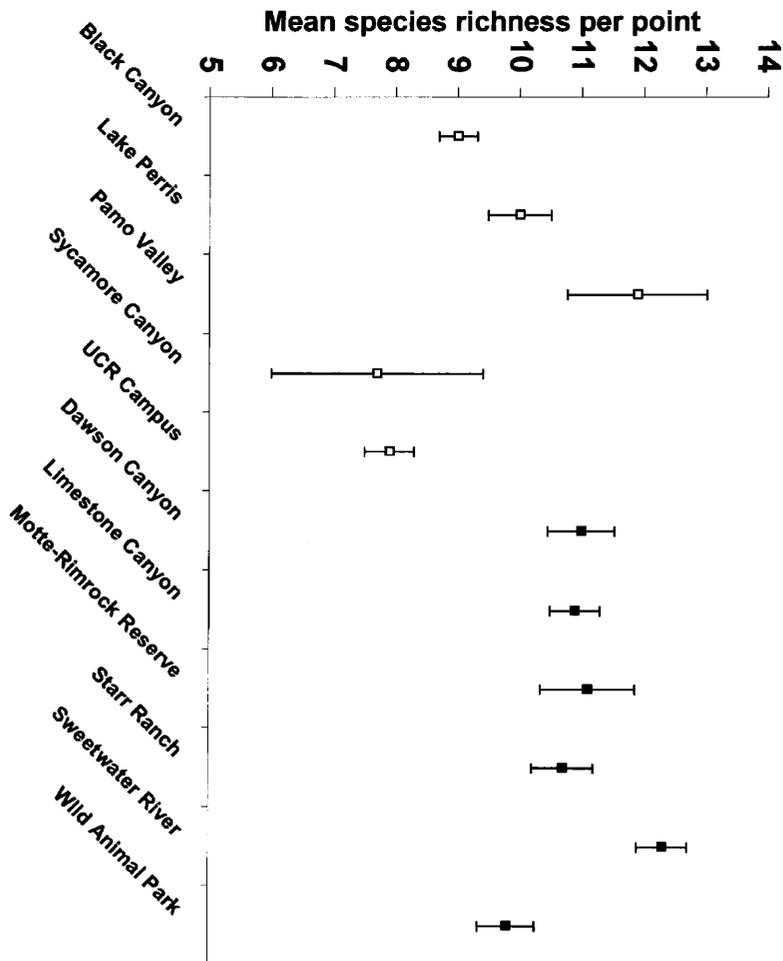


Figure 2. The mean number of species detected per point at each site sampled in 1995. Bars, one standard error. Open squares, sites where California Gnatcatchers were not detected; closed squares, sites where they were detected.

species richness in 1995, the differences were slight, and disappeared in our second year of sampling. The difference between the two years of the study may have been due to the increase in the number of sampling locations and to the more extensive geographical distribution of sampling locations in 1996. In 1996, California Gnatcatchers were detected at sites where the number of species per point was low, such as Kabian Park, as well as at more speciose sites, such as Limestone Canyon (Figure 3).

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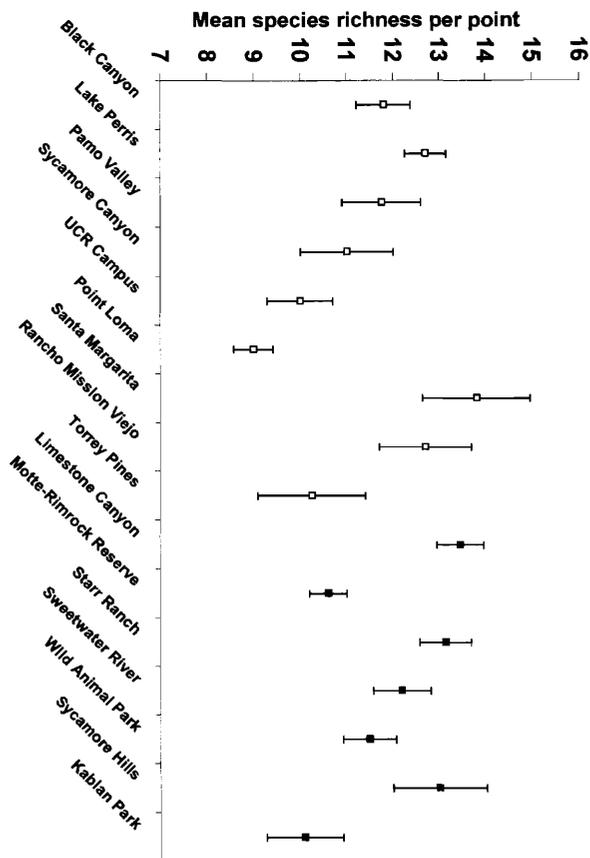


Figure 3. The mean number of species detected per point at each site sampled in 1996. Bars, one standard error. Open squares, sites where California Gnatcatchers were not detected; closed squares, sites where they were detected.

More generally, our results suggest that rare species cannot be assumed to be indicators of “hotspots” of species richness. Two recent studies have found little geographical correspondence between species richness and rarity (birds, liverworts, and aquatic plants, Prendergast et al. 1993; birds, Williams et al. 1996). In contrast, Debinski and Brussard (1994) did find an overlap between sites that support high species diversity and sites that support rare species of birds and butterflies.

To evaluate further the California Gnatcatcher as a biodiversity indicator in coastal sage scrub, future research should also investigate the relationship between gnatcatchers and species richness in other taxonomic groups. Because small mammals and plants have also been sampled in the same sites

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as were used for the present study, we will be able to explore this relationship more in future analyses.

Several other bird species have been identified as "target species" or "species of concern" in coastal sage scrub (Calif Dept. Fish & Game 1993). These species, or others not considered to be in special need of conservation, may be of greater value than the California Gnatcatcher as indicators of species richness in coastal sage scrub. The value of other species remains to be explored.

SUMMARY

We evaluated whether the California Gnatcatcher is an indicator of species-rich bird communities in coastal sage scrub. Bird-species richness was estimated from point counts conducted in 1995 and 1996 at 17 sites in San Diego, Orange, and Riverside counties. Because California Gnatcatchers were detected at a small proportion of the points, we compared the species richness at points where California Gnatcatchers were detected to the species richness expected at randomly sampled points. Slightly more bird species were detected at points where California Gnatcatchers were also detected (mean 11.7 species) than at the random points (mean 10.6 species) in 1995. In 1996, however, there was no significant difference in species richness between points with gnatcatchers and random points. The results were similar when the mean species richness of sites with and without gnatcatchers were compared. This suggests that the California Gnatcatcher is not a particularly good indicator of bird-species richness in coastal sage scrub.

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