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BIOLOGY OF THE CALIFORNIA GNATCATCHER: FILLING IN THE GAPS

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Interest in the coastal populations of the Black-tailed Gnatcatcher (*Polioptila melanura*) first diffused outside of the ornithological community in 1978. Notable for its odd vocalizations, localized distribution, and co-occurrence with a vegetation then known as "inland sage scrub" (Thorne 1976), the coastal subspecies of the Black-tailed Gnatcatcher (*P. m. californica*) was judged by environmental planners to be sensitive because of its small range and vulnerability to habitat conversion (M. U. Evans pers. comm.). Therefore, it warranted discussion in reviews of development projects written in response to the California Environmental Quality Act. Discussions of the bird's sensitivity, however, rapidly intensified as it became apparent that the subspecies inhabited some of the most developable lands of coastal California. Conservation of the subspecies soon became synonymous with broader goal of conserving coastal scrub vegetation, which by 1980 was considered one of the most rapidly disappearing vegetation types in California (Westman 1981). In the late 1980s, Phillips (1986:xxvi and 75, 1991:25–26) and Atwood (1988) elevated the subspecies, with its relatives in Baja California, to the level of a species, the California Gnatcatcher (*P. californica*), restricted in the U.S. to the coastal sage scrub vegetation type and its variations (Westman 1981, O'Leary 1990, White and Padley 1997). Although the California Gnatcatcher was originally described as a species by William Brewster in 1881, its reappreciation as such a century later almost guaranteed that southern California would experience an endangered-species conflict involving billions of dollars of real-estate development. Because of extensive habitat loss (due to conversion to urban, suburban, and agricultural development; Westman 1981, O'Leary 1990) and associated decline in the species' population (e.g., Atwood 1993), the U.S. Fish and

Wildlife Service listed the California Gnatcatcher as a "threatened" species under the Endangered Species Act (ESA) in March 1993 (USFWS 1993). The USFWS went on to state that the species probably warranted "endangered" status but that ongoing conservation planning ("Natural Communities Conservation Plan"; Calif. Dept. Fish & Game 1993) reduced the level of threat.

In anticipation of (and subsequent to) the federal listing of the gnatcatcher under the ESA, local, state and federal agencies, as well as conservationists and developers, began collecting information and data to support policy decisions and permits required under the act. Unlike previous conflicts over endangered birds, which occurred primarily on federal lands and were investigated by teams of agency and resource-industry scientists [e.g., the Northern Spotted Owl (*Strix occidentalis caurina*); Murphy and Noon 1992, Gutiérrez et al. 1996), that over the gnatcatcher represented a new model of conflict over private land, where scientists would be contracted for research by a bewildering array of public agencies, corporations, and private individuals.

Most of this information-gathering activity focused on the fine-scale details of gnatcatcher distribution, particularly the identification of occupied and unoccupied habitat. Ancillary to these distributional studies, data were also gathered on local movements, breeding biology (particularly reproductive success), habitat association, and territory sizes. Much of the information amassed for management and conservation decisions, however, was recorded only in unpublished reports, or even simply buried in an individual's field notebook. Mechanisms for objective review of the information used in policy decisions did not exist. Although thousands of hours of research effort had been expended on the California Gnatcatcher, few peer-reviewed papers describing this work were published. Administrative functions, such as issuance of permits, continued in absence of published information, but conservation science suffered. Researchers had few avenues of communication, no one could build off the established work of others, and mechanisms for identifying reliable data went unused. Thus the need for a symposium on the biology of the California Gnatcatcher, and perhaps a new manner of looking at endangered-species research, arose from the chaos created when so many researchers plunged into so many studies in such a short period.

We organized this symposium for the purpose of bringing gnatcatcher researchers together and lobbying for the publication of the large body of data generated on the species. The California Gnatcatcher Symposium, held 15–16 September 1995 on the campus of the University of California, Riverside, drew 160 participants from academia, biological consulting businesses, and government agencies. We asked the participants to present existing data and analyses and to help us identify the current status of scientifically based knowledge on the species. Our hope for the symposium proceedings was to move as much of this knowledge as possible from the "gray" literature into the peer-reviewed (and more widely accessible) mainstream. The papers contained in this issue of *Western Birds* represent a major portion of the realization of that goal. In further support of that goal, we were successful in making a collection of previously unpublished reports available through the auspices of the Van Tyne Memorial Library, curated by

the Wilson Ornithological Society, at the Museum of Zoology at the University of Michigan. Although these reports have not undergone peer review, they contain valuable data; each is cited in one or more of the papers in this volume as appropriate.

At the symposium 45 oral and poster papers were presented, representing most aspects of California Gnatcatcher biology. Although many were explicitly conservation or management oriented, that focus was not a criterion for inclusion on the program. From these 45, 22 appear in this collection; we are aware of at least seven other presentations, portions or all of which have appeared or are currently in review in other professional journals. Publication of these proceedings would not have been possible without the generous support of Ogden Environmental Services, LSA Associates, the Metropolitan Water District of Southern California, the Riverside County Habitat Conservation Agency, and the University of California.

From these papers we can distill several facts about the California Gnatcatcher. For example, at a regional or landscape scale, the distribution of the species appears largely constrained by the distribution of coastal sage scrub vegetation; however, at more local scales birds may be found in (and perhaps depend on) additional vegetation types, depending on the particular local mosaic. Because individuals and pairs can be found in patches of suitable habitat quite isolated from the nearest population of any consequence, the power of dispersal of this nonmigratory species may be substantial. It is quite clear that gnatcatchers in southern California occupy a fragmented landscape and are governed by metapopulation dynamics. Territory sizes are highly variable, increasing significantly as one moves inland from the coast, and in general are much larger on average than those of other passerines of comparable body mass. They are persistent nesters, constructing as many ten nests within a breeding season. However, nests are frequently abandoned before eggs are laid, so that the number of clutches is usually less than the number of nests built by a pair. Clutch size is variable, and much of the variation seems related to variation in weather, particularly precipitation. Although California Gnatcatchers serve as frequent hosts to the Brown-headed Cowbird (*Molothrus ater*), they also suffer a high rate of nest predation, which seems to exert the greatest control over reproductive success.

Nevertheless, numerous gaps in our knowledge of gnatcatcher biology remain. For example, we lack certainty about the birds' mating system and criteria for mate choice; although they appear socially monogamous, they also demonstrate behaviors that clearly suggest a potential for extra-pair copulations for both sexes. While mating systems are of academic interest to behavioral ecologists, they are also relevant to conservation biologists because of the implications they may have for genetic structuring of populations and effective population size. Likewise, although there have been several investigations of gnatcatcher genetics with a goal of elucidating taxonomic relationships, we are currently unaware of any studies examining the genetics of populations or demes. In addition to providing information on effective population size, properly done molecular studies also assess gene flow, genetic traces of the connections among subpopulations distrib-

uted over a fragmented landscape. Because gnatcatchers nest persistently, their reproductive effort can be high; although there is a rich body of life-history theory that deals with trade-offs among aspects of reproduction, none has been systematically applied to the California Gnatcatcher. And although clutch size varies from year to year, it also varies from pair to pair at a site within a year; it is not known if this variation reflects differences in territory quality or differences in the quality of individuals. Indeed, we do not know how reproductive success varies with standard measures of habitat.

From a conservation and management perspective, our greatest concerns about knowledge gaps pertain to issues of landscape ecology and metapopulation dynamics. For example, it is evident that gnatcatchers must disperse through "unsuitable" habitat (i.e., habitat not suitable for territory establishment and subsequent reproduction); however, we have only a few tantalizing details about the actual paths taken or vegetation types used. We also have hints that there may be spatial correlation in temporal fluctuations in abundance, but the strength and spatial extent of this correlation throughout the region (which is critical to estimating metapopulation persistence) is unknown. Perhaps most important, we currently lack the ability to generalize source and sink subpopulations among the many disjunct assemblages of occupied habitat, which is critical if efforts to preserve the species in the region are to be successful. Ultimately, the natural dynamic cycles of gnatcatcher habitat have been disrupted by invasive, non-native grasses; increased frequency of fire in habitat preserves may radically alter the dynamics of gnatcatcher populations across the mosaic of remaining habitat.

Taken together, filling in these gaps will help answer what Atwood (pers. comm.) identified as the four principal questions that need to be answered for effective conservation planning in the region:

(1) How long does it take habitat disturbed by fire or created by restoration to achieve the point where it can support successfully breeding gnatcatchers?

(2) How do dispersal patterns affect the genetic and demographic connectivity of subpopulations?

(3) What drives long-term large-scale patterns of variation in demography?

(4) How can we identify, and perhaps rank, good-quality habitat over large spatial scales?

We hope that this symposium and the research it summarized and generated will be a major contribution to answering these questions.

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LITERATURE CITED

Atwood, J. L. 1988. Speciation and geographic variation in black-tailed gnatcatchers. Ornithol. Monogr. 42.

Atwood, J. L. 1993. California Gnatcatchers and coastal sage scrub: The biological basis for endangered species listing, in Interface between Ecology and Land Development in California (J. E. Keeley, ed.), pp. 149–166. S. Calif. Acad. Sci., Los Angeles.

California Dept. Fish & Game. 1993. Southern California coastal sage scrub Natural Community Conservation Plan, Scientific Review Panel conservation guidelines and documentation. The Resources Agency, Calif. Dept. Fish & Game, 1416 9th St., Sacramento, CA 95814.

Gutiérrez, R. J., Forsman, E. D., Franklin, A. B., and Meslow, E. C. 1996. History of demographic studies in the management of the Northern Spotted Owl. Studies Avian Biol. 17:6–11.

Murphy, D. D., and Noon, B. R. 1992. Integrating scientific methods with habitat conservation planning: Reserve design for the Northern Spotted Owl. Ecol. Appl. 2:3–17.

O'Leary, J. F. 1990. Californian coastal sage scrub: General characteristics and considerations for biological conservation, in Endangered Plant Communities of Southern California: Proceedings of the 15th Annual Symposium (A. A. Schoenherr, ed.), pp. 24–41. S. Calif. Bot. Spec. Publ. 3, Claremont, CA.

Phillips, A. R. 1986. The Known Birds of North and Middle America, part I. A. R. Phillips, Denver.

Phillips, A. R. 1991. The Known Birds of North and Middle America, part II. A. R. Phillips, Denver.

Thorne, R. F. 1976. The vascular plant communities of California, in Plant communities of southern California (J. Latting, ed.), pp. 1–31. Calif. Native Plant Soc. Spec. Publ. 2.

U.S. Fish and Wildlife Service. 1993. Endangered and threatened wildlife and plants: Threatened coastal California Gnatcatcher; final rule and proposed special rule. 50 CFR Part 17. Fed. Register 58(59).

Westman, W. E. 1981. Factors influencing the distribution of species of Californian coastal sage scrub. Ecology 62:439–455.

White, S. D., and Padley, W. D. 1997. Coastal sage scrub series of western Riverside County, California. Madroño 44:95–105.