

# DISTRIBUTION AND POPULATION SIZE OF CALIFORNIA GNATCATCHERS ON THE PALOS VERDES PENINSULA, 1993–1997

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The potential effects of fragmentation of natural communities by urban development are dramatically evident on the Palos Verdes Peninsula of Los Angeles County, California. Because of the long history of agricultural and, more recently, intensive urban development of the Los Angeles basin, tracts of natural scrub habitat on the peninsula have become increasingly isolated and smaller since the mid-1900s (Fink 1966, Gales 1974). The populations of the California Gnatcatcher (*Poliophtila californica*) nearest that on the peninsula occur in Los Angeles County near Montebello and in Orange County near Fullerton and Newport Beach, all approximately 45 km from the Palos Verdes Peninsula across the urbanized areas of greater Los Angeles. In fact, Palos Verdes exemplifies the situation that California's Natural Community Conservation Planning (NCCP) program is intended to avoid—small, disjunct islands of natural habitat surrounded by a vast, nearly continuous urban “ocean” (Calif. Dept. Fish & Game 1993). Long-term maintenance of viable natural communities in such a landscape poses an especially difficult conservation challenge.

Through preparation of land-use plans that address the ecological requirements of selected “target species” at a regional scale, the NCCP attempts to allow economic development while ensuring the protection of biologically viable tracts of natural habitat (Atwood and Noss 1994, Reid and Murphy 1995). Two songbirds, the California Gnatcatcher and Cactus Wren (*Campylorhynchus brunneicapillus*), have been selected throughout much of southern California as the primary flagship species for a test-case application of an NCCP to the coastal sage scrub (Calif. Dept. Fish & Game 1993, Atwood and Noss 1994, Reid and Murphy 1995). Despite the centrality of these species to this planning process, however, little is actually known of their behavioral ecology (Atwood 1993, Rea and Weaver 1990). Consequently, to obtain basic biological data required for effective conservation planning, in 1993 Manomet Center for Conservation Sciences began an ongoing study of gnatcatchers and wrens on the Palos Verdes Peninsula. Here we summarize some of the results of the first five years of this project, especially with regard to annual fluctuations in population size and use of natural habitats by gnatcatchers on the peninsula.

## METHODS

### Vegetation Analyses

Discrete units of natural vegetation on the Palos Verdes Peninsula were identified on plastic overlays affixed to color aerial photographs, scale 1 inch

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= 1200 feet, dated 8 January 1992 and 19 April 1993. The minimum size of delineated polygons was approximately 0.2 ha. We inspected each vegetation unit in the field, either from nearby vantage points through binoculars or by visits to the sites. We adjusted polygon boundaries as appropriate, and visually estimated the percent cover of the following plant species or categories for each unit: (a) *Artemisia californica*, (b) *Eriogonum* spp. (including *E. fasciculatum* and *E. cinereum*), (c) *Salvia* spp. (including *S. leucophylla* and *S. mellifera*), (d) *Opuntia littoralis*, (e) *Rhus integrifolia*, (f) *Opuntia prolifera*, (g) *Encelia californica*, (h) *Elymus condensatus*, (i) *Baccharis pilularis*, (j) *Foeniculum vulgare*, (k) *Salsola kali*, (l) miscellaneous ornamental shrubs, (m) disturbed grassland, (n) riparian, and (o) bare ground. Vegetation data were entered in a geographic-information system by means of ArcInfo software.

Various classification systems have been applied to subassociations of coastal sage scrub (Munz 1970, Thorne 1976, Kirkpatrick and Hutchinson 1977, Westman 1981, DeSimone and Burk 1992, Jones and Stokes Associates, Inc. 1993). Here, we used a cluster analysis to identify major vegetation groupings, then prepared a dichotomous key reflecting these results (Table 1). Using this key, we then categorized each mapped polygon as one of four scrub subassociations (lemonadeberry scrub, sage-lemonadeberry scrub, sagebrush scrub, and cactus scrub) or two types of disturbed grassland (grassland-scrub ecotone and grassland). Residential areas, landscaped parks, playing fields, golf courses, shopping centers, roads, and ruderal areas with >50% cover by *Eucalyptus*, *Acacia*, or other ornamental species were considered to be developed. Polygons classified as the same subassociation and sharing a common boundary were subsequently merged to form larger units than originally had been mapped in the field. Area estimates for vegetation polygons, uncorrected for slope effects, were obtained through ArcInfo.

**Table 1** Key to Coastal Sage Scrub and Grassland Categories Used in Vegetation Mapping on the Palos Verdes Peninsula<sup>a</sup>

A	Percent cover of Ac + Er + Sa + Op + En + Rh < 30%	..... B
A'	Percent cover of Ac + Er + Sa + Op + En + Rh ≥ 30%	..... C
B	Percent cover of Ac + Er + Sa + Op + En + Rh < 15%	..... Grassland
B'	Percent cover of Ac + Er + Sa + Op + En + Rh ≥ 15%	..... Grassland-scrub ecotone
C	Percent cover of Rh ≥ percent cover of Ac + Er + Sa + Op + En	.....
		Lemonadeberry scrub
C'	Percent cover of Rh < percent cover of Ac + Er + Sa + Op + En	..... D
D	Percent cover of Sa + Rh ≥ percent cover of Ac + Er + Op + En	.....
		Sage-lemonadeberry scrub
D'	Percent cover of Sa + Rh < percent cover of Ac + Er + Op + En	..... E
E	Percent cover of Op ≥ 25%	..... Cactus scrub
E'	Percent cover of Op < 25%	..... Sagebrush scrub

<sup>a</sup>Ac, *Artemisia californica*; Er, *Eriogonum* spp.; Sa, *Salvia* spp.; Op, *Opuntia* spp.; Rh, *Rhus integrifolia*; En, *Encelia californica*.

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### Population Surveys

All major areas of natural habitat on the Palos Verdes Peninsula were surveyed for breeding California Gnatcatchers from February to June of each year of the study (1993–1997). Surveys were generally conducted before 11:00 and after 16:00, in weather deemed acceptable in terms of wind and temperature. Taped recordings of gnatcatcher calls were used to elicit responses. In areas where adjacent territories of unbanded birds posed potential confusion over the number of pairs actually present, teams of two to four biologists revisited the site to observe all birds in question simultaneously. Because of the limited amount of suitable habitat and our population estimates' being based on observations of uniquely banded birds, the locations of simultaneously active nests, or simultaneous observations of unbanded birds, we feel confident in the accuracy of our results. There was no substantial change in survey effort or technique during the study. We recorded the locations of breeding pairs on 7.5-minute USGS topographic maps that were enlarged to a scale of approximately 1 inch = 500 feet, then digitized with ArcInfo.

## RESULTS

### Habitat Distribution

We located approximately 642 ha of coastal sage scrub on the Palos Verdes Peninsula (Figure 1), of which 170 ha (26%) consisted of fragments of less than 5 ha each. Only one area of scrub exceeded 100 ha; this single tract represented approximately 17% of the total coastal sage scrub remaining on the peninsula.

Sagebrush scrub represented 46% of the total coastal sage scrub on the Palos Verdes Peninsula (Table 2). The least common of the four major subassociations was cactus scrub, which made up only 6%. Approximately 198 ha of grassland–scrub ecotone, where coastal sage scrub plants represented 15–29% of the vegetation cover, and 829 ha of grassland occurred on the peninsula.

Approximately 59% of coastal sage scrub remaining on the Palos Verdes Peninsula was located within the jurisdiction of the city of Rancho Palos Verdes (Table 2). Even greater percentages of the total remaining amounts of sagebrush scrub (69%) and cactus scrub (81%) occurred within Rancho Palos Verdes city limits. Scrub in the cities of Palos Verdes Estates and Rolling Hills was classified predominantly as lemonadeberry scrub or sage–lemonadeberry scrub (Table 2).

### Gnatcatcher Population Size and Distribution

We found 26 to 56 breeding pairs of the California Gnatcatcher during the 1993–1997 nesting seasons (Figure 2). The population was greatest (56 pairs) in 1994. From 1994 to 1995 the number of breeding pairs declined 54%, then increased 50% from 1995 to 1996. None of these population fluctuations was evidently related to changes in habitat availability, as the amount of coastal sage scrub on the peninsula did not vary significantly from

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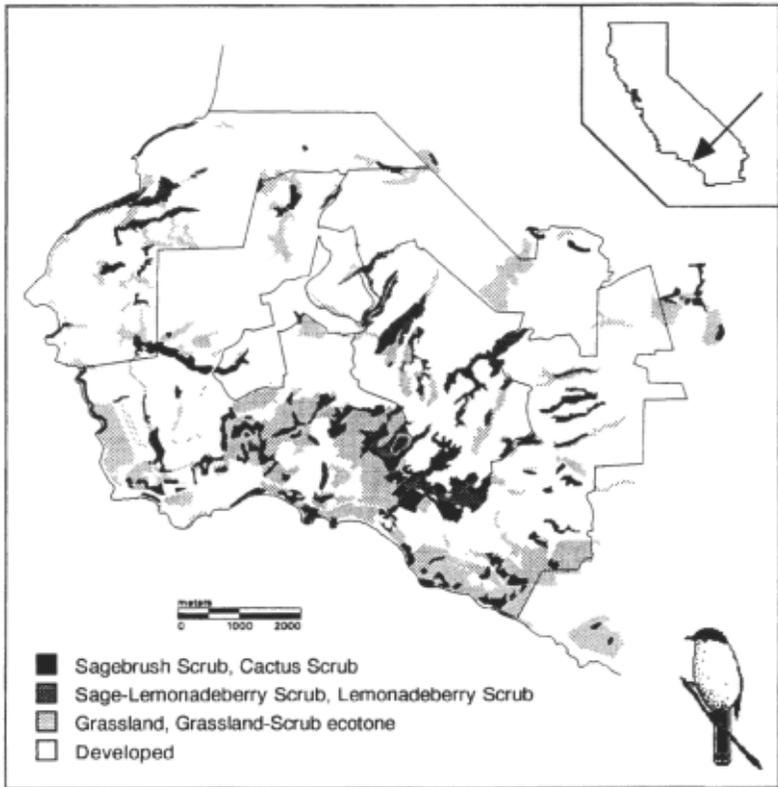


Figure 1. Distribution of coastal sage scrub, grassland-scrub ecotone, and grassland on the Palos Verdes Peninsula, 1993-1997. Black lines, coastline and city boundaries.

1993 to 1997. Most gnatcatchers on the peninsula were located in the city of Rancho Palos Verdes (Table 3).

In all years of our study the majority of pairs were located in polygons classified as sagebrush scrub (Table 3; Figure 3). In the absence of detailed territory mapping, however, plotting of locations must be somewhat arbitrary and therefore unlikely to fully reflect the habitat as the birds perceive it. We suggest that habitat preferences are better demonstrated by the broader landscape where pairs are found (Figure 3). For example, during 1997, 14 pairs were located in areas classified as "grassland" or "grassland-scrub ecotone," raising questions regarding precision of the mapped locations of these pairs and/or the vegetation classification of these polygons (Table 3). Habitat analysis at a larger scale, however, showed that virtually all of these pairs were located in areas containing large amounts of sagebrush scrub, grassland, and grassland-scrub ecotone (Figure 3). On the Palos Verdes

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**Table 2** Extent (ha) of Principal Coastal Sage Scrub and Grassland Habitats on the Palos Verdes Peninsula, 1993–1997

Vegetation type	Patch size					Jurisdiction <sup>a</sup>				
	Total area	Mean	SD	n	Max	RPV	PVE	RH	RHE	SP
Sagebrush scrub	298	2.79	2.90	107	22.4	205	27	33	14	19
Cactus scrub	37	1.06	0.76	35	2.9	30	5	2	0	0
Sage-lemonadeberry scrub	101	3.05	4.25	33	24.5	46	0	49	6	0
Lemonadeberry scrub	206	4.91	6.23	42	26.7	97	42	61	7	0
Grassland-scrub ecotone	198	2.28	2.42	87	15.9	135	25	24	2	12
Grassland	829	6.74	12.77	123	69.3	579	57	41	58	94

<sup>a</sup>RPV, Rancho Palos Verdes; PVE, Palos Verdes Estates; RH, Rolling Hills; RHE, Rolling Hills Estates; SP, San Pedro.

Peninsula, as well as elsewhere in southern California (Atwood unpubl. data), California Gnatcatchers are more likely to occur in landscapes where coastal sage scrub is patchily distributed within a grassland matrix than in continuous tracts of scrub as often occur near chaparral.

Some apparently suitable habitat on the peninsula was unoccupied by breeding gnatcatchers throughout the study. We never found breeding pairs in

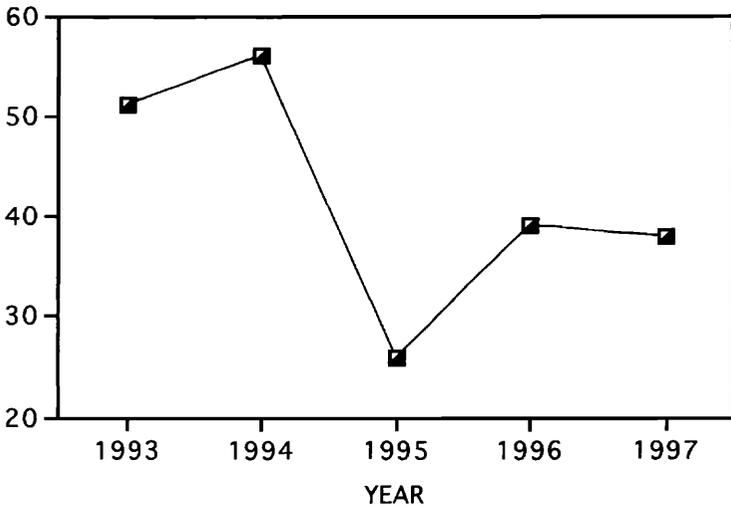


Figure 2. Annual variation in number of breeding pairs of California Gnatcatchers on the Palos Verdes Peninsula, 1993–1997.

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**Table 3** Distribution of California Gnatcatchers on the Palos Verdes Peninsula by Vegetation Type and Civil Jurisdiction

Year	Vegetation type <sup>a</sup>						Jurisdiction <sup>b</sup>				
	SS	CS	SL	LS	GS	GR	RPV	PVE	RH	RHE	SP
1993	34	9	2	2	2	2	42	3	1	0	5
1994	37	9	1	1	7	1	46	3	1	1	5
1995	15	4	2	1	2	2	24	1	1	0	0
1996	28	1	0	0	6	4	38	1	0	0	0
1997	15	5	3	1	8	6	35	1	1	0	1

<sup>a</sup>SS, sagebrush scrub; CS, cactus scrub; SL, sage-lemonadeberry scrub; LS, lemonadeberry scrub; GS, grassland-scrub ecotone; GR, grassland.

<sup>b</sup>RPV, Rancho Palos Verdes; PVE, Palos Verdes Estates; RH, Rolling Hills; RHE, Rolling Hills Estates; SP, San Pedro.

approximately 427 ha of coastal sage scrub vegetation, including approximately 159 ha that were classified as sagebrush scrub (representing 53% of the total amount of this subassociation). Patch size effectively predicted presence or absence of gnatcatchers in polygons classified as sagebrush scrub ( $P < 0.001$ , logistic regression) (Figure 4). Patches of this subassociation with gnatcatchers were significantly larger than unoccupied areas (occupied: mean 4.07 ha, SD 3.88,  $n = 39$ , range 0.34–22.4 ha; unoccupied: mean 2.05 ha, SD 1.81,  $n = 68$ , range 0.18–10.48 ha;  $P = 0.001$ , Mann-Whitney  $U$  test). Patch size showed no significant relationship with gnatcatcher occupancy for polygons delineated as cactus scrub, sage-lemonadeberry scrub, or lemonadeberry scrub ( $P > 0.10$ , logistic regression) (Figure 4).

Of 34 patches of coastal sage scrub (all subassociations combined) used by breeding gnatcatchers during the study, 7 (21%) supported pairs during all 5 years, 3 (9%) during 4 of the years, 5 (15%) during 3 of the years, 9 (26%) during 2 of the years, and 10 (29%) during only a single breeding season. Patch size was a successful predictor of the consistency of occupancy by gnatcatchers ( $P = 0.016$ , logistic regression). There was a significant difference in area among patches occupied for one to five years ( $P = 0.032$ , Kruskal-Wallis test), with patches used for four or five years being substantially larger than patches occupied one, two, or three years (Figure 5).

During each year of the study, a large portion of the peninsula's entire gnatcatcher population was concentrated in Agua Amarga Canyon, the vicinity of Edward's Canyon (McCarrell's Canyon), and near Klondike Canyon (Figure 6). These three localities, which included only about 33% of the area of coastal sage scrub (all subassociations) on the peninsula, supported from 41% to 58% (mean 46%) of the annual breeding population from 1993 to 1997.

DISCUSSION

Shaffer (1981), Gilpin and Soulé (1986), and Hanski (1991) summarized major forces that may contribute to population extinction. "Deterministic"

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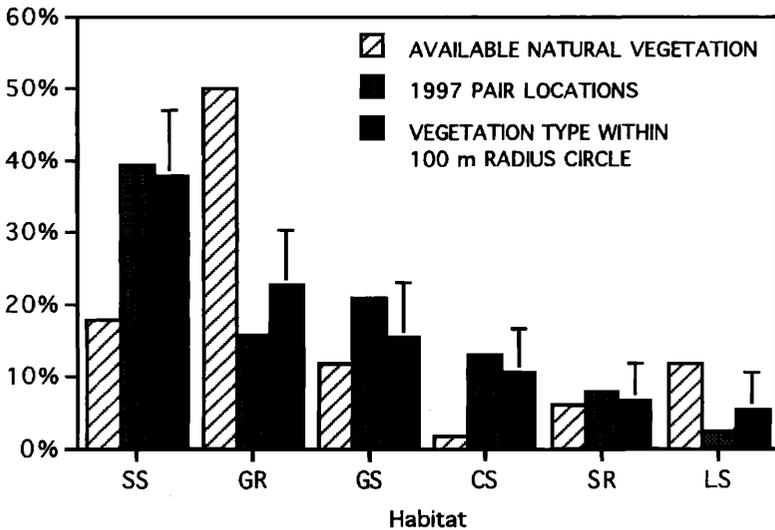


Figure 3. Distribution of California Gnatcatcher pairs relative to habitat availability on the Palos Verdes Peninsula. Cross-hatched bars, vegetation types as percentage of total natural habitats. Gray bars, percentage of 1997 pairs in each vegetation type. Black bars, mean value of each vegetation type based on its abundance within 100-m radius of each pair's location in 1997. Error bars, 2 standard errors. SS, sagebrush scrub; GR, grassland; GS, grassland-scrub ecotone; CS, cactus scrub; SR, sage-lemonadeberry scrub; LS, lemonadeberry scrub.

extinctions may result from the removal of an essential resource, such as a specific habitat type on which an organism is dependent. "Stochastic" extinctions may result from normal, random perturbations, such as demographic, genetic, and environmental variations, as well as catastrophes. As noted by Gilpin and Soulé (1986), "decay in one factor (such as population size) can exacerbate not only itself but also the behavior of other factors (such as inbreeding and fragmentation)."

Our results indicate that the population of California Gnatcatchers on the Palos Verdes Peninsula is characterized by a number of factors that place it at a high risk of extinction. Only about 30 breeding pairs of gnatcatchers now remain on the peninsula, and the surrounding megalopolis of Los Angeles makes immigration of birds from other portions of the species' range in southern California impossible or extremely unlikely. Furthermore, gnatcatchers remaining on the peninsula are distributed over a very fragmented landscape, with approximately 50% of the total breeding population concentrated in three relatively small areas that could easily be disrupted by development or fire. Soulé (1986) suggested that extinction due to demographic stochasticity is a real threat for populations of 20 or fewer breeding females. On the Palos Verdes Peninsula factors not yet fully understood but most likely related to weather variations have caused one-year declines exceeding 50%.

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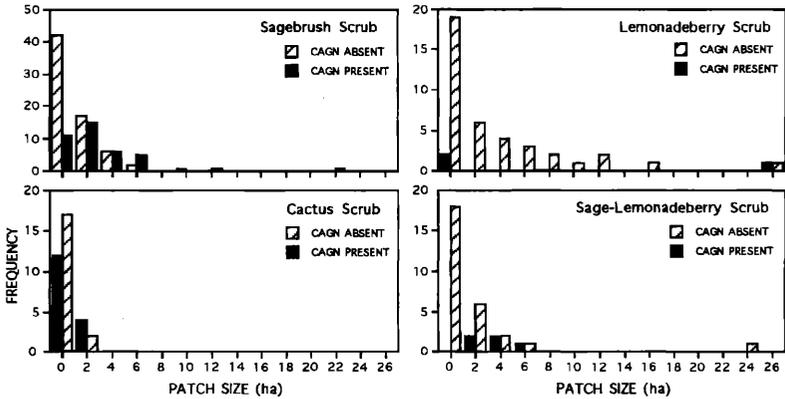


Figure 4. California Gnatcatcher distribution by size of habitat patch on the Palos Verdes Peninsula, 1993–1997.

Conservation of California Gnatcatchers in the Palos Verdes area will require careful protection of nearly all areas of currently occupied coastal sage scrub, especially in the Agua Amarga Canyon, Edward's Canyon (McCarrell's Canyon), and Klondike Canyon areas. Additional efforts should also focus on increasing the overall amount of sagebrush scrub through restoration, especially on lands adjacent to currently occupied habitat. However, given the Palos Verdes gnatcatcher population's current highly threatened status, plans to mitigate loss of presently occupied habitat through long-term habitat restoration projects may not be realistic.

While conclusions regarding the gnatcatcher's long-term status on the peninsula must await completion of further studies and planning, at this time we see no evidence suggesting that the Palos Verdes population is not severely threatened. Under present knowledge, it would certainly be foolhardy to base planning decisions elsewhere in coastal southern California on the mere fact that California Gnatcatchers now tenuously persist on the peninsula.

### SUMMARY

The population of the California Gnatcatcher on the Palos Verdes Peninsula of Los Angeles County provides a unique opportunity for studying the species' biology in a fragmented and highly isolated landscape. Annual surveys located 51, 56, 26, 39, and 38 breeding pairs from 1993 to 1997. Substantial areas of apparently suitable habitat were not used by breeding gnatcatchers. Approximately 50% of each year's breeding pairs were concentrated in approximately 33% of the peninsula's 642 ha of coastal sage scrub. Of discrete habitat patches occupied by breeding birds, only 21% were occupied during all 5 years. Patch size effectively predicted both the

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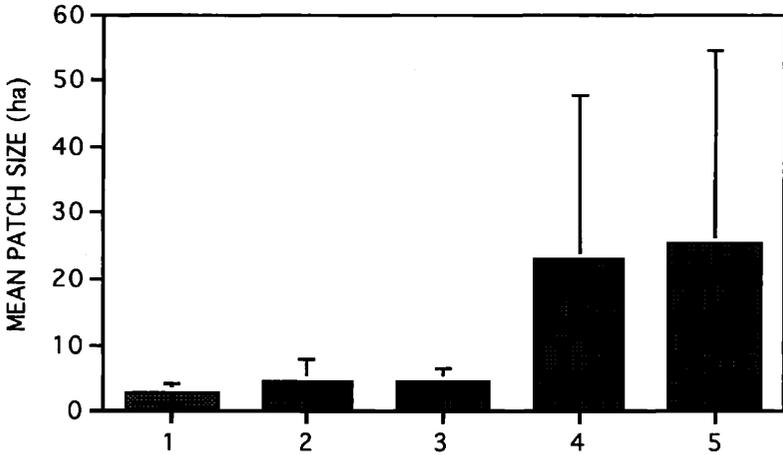


Figure 5. Mean patch size and number of years of occupancy by California Gnatcatchers on the Palos Verdes Peninsula, 1993–1997. Error bars, 2 standard errors.

likelihood of gnatcatcher occupancy of patches of sagebrush scrub and the year-to-year consistency of occupancy of scrub patches (all subassociations combined). Our results suggest that the Palos Verdes population of California Gnatcatchers is at a high risk of extinction because of its small size, concentrated distribution, and isolation from other populations in Los Angeles and Orange counties.

### ACKNOWLEDGMENTS

Financial support for various aspects of this work was provided by the U.S. Navy, Southern California Edison, Ed Almanza and Associates, the National Fish and Wildlife Foundation, the Palos Verdes Peninsula Land Conservancy, the trustees of Manomet Center for Conservation Sciences, and an anonymous donor. Jack Cameron, Barbara Courtois, Jim and Lynda Luttrell, Amy Miller, Nancy Nicolai, Tim Overbey, and Mike Walther all contributed important field assistance. George Cox and John Rotenberry gave useful comments that improved an early draft of the manuscript. The U.S. Navy provided access to the Defense Fuel Support Point. The Environmental Systems Research Institute, Inc. (ESRI) provided GIS capabilities in the form of PC ArcInfo software; Stacie Grove of Manomet patiently explained how to make it work. Barbara and Sarah Atwood encouraged the senior author during his travels to southern California.

This research was conducted under U.S. Fish and Wildlife Service endangered species recovery permit PRT-800922, U.S. Fish and Wildlife Service master bird-banding permit 09996, California scientific-collecting permits and a California Department of Fish and Game memorandum of understanding dated 25 August 1992 (as amended).

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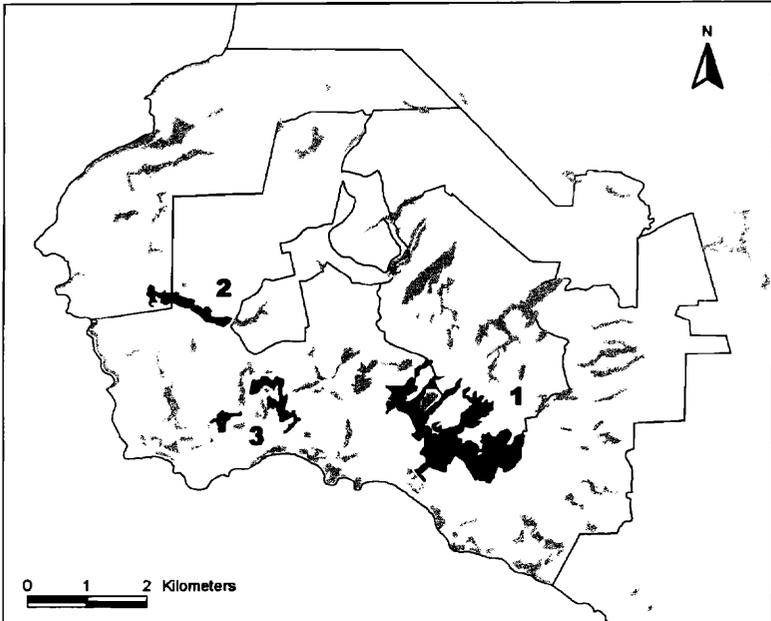


Figure 6. Principal locations of California Gnatcatchers on the Palos Verdes Peninsula, 1993–1997. Black areas, habitat that supported >5% of each year's total population; gray areas, other regions of coastal sage scrub. Area 1, Klondike Canyon and vicinity; area 2, Agua Amarga Canyon; area 3, Edward's (McCarrell's) Canyon and vicinity. Fine black lines, city boundaries.

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*Accepted 6 July 1998*