

A POPULATION CENSUS OF THE CACTUS WREN IN VENTURA COUNTY, CALIFORNIA

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ABSTRACT: The Cactus Wren (*Campylorhynchus brunneicapillus*) is a polytypic species widespread in the southwestern U.S. and northern Mexico. Though closer in plumage characteristics to the desert subspecies *anthonyi*, populations resident in coastal sage scrub on the coastal slope of Ventura County and Los Angeles County occupy an ecological niche more similar to that of the more southerly subspecies *sandiegensis*. Because of fragmentation of habitat associated with urbanization, the populations on southern California's coastal slope are almost entirely isolated from those of the deserts, and apparently from each other. They are declining precipitously for reasons not entirely understood but certainly related to loss, fragmentation, and degradation of suitable habitat. In 2012, we organized a volunteer effort to map the entire population in Ventura County and found 111 active, accessible territories with at least one adult or a fresh nest. Additional areas to which we did not have access could raise this total number to 166 territories county-wide. While historically the species occurred somewhat more widely in the eastern portion of the county, all active territories now appear to be restricted to a narrow band of cactus-rich scrub at the far western edge of the Santa Monica Mountains and Simi Hills, from Point Mugu northeast through Thousand Oaks to the west side of Simi Valley, roughly tracking the distribution of large patches of prickly-pear (*Opuntia* spp.) and coast cholla (*Cylindropuntia prolifera*).

During spring 2012, the California Department of Fish and Game (CDFG, now California Department of Fish and Wildlife) contracted with us to organize a volunteer-based survey to develop a baseline estimate of the number and distribution of the Cactus Wren (*Campylorhynchus brunneicapillus*) in Ventura County (Cooper and Hall 2012). The effort was modeled after similar recent surveys for the species elsewhere in coastal southern California (Mitrovich and Hamilton 2007, Cooper et al. 2012). Here we present an updated distribution map and population estimate of the wren, along with a historical overview of the species' range and former status in Ventura County.

All known populations of the Cactus Wren in Ventura County may be considered the "coastal Cactus Wren;" interior populations extending west from the Mojave Desert occur (or recently occurred) near Gorman, Los Angeles County (www.ebird.org), but these noncoastal birds are not known to extend into neighboring Ventura County. As recently summarized by Hamilton et al. (2011), coastal Cactus Wrens are confined to extensive stands of mature prickly-pear (*Opuntia* spp.) or cholla (*Cylindropuntia* spp.) cactus in cismon-tane southern California and adjacent Baja California, Mexico, occur mainly below 600 m elevation, are extremely sedentary, and are now largely isolated from desert populations. The San Diego Cactus Wren (*Campylorhynchus brunneicapillus sandiegensis*) is considered a California bird species of special concern (Unitt 2008), affording it some measure of protection under the California Environmental Quality Act (CEQA). Although not all coastal

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populations are attributable to *sandiegensis*, as discussed by Cooper et al. (2012), many land managers and regulatory agencies in the region nonetheless treat all coastal Cactus Wrens as having special status under CEQA. Today, the coastal Cactus Wren is essentially confined to sites dominated by mature, native coastal sage scrub near large tracts of open space; while the species may persist in small habitat patches within suburban development near these open spaces, it is highly prone to extirpation from such areas and unlikely to recolonize them quickly once extirpated (see Soulé et al. 1988 and Crooks et al. 2001; pers. obs.). Reflecting concern about the conservation of these populations, the coastal Cactus Wren has been proposed for listing under the Endangered Species Act (USFWS 1994) and has been identified as a focal species in local and regional conservation and management plans.

METHODS

Study Area

Ventura County is located in coastal southern California, just north and west of Los Angeles County. Development is concentrated in the southern half of the county; the rugged canyons and ridges of the San Rafael Mountains dominate the northern portion. The Santa Monica Mountains, a range of coastal hills rarely exceeding an elevation of 900 m, enter the county from the southeast, terminating at the Oxnard Plain near Point Mugu. The Santa Clara River bisects the county from east to west and is separated from the southern portion of the county by several ranges of hills, including the Santa Susana Mountains. Agriculture is still a major land use in the county; row crops occupy large areas of the Santa Clara River valley and Oxnard Plain in the south, while orchards (especially avocado and citrus) cover the low hills across the middle of the county.

We searched for Cactus Wren habitat by using Google Earth to locate suitable vegetation, identifiable from the distinct signature of large cactus patches in recent (>2005) aerial photographs (i.e., pale green, roughly circular areas within coastal sage scrub and chaparral, typically on south-facing slopes). We reviewed the literature to establish where Cactus Wrens had been observed or collected in Ventura County in the past, drawing from more recent sources such as www.ebird.org, as well as records of nests and specimens from museums (Table 1). Ultimately, we divided the study area into six subregions and selected 28 moderately to highly experienced birders to serve as observers (Table 1). We encouraged volunteers to form their own survey groups and coordinate visits, and we sent each volunteer aerial photographs (as JPEG files) of potentially suitable cactus patches, with instructions to print out these maps and check for access points prior to surveys.

Survey Methods

Survey methods followed Cooper et al. (2012), which were adapted from those developed for Cactus Wren surveys in the Nature Reserve of Orange County (Mitrovich and Hamilton 2007); however, we quickly realized that the cactus scrub in Ventura County presented unique challenges not anticipated from past experience. In some areas, such as north of the Conejo Grade

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Table 1 Specimens, Nests, and Egg Sets of the Cactus Wren Collected in Ventura County, California

Region and location	Type	Year	Institution and catalog number ^a
Santa Clara River valley			
Santa Paula	Eggs	1905	WFVZ 64142/85200
“Sespe”	Skin	1922	UWBM 27262
Oxnard Plain			
Pt. Mugu, “Broome Ranch”	Eggs	1935	WFVZ 64135/93129
2.9 mi. ESE Camarillo, E bank	Skin	1986	SDNHM 44455
Conejo Creek			
Conejo Creek, 2.9 mi. ESE	Skin	1986	SDNHM 44691
Camarillo			
3.0 mi. ESE Camarillo	Skin	1989	SDNHM 45699
Moorpark/Simi Valley			
“Simi”	Skin	1898	USNM 9180
Simi Valley	Eggs	1898	WFVZ 64128/101263
Simi Valley	Eggs	1901	WFVZ 64129/101187
Simi Valley	Eggs	1902	WFVZ 64131/100956
Simi Valley	Eggs	1906	WFVZ 64130/74537

^aSDNHM, San Diego Natural History Museum; USNM, U. S. National Museum of Natural History; UWBM, University of Washington Burke Museum; WFVZ, Western Foundation of Vertebrate Zoology.

into the Hill Canyon area, cactus was simply too extensive to be viewed or mapped from the ground, so here our first priority became having volunteers cover enough ground on foot or bicycle to intersect a wren territory (as suggested by a calling bird). By contrast, in other areas such as near Moorpark, wren habitat was highly fragmented and sometimes impossible to access, often hidden within gated residential areas where access was difficult to obtain. Ultimately, the priority shifted mid-season from careful mapping of the boundaries of suitable cactus patches to simply searching for birds and nests throughout the study area, mapping patches only in the vicinity of detections of the species as we went. On both public and private properties we surveyed potential habitat from trails, roads, utility rights-of-way, and “neighborhood trails” used by dog-walkers.

We mapped large, contiguous areas of cactus scrub (“polygons”) only if they were found to hold either wrens or nests (of any age). We further divided polygons into multiple (occupied) “sites;” in general, each site represented a single wren territory, and a group of sites constituted a polygon (occasionally, a polygon had just a single site, particularly if it was small or isolated). Volunteers categorized each site on the basis of the extent and height of its cactus, and used colored pens to outline areas of cactus scrub directly on aerial photos. Volunteers also recorded up to four dominant shrub species within each site. We considered initial mapping to be “round one” of a minimum of three total visits to be made in April, May, and June, with visits spaced at least two weeks apart. All Cactus Wrens observed or heard, and all nests found during the first visit, were recorded directly on aerial photos and noted on data sheets; surveyors also recorded whether nests appeared

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to be old or fresh. In subsequent visits, surveyors mapped only the locations of birds and nests where they had *not* been detected on prior visits (see Cooper et al. 2012 for further discussion of methods).

We did not ask our volunteers to assess and map the extent of cactus in areas where nests or birds were not observed during initial mapping, but we encouraged participants to visit all accessible habitat in their subregions whenever possible during the survey, to ensure that any new territories established later in the spring were detected. We encouraged volunteers to conduct surveys with at least one other partner, and we recommended that all visits be done during the morning, although this was not always possible. However, we found wrens to be active throughout the day, foraging and calling frequently (pers. obs.). Broadcast recordings were not used during the survey, since a CDFG collecting permit would have been necessary for all volunteers; instead, volunteers relied on “pishing” and visual scans of cactus habitat. We encouraged volunteers to record incidental observations of the California Gnatcatcher (*Polioptila californica*), which shares habitat with the Cactus Wren in the region, as well as sightings of potential predators such as Cooper’s Hawk (*Accipiter cooperii*). We gave clear instructions for not disturbing gnatcatchers or wrens during observations.

In our population estimate, we considered “active territories” to be sites where we found at least one adult and at least one nest of any condition or age. “Probable territories” were sites where we found either an adult but no nest, or a fresh or recent nest but no adult. “Possible territories” were sites where we found only a nest that appeared either old or of unknown age. We based our estimate of the number of territories in areas to which we could not gain access on the apparent extent of cactus as observed in aerial imagery for each subarea and on the number of territories found in similar habitat elsewhere in the region.

RESULTS

2012 Survey

Including a handful of incidental sightings, we and our volunteers detected 69 active Cactus Wren territories (adult birds and nests), 35 probable territories with adults but no nests of any kind, 7 probable territories with freshly built nests but no adults, and 6 possible territories with no adults but with at least one nest that appeared to be old or of unknown age, for a total of 117 potential territories. Of these, we considered 111 as likely active in 2012, excluding the 6 sites with no birds and only old/unknown nests. In addition to these documented sites, we estimated an additional 55 potential territories elsewhere in the county on lands that were inaccessible to our surveys, either because of exclusion from private property or because of steep terrain (Table 2). This latter number should be seen as very preliminary; we did not attempt to map habitat within these inaccessible areas but only estimated a rough number based on our findings in apparently similar (in aerial photos) habitat in the area.

Figure 1 shows the locations of adult Cactus Wrens or their nests in Ventura County found during the survey (solid circles), locations of seemingly suitable habitat in which we found no birds despite multiple visits (open

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Table 2 Active Cactus Wren Territories in Ventura County, 2012

Region and subregion	Nearest cities	Active territories (2012 survey)		
		Documented	Estimated (additional)	Total
Santa Clara River valley				
Lower	Santa Paula	0	0	0
Upper	Fillmore	0	0	0
Moorpark				
“Moorpark Grasslands” (north of state route 118)	Moorpark, Simi Valley	0	0	0
Tierra Rejada/Las Posas Hills (south of state route 118)	Moorpark, Simi Valley	15	15	30
Thousand Oaks				
Mountclef Ridge/Wildwood Park	Thousand Oaks	26	10	36
Hill Canyon/Camarillo Springs (north of S.R. 101)	Newbury Park, Camarillo	40	10	50
Oxnard Plain (including Point Mugu)				
CSU Channel Islands and vicinity (south of state route 101)	Camarillo	30	20	50
Total		111	55	166

circles), locations we failed to gain access to but that appeared suitable (question marks), and locations where birds were known historically but where we found no evidence of current occupation (x). For a variety of reasons (including private-property concerns), we intentionally do not show the exact locations of territories, or areas where we searched for additional birds, but these can be found in our original report to the California Department of Fish and Wildlife (Cooper and Hall 2012). From information provided by our volunteers as well as from incidental sightings forwarded to us, the entire population of the Cactus Wren in Ventura County appears to be restricted to a narrow band of mostly volcanic soils with strong coastal influence from the western edge of Simi Valley (near Tierra Rejada Rd.), southwest through the western edge of the city of Thousand Oaks, and southwest along the western flank of the Santa Monica Mountains to the coast near Point Mugu. The entire area does not exceed 240 km².

Cactus Wrens were found widely on both public and private lands. On the basis of available maps (COSCA 2008), of the 111 active territories, 44 were on public lands, and 22 were on lands whose ownership we could not determine but that were otherwise accessible, mainly near the campus of California State University Channel Islands. The largest concentration we confirmed on known private lands was in the Hill Canyon ranchland near the Conejo Grade north of state route 101 (west of Thousand Oaks/Newbury Park), which we had permission to survey; however, it is possible that other large concentrations exist, particularly at the southeastern edge of the Oxnard Plain and north of Thousand Oaks, where fairly extensive cactus scrub was visible on private ranchland but inaccessible to us.

On the basis of our survey, the largest aggregations of wren territories lie in three main areas. From north to south, they are

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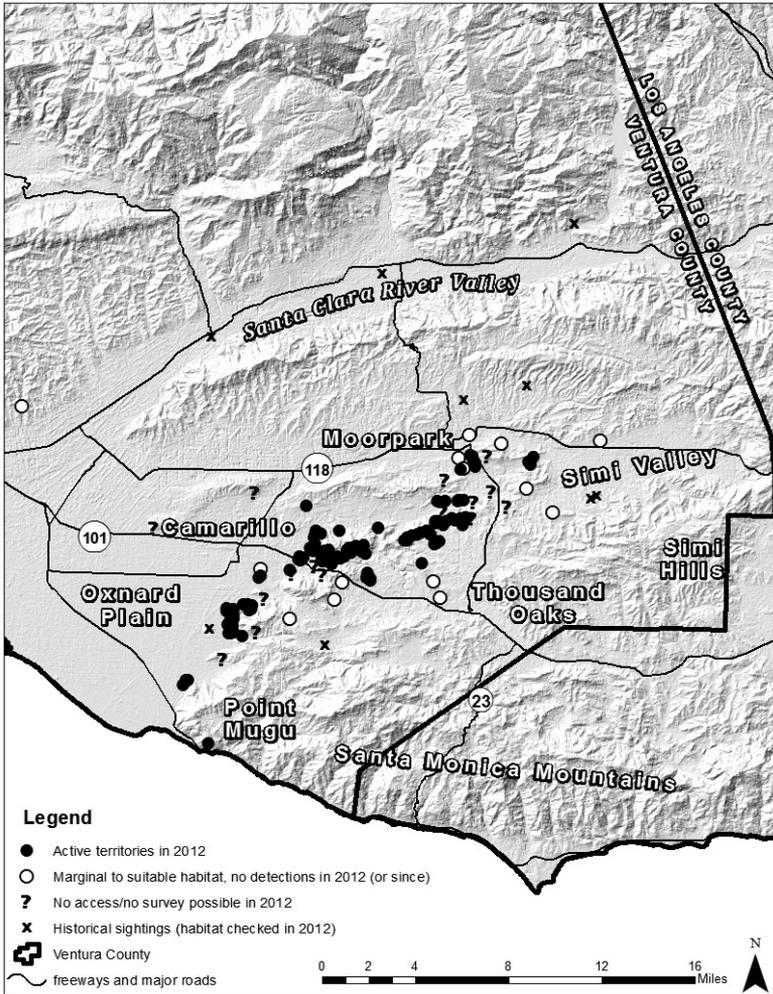


Figure 1. Current and historical range of the Cactus Wren in Ventura County.

- Mountclef Ridge/Wildwood Park on the northwestern edge of Thousand Oaks,
- The Hill Canyon area along the Conejo Grade west of Thousand Oaks/Newbury Park, and
- Near California State University Channel Islands at the edge of the Oxnard Plain southeast of Camarillo.

Countywide, all active territories were found within 5 km of these three main areas, with the exception of a small number of pairs in the eastern

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Tierra Rejada valley area at the border of Simi Valley and Moorpark and a single pair just north of Point Mugu. We should note that even these “outliers” were within 5 km of other occupied territories; they were just more distant from the three main concentrations. Additional surveys on private property between known territories (especially at the eastern edge of the Oxnard Plain and in the Moorpark area) may show that no pair is more than about 2 km from any other pair in the county.

Although a majority of territories were in extensive blocks of open space, such as in the Hill Canyon area, numerous isolated subpopulations were in habitat surrounded by agriculture (especially on the southeastern Oxnard Plain) or in undeveloped patches within residential development (especially in Thousand Oaks and Moorpark). Several of these isolated subpopulations included fewer than five pairs, and at least one (at Monte Vista Nature Park in Moorpark) apparently consisted of a single pair in about 2 hectares of open space surrounded by residential development. However, even this site was within 1 km of other pairs just to the east, at Miller Park, also in Moorpark.

Past Distribution

We located historical records of wrens from an area wider than the current known range in Ventura County—perhaps twice its current extent, if one considers the amount of alluvial scrub and other suitable habitat in the pre-agricultural Santa Clara River valley. The distribution continued to contract through the late 1900s, when the last Santa Clara River valley subpopulation was last detected; birds occurred along the Santa Clara River valley until the early 1980s, apparently isolated from subpopulations elsewhere in the county. Paul Lehman (in litt. to D. Guthrie, 1988) wrote, “we used to get one or two every year on the Sespe Christmas (Bird) Count...in an isolated hillside patch of prickly pear just east of the town of Piru on the road to Lake Piru. It was last gotten in 1981–1982.” One hundred years prior, Evermann (1886:86–87, 185), writing about the “village of Santa Paula” described the area:

“Along the river are small, isolated groves of cottonwoods and willows, with here and there an occasional sycamore. Scattered irregularly over the valley in its narrow portion are clumps of live-oaks, which are still more numerous in the cañons and on the adjacent foothills. Further up the sides of the mountains are dense growths of chaparral. At many places in the valley are large patches of prickly pear (*Opuntia tuna*), where the Cactus Wren, Mockingbird, Roadrunner, etc., are most numerous.”

Evermann (ibid.) termed the Cactus Wren “a common summer resident where cacti are abundant” in Ventura County, but by the early 1900s, it was apparently already in decline in the Santa Clara River valley. Willett (1933:126) considered it “apparently much less plentiful in that section at present time, as land has been largely cleared for agricultural purposes.” Interestingly, Willett [ibid.: “S. B. Peyton (MS)”] mentioned “at least two pairs still nesting near Sespe,” and a 1922 specimen from “Sespe” (University of Washington Burke Museum specimen 27262, also attributable to Peyton) suggests that the area mentioned by Lehman decades later may have been the same long-occupied locale noted by early ornithologists. Unfortunately, this site no longer supports any large stands of cactus, apparently because of frequent fire (D. S. Cooper, pers. obs.).

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We found no evidence (historical or recent) to suggest that Cactus Wrens ever occurred farther downstream along the Santa Clara River than Santa Paula (nor in the Ventura River drainage to the northwest). During our 2012 survey, the most promising area of habitat remaining along the Santa Clara River, cactus patches in Harmon Canyon north of Saticoy (a tributary of the Santa Clara River), were surveyed for the Cactus Wren on several days without success (D. Blankenship, CDFW, pers. comm.). Otherwise, so little cactus scrub habitat remains along the river and its tributaries that we could not locate a suitable area to include in the survey.

Another large area from which the Cactus Wren has been extirpated recently is the “Moorpark Grasslands,” a region of formerly cactus-rich coastal scrub and oak savanna at the southwestern edge of the Santa Susana Mountains between Moorpark and Simi Valley, just north of state route 118. Prior to devastating wildfires in the early 2000s that converted the scrub to annual grassland and eliminated essentially all mature cactus here, this area apparently supported a fairly large population of Cactus Wrens, with up to eight birds recorded by Mike San Miguel during surveys in November 2001 (www.ebird.org). In the western part of this area north of Moorpark, the birds occurred in Happy Camp Canyon at least through the late 1990s (www.ebird.org; D. Pereksta, Bureau of Ocean Energy Management, pers. comm.). Today, cactus patches in this area are small, isolated, and not robust (i.e., pads appear desiccated, and many patches are invaded with weeds).

Several early specimens and nest records refer to “Simi” or “Simi Valley.” Since this is such a large area, it is not possible to determine where the records might have originated. A population remains at the extreme western edge of Simi Valley, including the vicinity of Tierra Rejada Park and on the Reagan Foundation property (on opposite sides of Tierra Rejada Rd., C. Dellith, USFWS, pers. comm.; pers. obs.), and a small population of Cactus Wren was apparently resident southeast of here in the vicinity of Azure Hills Dr. on the south side of Simi Valley until about the year 2000, after which time birds were no longer seen (M. Campbell pers. comm.). Some robust cactus habitat remains here, including at least one patch strongly dominated by cholla, as well as in the Wood Ranch area to the west, although the latter has public access blocked by gated communities and could not be surveyed. However, this area is at the far eastern edge of the known range in the county, and in two visits to the Azure Hills Dr. area we found no birds and no nests in 2012, so the species is probably no longer present east of Madera Rd. in Simi Valley, which likely marks the current northeastern edge of its local range.

The southeastern edge of the range appears to lie just west of Newbury Park, but a single Cactus Wren was observed at Rancho Sierra Vista/Satwiwa, a National Park Service property within the western Santa Monica Mountains south of Newbury Park (Figure 1), in May of 1987 and 1988 (www.ebird.org, K. L. Garrett; J. Nash, in litt. to D. Guthrie, 1988). Whether it represented a vagrant, a pioneering individual, or the last remnant of a historical population is not known, but this record is as far east as we could find evidence of the species in the Santa Monica Mountains proper. The area still has patches of cactus scrub (pers. obs.), and it is possible that future visits will reveal a very small number of birds here.

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Cactus Wren Habitat in Ventura County: Vegetation and Soils

Because vegetation data were not collected uniformly (volunteers varied in ability to identify plants and to assess percent cover), and because we recorded vegetation data only at sites that had either wrens or nests, we cannot analyze the Cactus Wren's habitat selection in Ventura County at this time. However, we can assess broad trends in breeding-habitat use that add to our understanding of the needs of this species. For example, at the 101 sites for which we have some vegetation data, prickly pear was present at all, and coast cholla was noted at 42. "Type I cactus scrub" (i.e., the category of tallest, most extensive cactus) was noted at 88 sites. As for other plant species, lemonadeberry (*Rhus integrifolia*) was at 85 sites, blue elderberry (*Sambucus mexicana*) at 68 sites. Shrub species most often cited as either the first or second most dominant species (after cacti) were California buckwheat (*Eriogonum fasciculatum*), California sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), and ashy-leaf buckwheat (*E. cinereum*). While just one of the active sites found during the survey was within view of the ocean (near Point Mugu), nearly all sites were within the zone of coastal breezes coming up the canyons of Calleguas Creek and Arroyo Simi, and most, but not all, were on slopes with southern exposures.

The rocky "Conejo Volcanics" soil type that is dominant within the distribution of the Cactus Wren in Ventura County deserves comment, as it likely contributes to the presence of cactus and, therefore, the Cactus Wren. This substrate occurs throughout the western Santa Monica Mountains from near Calabasas (Los Angeles Co.) south and west to Point Mugu and thence northeast to the Moorpark-Simi Valley area via Mountclef Ridge (which terminates just south of Simi Valley, near state route 23 and Olsen Rd.) (National Park Service 2007). Inland (east) and coastward (south) of this zone of volcanic soils, the soil type shifts to the sandstones and shales found widely in the Santa Susana Mountains and Simi Hills, or the elevation increases, and both the wren and extensive cactus are absent. Elsewhere, volcanic soil is replaced by fine alluvium in several "interior coastal" valleys in the area, including the Conejo Valley, which includes much of the flatter areas of Thousand Oaks and Newbury Park. While now intensively developed, these alluvial soils would have supported oak savanna or, locally, oak woodland unsuitable for the Cactus Wren. At a slightly greater elevation (most of the Cactus Wren territories located in 2012 were below 300 m), coastal sage scrub is replaced with chaparral, and cacti become rare. Therefore, the vegetation supporting the Cactus Wren in Ventura County appears to be dependent on both soil type and elevation, and perhaps numerous other interrelated factors, such as proximity to the coast and aspect of slope.

Historically, Cactus Wrens were found in two distinct habitat types in Ventura County. In addition to cactus-dominated scrub on south-facing slopes, they inhabited alluvial sage scrub, which they use heavily where it remains in neighboring Los Angeles County (Cooper et al. 2012) and southwestern San Bernardino County (e.g., Santa Ana River wash, pers. obs.). In Ventura County, this habitat occurred along the Santa Clara River, Arroyo Simi, and in Happy Camp Canyon as well, where relict occurrences persist. However, alluvial scrub is now largely gone from the county, at least

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in areas near known Cactus Wren populations, so the species is largely dependent on a relatively narrow band of “upland” coastal scrub, underlain by Conejo Volcanics.

California Gnatcatcher

Though not a target of this survey, the California Gnatcatcher (designated as threatened by the USFWS) was detected incidentally by volunteers at 14 Cactus Wren sites, mostly in the eastern part of Mountclef Ridge near Moorpark Rd. Other observations came from near Tierra Rejada Rd. on the border of Simi Valley and Moorpark (C. Dellith, USFWS, pers. comm.), the eastern slope of the Conejo Grade west of Newbury Park, and from the vicinity of California State University Channel Islands. However, neither the species nor its preferred habitat (which often lacks cactus) was the focus of our study. On the basis of historical specimens and recent sightings (WFVZ, www.ebird.org), the distribution of the California Gnatcatcher in Ventura County appears to be virtually identical to what we now know is that of the Cactus Wren. Similarly, it is essentially absent from areas historically occupied by both species, such as the Santa Clara River valley.

DISCUSSION

Unlike that in many parts of coastal southern California (e.g., the Palos Verdes Peninsula in Los Angeles County), most of the open space in this portion of Ventura County is at least tenuously connected, even if across a busy road, to other open space. So, currently, ecological connectivity between subpopulations around Ventura County appears to be relatively good (though future development may change that). However, at a larger scale, the Ventura County population as a whole is very isolated, separated by a distance of roughly 45 km from the nearest population in Los Angeles County (at Big Tujunga Wash in the northeastern San Fernando Valley) and roughly 70 km from the nearest population with more than 10 pairs, located south along the coast on the Palos Verdes Peninsula. Little cactus scrub—almost none of it suitable for Cactus Wrens—is found in the intervening areas between the Ventura County populations and those in Los Angeles County.

As discussed by Cooper et al. (2012), prior to the 2009 census in Los Angeles County, the northern range of the coastal Cactus Wren was imperfectly known and therefore poorly represented in the published literature, often depicted as contiguous with populations in the Los Angeles Basin (Garrett and Dunn 1981). Although the population in Ventura County was likely contiguous with that in Los Angeles County along the upper Santa Clara River, this population was apparently itself isolated, both from others in Ventura County and from the nearest Los Angeles County population in the San Fernando Valley, cut off from both by the Santa Susana Mountains. In any event, the Santa Clara River population is now apparently extirpated, and so Ventura County wrens appear to be even more geographically isolated from interior birds than they were historically.

The question of how the Cactus Wren, largely a desert species, came to occur in coastal Ventura County involves several possible scenarios. While Atwood and Lerman (2007) did not detect vocal differences among coastal

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populations of the species, Barr et al. (2013), in multiple genetic analyses, found that in the genes analyzed Ventura County birds were more similar to other northerly populations from across the Los Angeles Basin into south-western San Bernardino County (including the Palos Verdes Peninsula on the coast) than they were to those in Orange County and San Diego County south. Further analysis of genetic substructures identified three distinct clusters within this northernmost population: birds in Ventura County, those in Diamond Bar/Chino Hills, and the remainder of the Los Angeles/San Bernardino County populations. Cactus Wrens could have spread coastward from the western Mojave Desert down the Santa Clara River into the Oxnard Plain, and then back northeast toward the Santa Monica Mountains and Simi Hills via the Calleguas Creek watershed, where they persist today. They could also have arrived from the San Fernando Valley, perhaps over Santa Susana Pass into Simi Valley, or along the northern base of the Santa Monica Mountains into the Conejo Valley. Or, wrens could have dispersed north along the coast from the Palos Verdes Peninsula along the southern face of the Santa Monica Mountains and northwest to Point Mugu, with extirpation over time eliminating them from the intervening areas.

Today, large areas of cactus-rich coastal scrub are limited in these intervening areas on the Ventura/Los Angeles County border (which are dominated by chaparral or are completely urbanized); however, cactus is found along the southern face of the Santa Monica Mountains, from Point Mugu east to near Arroyo Sequit just inside Los Angeles County. Although this cactus is relatively short in stature and becomes increasingly patchy east of Arroyo Sequit, it may still allow for occasional dispersal of wrens. However, despite regular coverage of this area by birders for decades (including Big Sycamore Canyon and Leo Carrillo State Park), the Cactus Wren has never been confirmed (e.g., by photograph or voice recording) along this stretch of coast (*vide* K. L. Garrett), nor east of here into Malibu (Cooper et al. 2012).

With a few exceptions, such as on the immediate coast east of Pt. Mugu where cactus, but not the Cactus Wren, is present, the wren's distribution in Ventura County closely tracks the distribution of the largest patches of mature cactus within large, unfragmented blocks of open space. Although we did not compare the sizes of patches of cactus with and without wrens quantitatively, we encountered very few occupied sites in patches located in smaller areas of open space (<5 ha) that were entirely surrounded by development or that were farther than about 1 km from another active territory, a pattern similar to that seen elsewhere in the region (e.g., Cooper et al. 2012). However, we did note that patches of cactus in habitat fragments were often occupied by wrens if close enough to the main population clusters (e.g., in the Wildwood Park, Hill Canyon, and adjacent areas). Away from these areas, the Cactus Wren apparently reaches both a natural distributional limit, with tall cactus scrub becoming scarce at higher elevations and with greater distance from coastal breezes, as well as an anthropogenic limit implying that wrens are unable to persist in small fragments of habitat isolated by development. Where these two factors coincided, such as at isolated interior sites (as in the north Moorpark area), Cactus Wrens were predictably absent.

The Cactus Wren faces a variety of threats in Ventura County. Development, including wholesale clearing of cactus-rich scrub for agricultural,

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residential, and commercial use, continues each year, even despite downturns in the economy. Aggressive clearing for fire control is also a potential threat; we noted occupied Cactus Wren habitat near several areas where all vegetation had been cleared (to dirt) along “fuel modification zones” around development and below power lines. In contrast to Los Angeles County and most of Orange County, in Ventura County agriculture is adjacent to many occupied Cactus Wren territories, and we observed numerous examples in Ventura County where a hillside might support robust, native cactus scrub and wrens on one side, and a hard line where an orchard began and extended across the remainder of the slope.

Even if cactus patches are maintained and preserved, the deleterious effects on the Cactus Wren of both isolation and proximity to the urban edge are likely to increase if development continues without providing corridors of open space with suitable habitat between these patches (Preston and Kamada 2012). Encouragingly, we noted several cases where birds were maintaining adjacent territories split by fairly busy roads (e.g., along Moorpark Road south of Tierra Rejada Rd.) or adjacent to yards and houses (as near Wildwood Canyon Park). But we also noted fairly large patches of cactus scrub that appeared to be too far from the main concentration of territories to support the wrens (as near Azure Hills Dr. on the southwestern edge of Simi Valley). Thus conservation of habitat patches would probably be most effective near existing large populations of birds, as south of Moorpark and to the north and west of Thousand Oaks.

Notably, we found that a single entity, the Conejo Open Space Conservation Authority (COSCA), manages nearly 40% of the known Cactus Wren territories in Ventura County, mainly near Thousand Oaks (44 active territories in 2012). This proportion would have been somewhat lower had we been able to access private lands, but it still is a remarkable number, and there is no other similar public entity with anything close to that degree of representation in the county. It is likely that a similar proportion of California Gnatcatcher territories also lie on COSCA lands.

Several potential improvements to our survey, and to future surveys, involve the management and training of volunteers. We recommend that similar volunteer-based projects not require volunteers to map cactus patches, but that such mapping be completed in advance where possible, as it proved beyond the ability of most of our volunteers (and so was never completed). And, we recommend that volunteers use a checklist of conspicuous indicator species of plants, rather than trying to identify the dominant scrub species and their relative cover, since plant identification was not a skill of many volunteers. This problem particularly affected sites lacking easy access and having to be observed from a long distance away, through binoculars. Thus the utility of the data on vegetation structure and composition is limited. Ultimately, we concluded that too much of the volunteers’ time was devoted to locating both promising habitat and determining access points (which could also have been done in advance), and this detracted from the total time spent actually surveying and mapping locations of birds and nests. Thus our plan of having each volunteer commit to three survey days stretched into many more days for several participants, since so much time was spent navigating various neighborhoods and open spaces. Finally, we would not recommend

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that observers survey in groups, but rather in pairs, or even individually if their skill level is sufficient; it became difficult to coordinate multiple persons' schedules. These "lessons learned" could be incorporated into guidelines for future surveys, particularly those relying heavily on volunteers.

As ours was the first attempt to map the range of the Cactus Wren in Ventura County, the dearth of information on such variables as nesting success or dispersal should not detract from the value of a baseline distributional map, which will allow for future calculations of population fluctuation. Our finding that around 40% of the known territories are reasonably secure on protected open space (mainly COSCA lands), and agencies charged with recommending and enforcing mitigation for development being more aware of the wren's conservation needs than they were just a decade ago, should help conserve this important population. However, there is no legal prohibition against a landowner's removing habitat suitable for the Cactus Wren (or any protected species) on his or her private land in Ventura County, and cactus scrub continues to be lost away from parkland, potentially affecting more than half the known territories. So, while a Ventura County population of the Cactus Wren could persist for many years, its boundaries could continue to contract as pockets of habitat and their birds are lost in this piecemeal fashion. How small an isolated population can become and remain viable remains an open question; that in Big Tujunga Wash in Los Angeles County was down to just seven pairs in 2009, and that in the Baldwin Hills, never more than around 5–10 pairs, vanished, apparently permanently, by the mid-1990s (Cooper et al. 2012).

Fire presents another, probably more immediate threat; Preston and Kamada (2012) documented declines of >80% in reserves in south Orange County after major wildfires in the past 20 years. On the morning of 2 May 2013 (after the end of our survey), the devastating Springs Fire burned more than 9700 hectares at the far southwestern edge of the Santa Monica Mountains, including most of the Cactus Wren habitat south of state route 101 (http://cdfdata.fire.ca.gov/incidents/incidents_details_info?incident_id=780). An estimated 24 territories were affected, or 22% of the known population in Ventura County (per K. Miner, CDFW). We hope to investigate the actual effect of this fire and to assess the Cactus Wren's recovery within the area burned.

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