

# California Partners in Flight Coastal Shrub and Chaparral Bird Conservation Plan



Coastal Cactus Wren (*Campylorhynchus brunneicapillus*)



Photo by James Gallagher, Sea and Sage Audubon

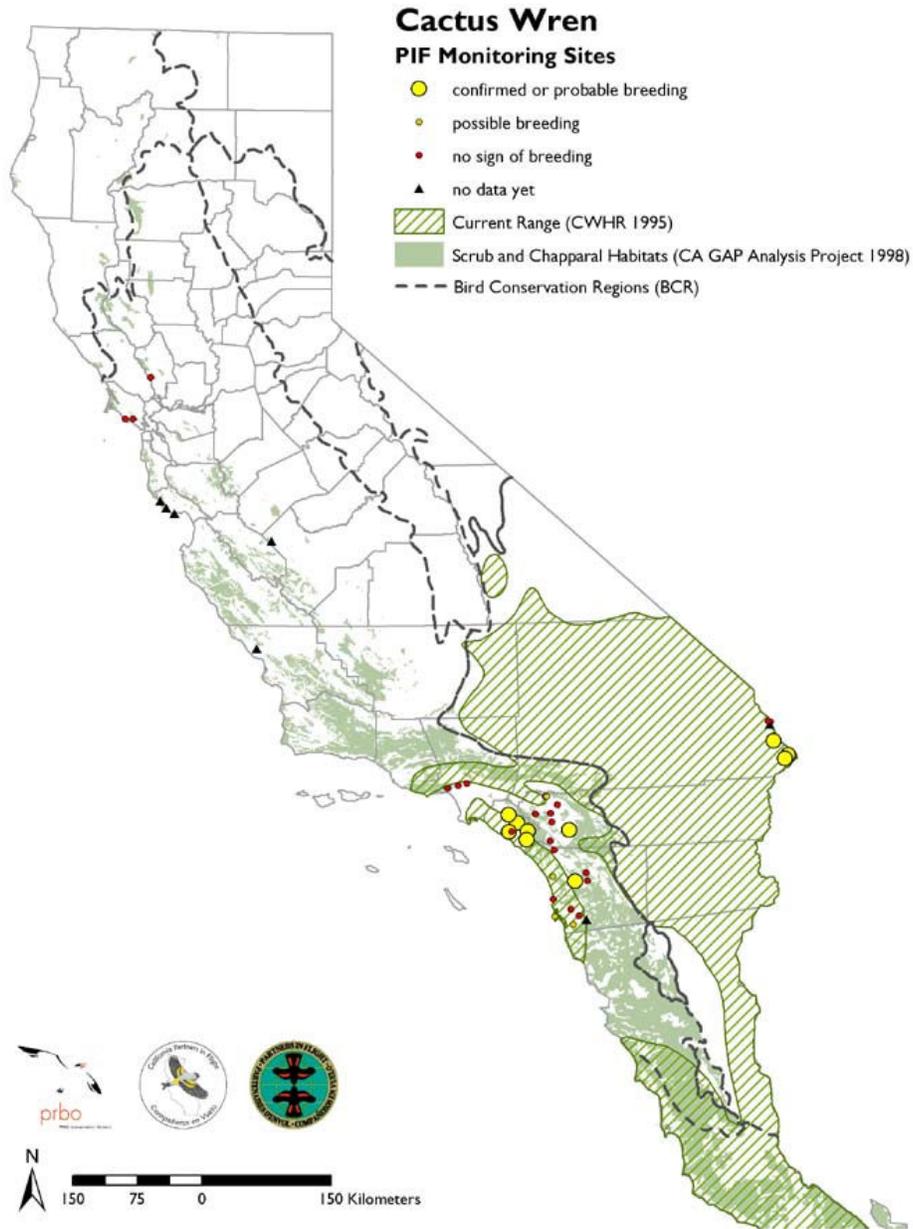
Prepared by: **Christopher W. Solek** (csolek@nature.berkeley.edu)  
University of California, Berkeley  
Berkeley, CA 94720

**Dr. Laszlo J. Szijj** (ljszjij@csupomona.edu)  
Biological Sciences Department  
California State Polytechnic University, Pomona

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**Range Map:**



## **ACTION PLAN SUMMARY**

**Species:** Coastal Cactus Wren (*Campylorhynchus brunneicapillus*)

**Status:** A coastal population from San Diego County was nominated for subspecies status as *C. b. sandiegensis* in 1990 and subsequently proposed for Federal Threatened status in 1991. Since this subspecies designation was not recognized by the American Ornithologists' Union Committee on Classification and Nomenclature, the San Diego population was declined for Federal Threatened listing by the U.S. Fish and Wildlife Service in 1994.

**Habitat Needs:** Coastal sage scrub with patches of tall *Opuntia* cacti for nesting and breeding. This coastal population appears to nest almost exclusively in *Opuntia* cacti of at least 1 m in height. Protection of habitat areas with this vegetation type and structure should be a high priority.

**Concerns:** Habitat loss, degradation, and fragmentation are the most critical management issues facing this species. Although the species appears capable of sustaining breeding populations in small, fragmented areas containing suitable habitat, isolation of coastal populations due to urban fragmentation may be promoting loss of genetic variation within these smaller populations and compromise long-term metapopulation viability. Lack of demographic data on the species in California, accompanied by large-scale habitat destruction, will make it difficult to identify threatened populations and implement management plans in a timely manner.

**Objectives:** Protection of the remaining coastal sage scrub habitat in California is crucial for preservation of coastal populations of the Cactus Wren. Necessary actions should be taken to improve habitat protection and conservation efforts on a county-wide and regional scale. Long-term demographic and behavioral studies of this species in California are needed and should be encouraged through research by federal, state, and academic institutions.

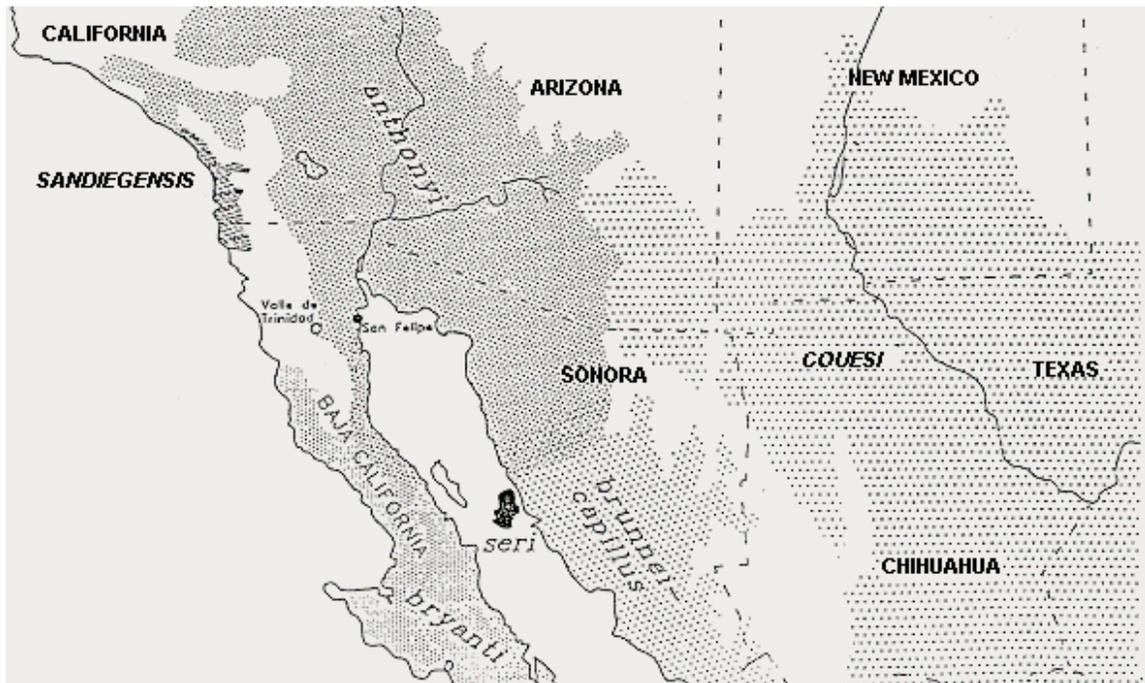
### **Actions:**

1. Identify all localities with breeding populations by initiating population surveys by county, with particular emphasis on counties where population status is unclear (e.g. Ventura County).
2. Increase the number of protected areas of coastal sage scrub habitat with populations of Cactus Wrens through land acquisitions on a state and local level. Create habitat buffers around existing protected areas, if feasible.
3. Promote scientific studies of reproductive success, survivorship, and dispersal capacity in the species. Identify on-going research on coastal Cactus Wren ecology, improve communication among the principal investigators, and coordinate research efforts whenever possible.

4. Explore the efficacy of habitat restoration and promote sound urban habitat conservation practices (e.g., discourage cactus removal by homeowners at the urban/rural interface and modify current city/county weed abatement and fire suppression programs to limit the unnecessary destruction of cactus and coastal sage scrub habitats).

### SUBSPECIES STATUS

Taxonomic affiliation of the populations in California have been under debate (Bancroft 1923, Rea and Weaver 1990). Both a coastal and interior population exist in the state, historically connected through the San Geronio Pass in Riverside County. (Rea and Weaver 1990). The coastal population is unique in that it occurs exclusively within the coastal sage scrub plant community. The Checklist of North American Birds (American Ornithologists' Union 1998) currently recognizes all California populations of the cactus wren as *Campylorhynchus brunneicapillus couesi*, inclusive of both the coastal and interior segments. Rea and Weaver (1990) proposed an alternative subspecies distribution (Figure 1).



**Figure 1.** Rea and Weaver's (1990) proposed distribution of the subspecies of the Cactus Wren in the southwestern U.S. and northern Mexico.

A portion of the coastal population, inhabiting southern Orange County, coastal San Diego County, and extreme northwestern Baja California, was proposed for subspecies status in 1986, and described as *C.b. sandiegensis* (Rea 1986). This designation was not accepted by the American Ornithologists' Union Committee on Classification and Nomenclature. It was concluded that *C.b. sandiegensis* represents an intermediate form between *C.b. couesi* and *C.b. bryanti*, a recognized subspecies found from San Diego County to northern Baja California, Mexico (Department of the Interior 1994). The range of *C.b. couesi* is separated from that of *C. b. bryanti* by about 150 miles (Bancroft 1923).

## **MANAGEMENT STATUS**

The coastal cactus wren is presently listed as a California State Species of Special Concern [as of 2008, only *C. b. sandiegensis* has this status] and Cleveland National Forest Federal Sensitive (Dudek and Assoc. 2000). In 1993, it was selected as one of three target species in California's Natural Communities Conservation Planning Program (NCCP) and a surrogate for conservation of coastal sage scrub habitat.

In September 1990, the U.S. Fish and Wildlife Service (USFWS) was petitioned to recognize the San Diego cactus wren (*C. b. sandiegensis*), as an endangered subspecies pursuant to the Federal Endangered Species Act of 1973. In March 1991, the U.S. Fish and Wildlife Service announced the initiation of a status review for the Coastal Cactus Wren. Based on the findings of the AOU Committee on Classification and Nomenclature, it was decided that the coastal population of the Cactus Wren be transferred from Category 2 to category 3B, which includes taxa that do not meet the definition of distinct species under the Endangered Species Act (Department of Interior 1994).

## **DISTRIBUTION**

### **HISTORICAL DISTRIBUTION REFERENCES:**

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### **CURRENT BREEDING DISTRIBUTION:**

Breeding populations of the coastal Cactus Wren have been reported from the following counties in California: Ventura ([Appendix 1](#)), Los Angeles ([Appendix 2](#)), Orange ([Appendix 3](#)), San Bernardino ([Appendix 4](#)), Riverside ([Appendix 5](#)), and San Diego ([Appendix 6](#)). Orange County contains the majority of the coastal population (Harper and Salata 1991).

While not addressed in this report, interior (or non-coastal) populations can be found in desert portions of Los Angeles, Riverside, San Bernardino, as well as most of Imperial, and portions of Kern and Inyo Counties. Cactus Wrens are most abundant in these interior, desert regions of the state.

Coastal populations of the Cactus Wren occur from southern Ventura county, southeast to the Baldwin Hills and the Palos Verdes Peninsula in Los Angeles County, and east along the southern flank of the San Gabriel and San Bernardino mountains from the northern San Fernando Valley in Los Angeles County to Mentone in San Bernardino County. Populations also extend south along the coastal slopes and interior valleys west of the Peninsular ranges in western Riverside, Orange, and San Diego counties to extreme northwestern Baja California, Mexico, in the vicinity of Tijuana and Valle de las Palmas (Harper and Salata 1991).

BBS surveys have shown that smaller numbers extend onto the coastal slope in the uppermost Santa Clara River drainage, in the vicinity of Acton and Agua Dulce. Populations are also reported from the San Fernando Valley (Big Tujunga Wash, Los Angeles County) and the Camarillo/Moorpark area of Ventura County (Garrett, pers.com.). A nearly continuous population occurs along the western flank of the Santa Monica Mountains from Point Mugu north to the Camarillo Grade and east to Newbury Park (Garret 1991). Most populations in Ventura County are found within the Calleguas Creek watershed (Wehtje, pers, comm). Intensive surveys have been conducted in southern Orange and San Diego counties (Rea and Weaver1990, Tutton et al 1991, Ogden Environmental and Energy Services 1992, Jones and Stokes 1993).

**WINTER DISTRIBUTION:** There appears to be some northward expansion in distribution for this species during the winter months (Fig. 4 – *note: figure missing from original report*). This is most likely related to limited winter dispersal to alternate foraging locations. Wintering ground requirements are assumed to be similar to breeding ground needs.

## **ECOLOGY**

**AVERAGE TERRITORY SIZE:** Anderson and Anderson (1973) found territories of Arizona populations *C. brunneicapillus* ranging from 1.2 to 2.8 ha, with an average of 1.9 ha. Rea (1990) described territory sizes in San Diego County, California, ranging from 0.8 to 2 ha, with an average of 1.3 ha. Steinitz et al. (1997) found territories on Camp Pendleton, California ranging from 0.5-2 ha. [*Editorial note from R. A. Hamilton: this last cited reference is of questionable value; the basis for the stated range of territory sizes is not indicated, but it is clear that the report's authors did not conduct field work to determine Cactus Wren territory sizes at Camp Pendleton.*]

**TIME AND OCCURENCE OF SEASONAL MOVEMENTS:** *C. brunneicapillus* is resident throughout its range in California and does not migrate or make long distance seasonal movements.

## **FOOD HABITS**

**FORAGING STRATEGY:** The Cactus Wren is described as a shrubby skulker, foraging primarily on the ground or low in the vegetation for insects. Open ground is ignored during periods of greatest heat stress, with the species preferring to forage on shady ground or in the lower branches of midstory vegetation at these times (Ricklefs and Hainsworth 1968). Foraging techniques appear to vary seasonally (Miles 1990).

**DIET:** The diet of the Cactus Wren consists primarily of insects year-round. Bent (1948) summarized food habit data for Cactus Wrens taken from southern California during July through January and found that 83 % of all stomach samples (n = 41) consisted of animal matter: 27% beetles, 27% Hymenoptera (wasps, bees, and ants), 15% grasshoppers, 5% Hemiptera (bugs), 5% Lepidoptera (caterpillars) and 3% spiders. Vegetable matter made up 17% of all stomach contents and consisted of fruitpulp (13%) from cactus (*Opuntia sp.*), elderberry (*Sambucus sp.*) and cascara (*Rhamnus sp.*) and seeds (4 %) from sumac (*Rhus sp.*), filaree (*Erodium sp.*) and fiddleneck (*Amsinckia sp.*). Plant matter may become more important during the cooler months when some animal items are unavailable.

Anderson and Anderson (1973) found that animal matter comprised 96.3% of Cactus Wren gizzard contents (n=12) collected from March through October in Arizona and 90.1% of all gizzards (n=5) from November through February.

**DRINKING:** No data exists on free water consumption in California populations, but the species presumably obtains the majority of its water from its diet. Anderson and Anderson (1973) report that adult Cactus Wrens in Arizona infrequently drink free water in July and August, although immature birds were observed drinking water in August. Adults begin to drink free water in September, and the rate of consumption apparently increases to high levels in December and January. Ricklefs and Hainsworth (1968) stated that the Cactus Wren relies exclusively on water obtained from its food during the period of greatest heat stress.

**BREEDING HABITAT:** Coastal populations of the Cactus Wren are obligate inhabitants of coastal sage scrub, a natural vegetation community of low, semi-woody vegetation found only in coastal and near-coastal portions of the state, generally below 3000 ft.. While some coastal birds have been observed using riparian woodland areas below 2000 ft., it is unlikely that this habitat type is used for nesting (Gallager 1997).

**Table 1. Mean Abundance of Cactus Wrens by California Physiographic Region (Sauer et al 1997)**

<b>Physiographic Region</b>	<b>Mean Abundance</b>
California Foothills	0.2
So. Cal. Grasslands	5.4
Sonoran Desert	8.1
Mojave Desert	8.0
Great Basin Desert	0.3

Areas supporting Coastal Sage Scrub are dry, generally receiving 14 inches of rainfall annually, concentrated in the spring months (Guthrie 1974). Plant species diversity is relatively high, and includes such shrub species as Buckwheat, *Eriogonum fasciculatum*; California Sagebrush, *Artemisia californica*; White Sage, *Salvia apiana*; and Black Sage, *Salvia mellifera*. Prickly Pear and Cholla Cacti, *Opuntia spp.* are dominant components of this vegetation type in certain regions of the state. Characteristic trees and tree-like shrubs can include California Black Walnut, *Juglans californica*, Elderberry, *Sambucus mexicana*, Laurel Sumac, *Malosma laurina*, and Lemonade Berry, *Rhus integrifolia*.

**NEST SUBSTRATE:** Coastal Cactus Wrens nest almost exclusively in prickly pear (*Opuntia littoralis* and *O. oricola*) and coastal cholla (*O. prolifer*). Coastal cholla is the typical choice in southern San Diego County, where large prickly pears are scarce (Rea and Weaver 1990). Two reports of nests found in yellow bush penstemon (*Keckiella antirrhinoides*) exist from San Diego County (Rea and Weaver 1990).

**HEIGHT OF NEST:** Averaging 1 m (3 ft.) above ground level.

**HEIGHT OF PLANT:** Averaging 1.2-1.5 m ( 4-5 ft).

**NEST CONCEALMENT:** Nests are placed in relatively conspicuous, unconcealed locations, but are afforded protection by being built within *Opuntia* cacti patches and are therefore difficult to approach and access.

### **VEGETATION SURROUNDING THE NEST**

**CANOPY COVER:** Nests are built in relatively open, *Opuntia* scrub areas with little or no canopy cover. While this factor does not appear to directly affect selection of nesting sites, some reports suggest that numerous large shrubs (> 2 m) reduce the desirability of the habitat for this species (Wheeler 1997).

**DOMINANT PLANT SPECIES IN CANOPY:** When a taller canopy vegetation is present in coastal sage scrub habitats, California black walnut (*Juglans californica*), and elderberry

(*Sambucus mexicana*) are the dominant species. Coast live oaks (*Quercus agrifolia*) and California sycamore (*Platanus racemosa*) may also occur in the vicinity of nests.

**AVERAGE SHRUB COVER:** Shrubs and shrub-like vegetation, such as cacti, are the dominant component of the Cactus Wren's habitat. Wheeler (1997) found *O. littoralis* cover ranging from 27.3 % to 63.1 % (mean = 40.1 %) at four different sites in Los Angeles County supporting a population of cactus wrens. Shrub cover is important in providing shade and cooler microhabitats, which cactus wrens use when temperatures within desert habitats are high (Ricklefs and Hainsworth 1968a).

**DOMINANT SHRUB SPECIES:** California buckwheat, *Eriogonum fasciculatum*, California sagebrush, *Artemisia californica*, prickly pear and coastal cholla *Opuntia sp.*; California encelia, *Encelia californica*.

**AVERAGE FORB COVER:** Herbaceous annuals during the spring and early summer comprise the dominant forb cover around Cactus Wren nests. Unlike the chaparral plant community, coastal sage scrub contains a persistent herbaceous understory that remains an important part of the total cover (greater than 20 %) for twenty years or more following fire (DeSimone 1995). Wheeler (1997) found that herbaceous annuals comprised from 6.9 % to 39.8 % of the forb cover at four different sites.

**DOMINANT FORB SPECIES:** *Mimulus sp.*, herbaceous annuals

**GROUND COVER:** Dead vegetation and bare ground/rock are the predominant ground cover around Cactus Wren nests. Wheeler (1997) found dead vegetation to cover from 1.8 % to 9.6 % and bare earth and rocks to cover from 1.2 % to 12.2 % of the surface at four different sites.

**SLOPE:** Nests have been observed on slopes ranging from zero to 45 degrees. Rea and Weaver (1990) found territories corresponding to the down slope flow of narrow draws in San Diego County.

**ASPECT:** The most favorable nest locations appear to be on southern or southwesterly facing slopes where *Opuntia* cacti are most dominant. (Rea and Weaver 1990, C. Solek, pers. obs.) .

**SNAGS:** Individuals have been observed using snags, fence posts and fence lines for calling and display.

**NEST TYPE:** The nest is a bulky, domed structure, constructed of grasses, twigs, leaves, and other plant fibers. It contains a tube-like entrance that can be up to 15 cm (6 in.) long. The inside of the nest is lined with feathers and down from cactus wrens and other bird species. Nests are constructed year-round and used for both roosting and nesting. A single bird can build multiple nests. Cactus Wrens often orient the entrance of the nest to take advantage of convective ventilation provided by prevailing winds (Austin 1974, Facemire et al 1990).

## **BREEDING BIOLOGY**

Monogamous and reported to mate for life (Anderson and Anderson 1973). Cactus Wrens can occur in family groups from late spring through winter, but the juveniles are driven off by the adults as the breeding season approaches (Weathers 1983). Some instances of nest helping, with juveniles from a first brood assisting with the care of a second brood, have been reported (Skutch 1935, Anderson and Anderson 1973).

**DISPLAYS:** Coordinated breeding displays include tail fanning and wing lifting by both the male and female. Vocalizations can include a simple, non-ritualized duet between the sexes (Freeman 1994).

**CLUTCH SIZE:** 3-5 eggs

**INCUBATING SEX:** Female

**INCUBATION PERIOD:** 16 days

**DEVELOPMENT AT HATCHING:** The altricial, nidicolous nestlings are totally dependent on the adults for the first three weeks of life. Nestlings eyes open at 6- 8 days. Feathers begin to break sheaths at approximately 8 days. Fledgings attain adult weight by approximately 38 days, and are fully independent at approximately 30-50 days after hatching (Harrison 1978, Anderson and Anderson 1973).

**NESTLING PERIOD:** 19-23 days

**PARENTAL CARE:** Both sexes tend the young.

**NUMBER OF BROODS:** One, possibly two, per season in coastal California . Anderson and Anderson (1973) found some Arizona populations producing up to three broods in one season.

**BROOD PARASITISM:** None reported. Anderson and Anderson (1973) observed Curved-bill Thrashers (*Toxostoma curvirostre*) destroying Cactus Wren roosting nests, but never breeding nests, in Arizona. No evidence of this activity with California Thrashers (*Toxostoma redivivum*) exists from coastal California.

## **LANDSCAPE FEATURES**

**ELEVATION:** Coastal populations typically inhabit areas from 0 - 150 m. There are some reports of coastal birds sighted at 400 - 450 m. (Rea and Weaver 1990).

**FRAGMENTATION:** This is a concern for the coastal populations of *C. brunneicapillus* in California, but empirical data on the effects of this fragmentation are limited. Most coastal populations are now isolated due to urbanization of the region and persist in highly fragmented habitats. Isolated populations of birds in coastal sage scrub have been

shown to have high rates of extinction (Soule et al. 1988), and Cactus Wrens may have difficulty in crossing urbanized areas to re-populate remnant parcels of suitable habitat. Population viability analyses suggest that the small size of these subpopulations coupled with habitat fragmentation may constrain the long-term viability of the metapopulation (Ogden Environmental and Energy Services 1992). Geographic isolation of coastal and interior populations has also been enhanced by urbanization, and may be facilitating genetic differentiation among these segments of the population (Rea and Weaver 1990, Eggert 1996).

**DISTURBANCE** (natural or managed): Disturbance from habitat loss and degradation is due primarily to suburban housing developments and the accompanying loss of the coastal sage scrub plant community in coastal southern California. Fire (both of natural and anthropogenic origins) is also a concern. Bontrager et al. (1995) found that Cactus Wrens may have difficulty recolonizing burned areas of coastal sage scrub, since the species requires cactus of at least 1 meter tall and cactus recovery after a fire can be slow. Benson (1969) considered fire to be the chief limiting factor in the distribution of native cactus in southern California, a fact that would obviously affect the distribution of coastal populations in the region. Incidental fires related to military activities have also contributed to habitat destruction, especially in and around Camp Pendleton Marine Corps Base, San Diego County (Rea and Weaver 1990, Harper and Salata 1991). Degradation of Cactus Wren habitat due to city/county weed abatement projects, legal and illegal grading/clearing activities, and recreational activities has been documented (Harper and Salata 1991).

**ADJACENT LAND USE:** Suburban development, agriculture and grazing

**SENSITIVITY TO HUMAN-INDUCED DISTURBANCE:** Nesting can occur close to roads and human habitations as long as the requisite vegetation for nesting and foraging exists (Solek, pers. obs., Eggert 1996, Wheeler 1997). Nests can be inspected and nestlings handled without abandonment by adults. Destruction of coastal sage scrub tends to eliminate the Cactus Wren from an area, with most populations unable to adapt to most suburban conditions (Guthrie 1974).

**PESTICIDE USE:** No information. Populations of this species can occur in close proximity to agricultural and suburban areas. Permissive use of industrial and residential pesticides may negatively impact populations by reducing the native insect fauna on which the cactus wren feeds.

**PREDATORS:** Cooper's Hawk (*Accipiter cooperii*), American Kestrel (*Falco sparverius*), Greater Roadrunner (*Geococcyx californianus*), snakes, woodrats. Aggressive interactions with Western Scrub Jays (*Aphelocoma coerulescens*) and Northern Mockingbirds (*Mimus polyglottus*) have been observed.

**EXOTIC SPECIES INVASION/ENCROACHMENT:** Feral cats, rats.

## **DEMOGRAPHY AND POPULATION TRENDS**

**AGE AND SEX RATIOS:** No information; sexes are monomorphic, so intensive behavioral observations and mist netting programs during the breeding season are necessary to determine both age and sex ratios for any population. Mist netting as a means to establish age and sex ratio ratios has the potential to bias any estimates, as juvenile cactus wrens are caught more frequently than adult birds, and territorial males more frequently than females (Solek, pers. obs.).

**PRODUCTIVITY MEASURE(S):** Atwood (1998) found that the mean number of fledglings produced per pair per year (1993-1997) ranged from 3.0 to 3.63 on the Palos Verdes Peninsula, but a small sample size precluded any statistical analysis of year to year variation. Anderson and Anderson (1973) determined a coefficient of variation of annual productivity at 26.5 percent (mean= 4.3 fledglings per pair). Nest counts alone are not a reliable indicator of population, as individuals tend to build multiple nests (Rea 1990, Solek, pers. obs.).

### **SURVIVORSHIP:**

*Nestling-* Ricklefs (1968) calculated nestling survival rate at 99.35 percent per day (n = 49 nests). Anderson and Anderson (1973) found an overall nestling survival rate of 99.03 percent per day (n = 55).

*Juvenile-* Atwood (1998) found that survivorship of juveniles ranged from 9.1 percent (n = 44 initially banded) to 75 percent (n = 12), with a mean survivorship of 32 percent from 1992-1997. Ricklefs (1968) reported a daily juvenile survival rate between 99.33 and 99.40 percent (n = 39), and concluded that survival rates for juveniles are comparable to those of nestlings and that the period of life following fledging does not represent a time of maximum mortality. Anderson and Anderson (1973) reported juvenile survival to be about 50 percent after one month of age and less than 15 percent beyond two months of age (n = 55). Simons and Martin (1990) reported juvenile survival rates after four to six weeks to be 48.5 percent (n = 33) and 20.5 percent (n = 34) during two different years.

*Adult-* Atwood (1998) found that adult survivorship ranged from 57.4 percent to 73.7 percent for the coastal population on the Palos Verdes Peninsula (1992-1997). It should be mentioned that these values are based on extrapolation of survivorship from subsequent sightings, which may produce a bias toward higher survivorship estimates. Anderson and Anderson (1973) reported an overall survival rate of 50.6 percent over a six-year period. The coefficient of variation in annual adult survival rate was 42.7 percent over a four years, with a mean survival rate of 52.8 percent per year. Less than 11 percent (n = 74 ) of this banded population survived to breed more than three seasons.

**DISPERSAL:** Information on the dispersal capacity of coastal Cactus Wrens is very limited. Short-distance dispersal to alternate foraging grounds may occur during the winter months, but adult birds are highly sedentary and tend to return to same breeding territory each year. The dispersal capacity of coastal Cactus Wrens may be sufficient to

allow for a moderate (e.g. about 1 %) migration rate between adjacent populations (Ogden Environmental and Energy Services 1992).

Movements of 10 km or greater probably occur very infrequently (Atwood, pers. com.). Atwood (1998) found the mean dispersal distance of juvenile Cactus Wrens from their natal territory was 1.59 km. (s.d. = 2.28, n = 71) on the Palos Verdes Peninsula, though it should be noted that this is now an extremely isolated population with limited dispersal options to alternate foraging/breeding sites. Data based on Arizona populations suggest that juvenile female Cactus Wrens disperse farther away from their natal territories than juvenile males (Anderson and Anderson 1973).

### **POPULATION TREND**

No definitive trends are evident from Breeding Bird Survey results (based on population counts throughout the species' range in North America), but coastal populations have been severely impacted by development throughout southern California (Ogden Environmental and Energy Services 1992, Garrett 1991, Wehtje, pers. comm.). The decline of the coastal segment of the Cactus Wren population in the region is indicative of the significant loss of the coastal sage scrub plant community. Based on information from historical accounts, the species has been extirpated from several locations where it previously bred (Dawson 1923, Willet 1933, Grinnell and Miller 1944). Dramatic declines have been documented in San Diego and Orange counties (Rea and Weaver 1990). Several of these populations described by Rea and Weaver have been extirpated since the study was conducted (Eggert 1996). The population in the Baldwin Hills, Los Angeles County, is declining and may be extirpated (Garret pers. com). Ventura County populations have been severely impacted by development (Wehtje, pers. comm.).

### **MANAGEMENT ISSUES**

Loss and degradation of coastal sage scrub are the immediate management issues affecting coastal populations of *C. brunneicapillus* in southern California. The loss of this plant community in the region has been substantial, with estimates ranging from a sixty-six to ninety percent loss due to development and agricultural displacement (O'Leary 1995). The absence of regulatory mechanisms, either at the local, county, state, or federal level, adequate to protect the coastal Cactus Wren and its habitat, may be the most significant factor responsible for the current situation facing the species (Harper and Salata 1991).

Habitat fragmentation is also a concern. The interior, desert population was historically connected to the coastal population through the San Gorgonio Pass in Riverside County, but now the ranges of these two populations appear to be geographically disjunct as a result of continuing urbanization of the corridor (Rea and Weaver 1990). Fragmentation of coastal habitat may also be facilitating genetic divergence of the now isolated coastal populations (Eggert 1996). Small population size coupled with fragmentation may compromise long-term viability of species by increasing genetic homozygosity and lowering species fitness (Ogden Environmental and Energy Services 1992).

Eggert (1996) suggested that a management plan for the species recognize the fact that certain populations of coastal birds are genetically distinct from the populations in Mexico, as well as those of the California desert. Translocations of individuals between sites should be considered only if suitable habitat does not contain a resident cactus wren population. Combining birds from genetically distinct populations could result in outbreeding depression.

Habitat restoration may be a management option in some cases. Further studies are needed to determine if enhancing and/or improving degraded habitat (e.g. translocation of mature *Opuntia* cacti to appropriate areas) would benefit the species. At this point in time, protection of the remaining coastal sage scrub habitat appears to be the most efficient and viable strategy for species management.

### **ASSOCIATED SPECIES**

California Gnatcatcher (*Poliophtila californica californica*), Costa's Hummingbird (*Calypte costae*), Bewick's Wren (*Troglodytes bewickii*), California Thrasher (*Toxostoma redivivum*); **Non-avian species:** Orange-throated whiptail lizard (*Cnemidophorus hyperythrus*), Stephen's kangaroo rat (*Dipodomys stephensi*).

### **MONITORING METHODS AND RESEARCH NEEDS**

It is clear that intensive demographic and life history studies, focusing on reproductive success, survivorship, and dispersal capacity of this species are needed. The considerable difficulty associated with field studies of the Cactus Wren makes this type of data difficult and labor intensive to gather.

Surveys and/or annual monitoring of the various populations throughout southern California are needed. This would allow for identification of threatened breeding populations and habitat areas. This is especially urgent for the counties where populations have been least studied and are most susceptible to large-scale habitat loss.

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**Appendix 1.** Coastal Cactus Wren Distribution-Ventura County, CA

Locality	Site	Source	Year	Method
Camarillo	Round Mtn.-near CSU Channel Islands	W. Wehjte	1999	1
Camarillo	vicinity of Pt. Mugu	Garret*	1991	1
Camarillo/Oxnard Plain	W. Potrero Road (north side)	W. Wehjte	1999	1
Moorpark (west)	Balcolm Canyon Road (Unocal property)	W. Wehjte	1999	1
Newbury Park	Conejo Grade (north of Hwy. 101)	W. Wehjte	1999	1
Santa Rosa Valley	south of 118 Fwy/west of Hwy 23	W. Wehjte	1999	1
Simi Valley	Alamos Canyon Road	W. Wehjte	1999	1
Simi Valley	Tijerra Rejada Rd. (north side)	W. Wehjte	1999	1
Thousand Oaks	west of California Lutheran Church	M. Long*	1991	1

\* Harper and Salata (1991); 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion

**Appendix 2.** Coastal Cactus Wren Distribution-Los Angeles County, CA (modified from Harper and Salata 1991)

Locality	Site	Source	Year	Method
Baldwin Hills	**	Garret	1991	1
Claremont	below San Antonio Dam	Guthrie, Wheeler	1997	1
Claremont	below Thompson Creek Dam	Guthrie	1989	1
Claremont	Ranch Santa Ana Botanic Gardens	Guthrie	1990	1
Duarte	San Gabriel Wash	Garret	1991	1
Duarte	west of Fish Canyon	Garret	1991	1
Glendora	southern slopes of San Jose Extension	Guthrie, Wheeler	1997	1
Irwindale	Santa Fe Dam, San Gabriel River	Pepin, Wheeler	1991, 1997	1
La Puente	San Jose Hills	McKernan	1991	1

Laverne	**	Oglesby	1989	1
Malibu	**	Guthrie	1989	1
Palos Verdes	Palos Verdes Peninsula	Atwood	1998	2, 3, 4
Pomona/San Dimas	inclusive of Bonelli Regional Park	Garret	1991	1
Puente Hills	**	Garret, Guthrie	1991, 1989	1
San Dimas	Bonelli Regional Park	Garret, McKernan, Wheeler	1991, 1997	1
San Dimas	Raging Waters Theme Park	Guthrie	1989	1
San Dimas	San Dimas Canyon Park	Guthrie	1989	1
San Fernando Valley	Big Tujunga Wash	Garret, Pepin	1991	1
San Jose Hills	Cal Poly Pomona	Solek	1999	2, 3, 4
Walnut	San Jose Hills	McKernan	1991	1
West Covina	San Jose Hills	McKernan	1991	1

\*\* No specific site specified; 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion

**Appendix 3.** Coastal Cactus Wren Distribution-Orange County, CA. (modified from Harper and Salata 1991)

Locality	Site	Source	Year	Method
Anaheim	Peralta Hills	Orange Co. BBA	1990	7
Anaheim	Gypsum Canyon	McKernan	1991	1
Anaheim Hills	Oak Canyon Nature Center	Eggert	1996	2,4
Orange Co.	Blind Canyon	McKernan	1991	1
Caspers Regional Park	Bell Canyon, San Juan Creek	Rea and Weaver, Orange Co. BBA	1990	2,4, 7
Chino Hills	Carbon Canyon Road	Guthrie	1989	1
Chino Hills	Carbon Canyon	Guthrie	1989	1
Chino Hills	Telegraph Canyon, Chino Hills State Park	Guthrie, McKernan	1989, 1991	1
Cystal Cove State Park	Cystal Cove Bluff	Atwood	1998	1,2,4

Dana Point	Dana Point Headlands	Orange Co. BBA, Roberts	1991	7
East Orange General Plan	**	Willick	*	1
Eastern Transportation Corridor	**	Willick	*	1
Costa Mesa	Fairview Rock	Willick	*	1
Fullerton	**	Guthrie	1989	1
Fullerton	Chevron Property	Guthrie	1989	1
Fullerton (north)	Coyote Hills	Orange Co. BBA	1990	7
Orange Co.	Gabino Canyon	McKernan	1991	1
Irvine	El Toro Marine Corps Air Station	Gould	1991	1
Irvine	Turtle Rock/Sand Canyon Reservoir	Atwood	1998	1
Irvine	UC Irvine Ecological Reserve	Atwood	1998	1
Irvine	San Joaquin Transportation Corridor	Roberts	1989	1
Irvine, San Joaquin Hills	south of Sand Canyon Reservoir	McKernan	1991	1
Irvine (east)	east to Live Oak Canyon	Orange Co. BBA	1990	7
Irvine Ranch	**	Jone and Stokes Assc.	1993	2,6
Irvine Regional Park	Irvine Regional Park	Guthrie	1989	1
La Mirada (east)	Coyote Hills	Orange Co. BBA	1990	7
Laguna Beach	Emerald Canyon, east to La Paz Road	Orange Co. BBA	1990	7
Laguna Canyon	Sycamore Hills	Atwood	1998	1,2,4
Laguna Hills	**	Orange Co. BBA	1990	7
north Laguna Niguel	**	McKernan	1991	1
Lake Forest	**	Orange Co. BBA	1990	7
Lake Forest	Foothill Ranch	Roberts	1991	1
Lake Forest	Serrano Creek	Roberts	1991	1
Loma Ridge, Santa Ana Mts.	between Irvine Regional Park/Modjeska Res.	Orange Co. BBA	1990	7
Mission Viejo	Oso Reservoir, south facing slope	Roberts	1991	1

Mission Viejo	Oso Reservoir, northwest facing slope	Roberts	1991	1
Mission Viejo	Naciente Ridge	Roberts	1991	1
Mission Viejo	English Canyon	Stockwell	1991	1
Mission Viejo	east to County Line	Orange Co. BBA	1990	7
Mission Viejo	southern portion	Orange Co. BBA	1990	7
Mission Viejo/Lake Forest	Upper Aliso Creek, El Toro Rd.	Roberts	1991	1
Newport Beach	Upper Newport Bay Ecological Reserve	Atwood	1998	1,2,4
North Laguna Laurel	west of Laguna Canyon Road	Atwood	1998	1,2,4
Northern San Joaquin Hills	northern section	Willick	*	1
Orange	Santiago Oaks Regional Park	McKernan	1991	1
Pacific Coast Hwy	between Laguna Beach/Newport Beach	Guthrie	1989	1
Placentia (east)	Chino Hills	Orange Co. BBA	1990	7
Portola Hills	Upper Aliso Creek, Santiago Canyon Rd.	Roberts	1991	1
Rancho Mission Viejo	San Juan Creek	Rea and Weaver, Orange. Co BBA	1990	2,4,7
Rancho Mission Viejo	San Mateo Creek, Cristianitos Canyon	Rea and Weaver	1990	2,4
Rancho Santa Margarita	**	Orange Co. BBA	1990	7
Rancho Santa Margarita	O'Neill Regional Park	Stockwell	1991	1
Rancho Santa Margarita/Trabuco	Rattlesnake Canyon to Plano Trabuco	McKernan	1991	1
San Clemente	Segunda Dashed Canada	Rea and Weaver	1990	2,4
San Joaquin Hills	Laguna Canyon	Roberts	1991	1
San Joaquin Hills	Irvine Company	Beedy	1991	1
San Joaquin Hills, Crystal Cove SP	Los Trancos Canyon to Emerald Canyon	McKernan	1991	1
San Juan Capistrano	**	Orange Co. BBA	1990	7
Starr Ranch Audubon	Crow Canyon, s. side of	McKernan,	1991,	1,2,4

Sanctuary	Pruesker Peak	Rea and Weaver	1990	
Tustin	**	Guthrie	1989	1
Tustin	Peter's Canyon	Willick	*	1
Tustin	Shady Canyon	Orange Co. BBA	1990	7
Yorba Linda	Chino Hills, north of Featherly Regional Park	McKernan	1991	1
Yorba Linda (north)	Chino Hills	McKernan	1991	1

\*\* No specific site specified; 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion

**Appendix 4.** Coastal Cactus Wren Distribution-San Bernardino County, CA (modified from Harper and Salata 1991).

Locality	Site	Source	Year	Method
Chino Hills	Chino Hills State Park	Guthrie	1988-1989	1
Chino Hills	Tonner Canyon, east of Diamond Bar	McKernan	1991	1
Chino Hills	Tonner Canyon, north of Arnold Reservoir	McKernan	1991	1
Fontana	**	McKernan	1991	1
Loma Linda	**	McKernan	1991	1
Mentone	**	McKernan	1991	1
Rancho Cucamonga	**	McKernan, Guthrie	1991	1
Redlands	**	McKernan	1991	1
Rialto	Lytle Creek Wash	McKernan	1991	1
north of Redlands Airport	Santa Ana River Wash	McKernan	1991	1

\*\* No specific site specified; 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion

**Appendix 5.** Coastal Cactus Wren Distribution-Riverside County, CA (modified from Harper and Salata 1991)

<b>Locality</b>	<b>Site</b>	<b>Source</b>	<b>Year</b>	<b>Method</b>
Riverside Co.	Arlington Mountain	McKernan	1991	1
Riverside Co.	Bad Springs Creek	McKernan	1991	1
Beaumont	southwest	McKernan	1991	1
Cajalco	**	McKernan	1991	1
Calimesa	The Badlands, near Woodhouse Rd.	McKernan	1991	1
Corona	south	McKernan	1991	1
Riverside Co.	Dawson Canyon	McKernan	1991	1
Riverside Co.	Eagle Canyon	McKernan	1991	1
Riverside Co.	Hagador Canyon	McKernan	1991	1
Riverside Co.	Horsethief Canyon	McKernan	1991	1
Riverside Co.	Laborde Canyon	McKernan	1991	1
Lake Mathews	southern portion	McKernan	1991	1
Lake Perris State Rec. Area	Bernasconi Hills	McKernan	1991	1
Riverside Co.	Lakeview Mountains	McKernan	1991	1
Riverside Co.	Maybey Canyon	McKernan	1991	1
Riverside Co.	McBride Canyon	McKernan	1991	1
Moreno Valley	Box Springs Mountains	McKernan	1991	1
Moreno Valley	The Badlands, near Redlands Blvd.	McKernan	1991	1
Moreno Valley/Lake Perris	**	McKernan	1991	1
Morongo Indian Reservation	Potrero Creek	McKernan	1991	1
Riverside Co.	Motte Rimrock Reserve	Carlson	1991	1
Riverside	city limits	McKernan, Carlson	1991	1
Riverside Co.	Saddleback Flat	McKernan	1991	1
San Jacinto	**	McKernan	1991	1
Murrieta	Santa Rosa Plateau	Carlson	1990	1
Temescal Wash	south of Dawson Canyon	McKernan	1991	1

\*\* No specific site specified; 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion

**Appendix 6.** Coastal Cactus Wrens Distribution-San Diego County, CA (modified from Rea and Weaver 1990).

Locality	Site	Source	Year	Method
Bonsall	San Luis Rey River	Rea and Weaver	1990	2, 4
Camp Pendleton	San Mateo/San Onofre Creeks	Rea and Weaver	1990	2, 4
Camp Pendleton	unnamed creek, sw slope of Horno Hill	Rea and Weaver	1990	2, 4
Camp Pendleton	Aliso Creek	Rea and Weaver	1990	2, 4
Camp Pendleton	Santa Margarita River	Rea and Weaver	1990	2, 4
Camp Pendleton	Naval Weapons Station (Fallbrook Annex)	Rea and Weaver	1990	2, 4
Camp Pendleton	San Luis Rey River, Wire Mountain	Rea and Weaver	1990	2, 4
Camp Pendleton	San Luis Rey River, Windmill Canyon	Rea and Weaver	1990	2, 4
Camp Pendleton	San Luis Rey River, Pilgrim Creek	Rea and Weaver	1990	2, 4
Camp Pendleton	San Luis Rey River, Windmill Canyon	Rea and Weaver	1990	2, 4
Camp Pendleton	San Luis Rey River, Naval Weapons Sta.	Rea and Weaver	1990	2, 4
Carlsbad	Agua Hedionda Creek	Rea and Weaver	1990	2, 4
Carlsbad	San Marcos Creek	Rea and Weaver	1990	2, 4
Chula Vista	Sweetwater River	Rea and Weaver	1990	2, 4
Dennery Canyon	Otay River	Rea and Weaver	1990	2, 4
El Cajon	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Encinitas	Escondido Creek	Rea and Weaver	1990	2, 4
Escondido	San Dieguito River	Rea and Weaver	1990	2, 4
Johnson Canyon	Otay River	Rea and Weaver	1990	2, 4
Lake Jennings County Park	Los Penasquitos Creek	Rea and Weaver, Eggert	1990, 1996	2, 4
Lakeside	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Lilac	San Luis Rey River	Rea and Weaver	1990	2, 4

Mission Hills	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Mother Miguel Mountain	Sweetwater River	Rea and Weaver	1990	2, 4
Otay Mesa	Tijuana River	Rea and Weaver	1990	2, 4
Paradise Hills	Sweetwater River	Rea and Weaver	1990	2, 4
Pauma Valley	San Luis Rey River	Rea and Weaver	1990	2, 4
Poway	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Proctor Valley	Otay River	Rea and Weaver	1990	2, 4
Ranch Bernardo	San Dieguito River	Rea and Weaver	1990	2, 4
Rancho Otay	Otay River	Rea and Weaver	1990	2, 4
Rancho Santa Fe	San Dieguito River	Rea and Weaver	1990	2, 4
San Diego	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
San Pasqual Valley	San Dieguito River	Rea and Weaver	1990	2, 4
San Pasqual Valley	San Pasqual SHP/SD Wild Animal Park	Rea and Weaver	1990	2, 4
Santee	Fanita Ranch, Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Spring Canyon	Tijuana River	Rea and Weaver	1990	2, 4
Spring Valley	Los Penasquitos Creek	Rea and Weaver	1990	2, 4
Sunnyside	Sweetwater River	Rea and Weaver	1990	2, 4
Sweetwater Reservoir	Sweetwater River	Rea and Weaver, Eggert	1990, 1996	2, 4
Valle de las Palmas	Baja California	Rea and Weaver	1990	2, 4

\*\* No specific site specified; 1= Expert Opinion, 2= Point Count, 3= Mist Netting, 4= Nest Searching, 5= Spot mapping, 6= Area Search, 7= Breeding Bird Atlas, 8= BBS Route, 9= Other/Local Opinion