

CACTUS WREN HABITAT ENHANCEMENT
on the
SAN DIEGO NATIONAL WILDLIFE REFUGE



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Introduction

Populations of Cactus Wren (*Campylorhynchus brunneicapillus*) in coastal San Diego County have apparently declined severely in the past 20-25 years. These populations are disjunct from transmontane populations, where Cactus Wrens are more abundant and populations are relatively stable. Though the American Ornithologists Union Committee on Classification and Nomenclature did not consider these coastal populations taxonomically distinct from the subspecies occurring in the inland deserts of San Diego County (*C.b. anthonyi*) (U.S. Fish and Wildlife Service 1994), Rea and Weaver (1990) proposed considering the San Diego Cactus Wren (*C. b. sandiegensis*) a distinct subspecies. Eggert (1996) found genetic evidence supporting the contention that coastal Cactus Wrens are distinct from transmontane populations. The California Department of Fish and Wildlife has designated the San Diego Cactus Wren as a *California Bird Species of Special Concern* (Shuford and Gardali 2008). The coastal Cactus Wren is a “covered” and “target” species of regional Natural Community Conservation Plans.

The species’ range is limited to Orange and San Diego counties and the coastal zone of northern Baja California, Mexico. Steep population declines and extirpation of local populations have recently been documented over the entire range of the taxon. In coastal San Diego County, Cactus Wrens are concentrated in four areas: Camp Pendleton and Fallbrook Naval Weapons Station; Lake Hodges and the San Pasqual Valley; Lake Jennings, and the Otay-Sweetwater area (Unitt 2004). They were formerly widespread and “abundant” at elevations below 300 m (1000 ft) in coastal San Diego County (Stephens 1921), especially in the area now covered by the inner city of San Diego (Rea and Weaver 1990, SDNHM specimens). Rea and Weaver (1990) quantified an apparent rapid decline in numbers and reduction in distribution between 1980-1990, primarily due to direct habitat loss for housing developments. Since then, destruction and fragmentation of Cactus Wren habitat has continued, though the Multiple Species Conservation Plan (MSCP) has to some extent guided developers and municipalities to conserve Cactus Wren habitat. However, a population viability analysis for the species within the MSCP area suggested that the likelihood of persistence therein was “marginal” primarily due to effects of fragmentation (Ogden 1992).

In 2003, and again in 2007, extensive fires burned tens of thousands of acres of coastal sage scrub and chaparral vegetation in coastal San Diego County, including occupied and potential Cactus Wren habitat. The Cedar Fire of 2003 burned the Lake Jennings area: one of coastal San Diego County’s core Cactus Wren habitat blocks. The Cactus Wren population there was reduced to a few pair primarily occupying residential yards and a remnant clump of cactus (Bruce April, California Department of Transportation, pers. comm.). In October 2007, the Witch Fire burned through the San Pasqual Valley and Lake Hodges areas, affecting the largest core population of Cactus Wrens in the MSCP area. Also in October 2007, the Harris Fire burned thousands of acres of coastal sage scrub, including an unquantified amount of actual and potential Cactus Wren habitat. The fire is thought to have temporarily extirpated Cactus Wren from the San Diego National Wildlife Refuge. Cactus Wrens were not detected in focused surveys on SDNWR since the fire, in an area that supported at least 7 Cactus Wrens prior to the fire.

Analysis of genetic structure of the Cactus Wren population in coastal southern California, and southern coastal San Diego County in particular, reveals that populations in the Otay Mesa area are genetically distinct from those in the Sweetwater Reservoir area, and that the restricted gene flow between these populations likely happened relatively recently (Kelly Barr and Amy Vandergast, USGS, pers. comm.).

In April 2008, a group of concerned biologists from government and nongovernmental organizations throughout coastal California met to discuss the plight of coastal populations of Cactus Wren in light of the ongoing onslaught of habitat loss, fragmentation, degradation, and fire. An ad hoc Working Group was formed, with representatives from each of the Southern California coastal counties, the resource agencies, and a science advisory group. The first actions of the working group have been to coordinate and prioritize projects with the intent of leveraging multiple funding sources including California Department of Fish and Game Local Assistance Grants for areas where Natural Community Conservation Planning (NCCP) programs have been approved; After-the-Fire Funds from the San Diego Foundation; Proposition 84; and Nature Reserve of Orange County. The priority projects that were identified for San Diego County focus on two primary recovery areas—San Pasqual Valley and the Otay-Sweetwater area, specifically the San Diego National Wildlife Refuge.

The Working Group formulated, and is implementing, a regional effort to address the precipitous decline of the coastal Cactus Wren populations in San Diego and Orange Counties. This grant would fund a component of that effort. The focus of grant implementation would be as an “enhancement” component of a coordinated, comprehensive regional coastal Cactus Wren recovery strategy that includes:

- Wren surveys and monitoring;
- Cactus scrub salvage and propagation;
- Restoration, enhancement, and creation of cactus scrub and maritime succulent scrub habitat;
- Additional adaptive management strategies.

A number of public agencies and non-profit organizations are cooperating to address this suite of recovery actions.

Failure to restore Cactus Wren habitat in the MSCP area has the potential to affect the coverage of Cactus Wren under MSCP. Table 3.5 of the MSCP presents “Details of rationale for identifying species as covered.” For Cactus Wren, the rationale for coverage stipulates that “The existing distribution of Cactus Wrens in the MSCP Plan area has been greatly reduced, and restoration of suitable Cactus Wren habitat and its management are important components of the MSCP Plan. Significant opportunities for restoration within the MHPA occur on...San Miguel Ranch [part of the San Diego National Wildlife Refuge]....” In addition, the Conditions for coverage state that: “Area-specific management directives must include restoration of maritime succulent scrub habitat, including propagation of cactus patches, active/adaptive management of Cactus Wren

habitat....” Therefore, rehabilitation and enhancement of the Cactus Wren habitat on SDNWR supports continued coverage of Cactus Wren under the MSCP.

Initial Conditions

San Diego National Wildlife Refuge is located on the eastern edge of the greater metropolitan San Diego area (Figure 1). It is the Federal government’s contribution to the MSCP Reserves. The refuge was established, and will continue to be managed, to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds and to maintain and enhance the biological diversity of native plants and animals. The 11,537-acre refuge includes coastal sage scrub, southern mixed chaparral, cottonwood-willow riparian forest, coast live oak woodland, native and non-native grasslands, and vernal pools. These habitat types on the refuge support a major component of coastal San Diego County’s diverse biota.

San Diego National Wildlife Refuge includes extensive areas with suitable soils, elevation, slope, aspect, and climate to support coastal sage scrub including tall *Opuntia littoralis* (coast prickly pear), *O. oricola* (chaparral prickly pear), and *Cylindropuntia prolifera* (cholla) which are necessary components of coastal Cactus Wren habitat. These cacti tend to occur in coastal San Diego County on west-to-south-facing slopes, at elevations below 200 m (Beauchamp 1986). Cactus has likely been reduced in this area by past agricultural practices, competition with exotic weeds, and increased fire frequency, including the 2007 Harris Fire.

San Diego National Wildlife Refuge is an advantageous place to implement Cactus Wren conservation measures for several reasons as it is conserved in perpetuity and the Refuge System’s primary purpose is conservation of wildlife. Relatively large areas of the refuge include the geographic, elevation, climatic, edaphic and vegetative conditions characteristic of coastal Cactus Wren habitat. Because the refuge is relatively extensive, species like Cactus Wrens inhabiting the refuge are less likely to suffer deleterious edge effects than are species in more fragmented habitats. Also, the refuge’s contiguous wildlife habitat means that wrens dispersing from one cactus patch to another within the refuge are likely to find relatively hospitable habitat through which to move, and thus are likely to successfully disperse from one habitat patch to another.

Prior to the Harris Fire, the area of the refuge south of Mother Miguel and San Miguel Mountains, roughly from the south end of Sweetwater Reservoir east to Proctor Valley, supported coastal sage scrub that included patches of cactus in excess of 1 m tall. Virtually all of this area was within the Harris fire footprint and burned with varying intensity (some thorough and hot, some light and patchy). Much of the cactus was killed. Some cholla survived the fire and begun to regrow in spring 2008. However, there is little or no live cactus sufficiently tall, dense or extensive to support Cactus Wrens on the refuge (except for an isolated, disjunct 13-acre patch of maritime succulent scrub on the San Miguel Ranch Otay tarplant preserve). The fire burned the vast majority of coastal sage scrub shrubs. After the well-timed seasonal rains that fell in late 2007 and early 2008, exotic annual weeds (e.g., *Avena* sp., *Bromus madritensis* ssp. *rubens*, *B.*

diandrus, *Centaurea melitensis*, *Cynara cardunculus*, *Erodium cicutarium*, *Foeniculum vulgare*, *Hordeum murinum*, *Lolium multiflorum*, *Malva parviflora*) dominate burned areas of coastal sage scrub. The growth of annual weeds had potential to inhibit the re-development of cactus stands in these areas.

To address the impacts to Cactus Wrens and their habitat, San Diego National Wildlife Refuge has been working to restore habitat for the Cactus Wren, funded by a grant from the Transnet Environmental Mitigation Program (Grant Agreement No. 5001141). This report shows results of the management actions supported by that grant.

Goals

Our overall goal was to establish stands of coastal prickly pear, chaparral prickly pear, and cholla distributed over the refuge west of Mother Miguel and San Miguel Mountains, south of Sweetwater Reservoir. Ultimately, the cactus should be at least 1 m tall and occur at densities of approximately 100 plants/ha to provide suitable Cactus Wren habitat. To that end we had several specific goals:

1. Restore cactus in 13 areas over a total of 50 ha (139 acres) on the San Diego National Wildlife Refuge.
2. Restore cactus at a density of about 100 plants/ha.
3. Cactus should show 75% survival 4 years after planting.
4. Cactus should average 0.5 m tall 4 years after planting.

Restoration/Enhancement Strategy

The restoration/enhancement of Cactus Wren habitat was accomplished by the following actions:

Cactus collection

Cactus cuttings were collected from naturally-occurring cacti in the wild. In October 2008 we salvaged approximately 6,000 cuttings of cholla (*Cylindropuntia prolifera*) from the construction site of the Bayshore Bikeway across San Diego Bay National Wildlife Refuge (Figure 2). Approximately 6,000 cuttings were grown in a nursery at Rancho Jamul Ecological Reserve, and an additional 6,000 were grown at Recon Native Plant Nursery in Imperial Beach. Cuttings consisted of a single stem segment ("joint") of cactus. After collection, they were stored in open air for 2-14 days to allow the injured surface of the cutting to callus. In early January 2010 SDNWR staff and volunteers planted the joints, proximal end down, in a prepared bed of sandy soil, outdoors (Figure 3). Though chaparral prickly pear is somewhat uncommon in the area proposed for enhancement, we made a point of including this species because it grows to heights exceeding 1 m more readily than does coastal prickly pear. To replicate the proportionate occurrence of prickly pear and cholla in the wild, we grew approximately 12,000 joints of cholla, 500 of coastal prickly pear, and 200 of chaparral prickly pear.

Cactus planting

Cuttings remained in the ground at Rancho Jamul and Recon Native Plant Nursery until January 2011, when they were removed and left in a shaded structure in preparation for planting. They were planted in the ground on SDNWR in February and March 2011. In determining the locations and configuration of planted cactus, our primary objective was to arrange the cacti so that when they matured, the area planted would support the maximum number of breeding pairs of cactus wrens. Personal observations of San Diego cactus wren habitat (J. Martin, SDNWR), and information from Proudfoot *et al.* (2000), and "Restoration Guidelines for Coastal Cactus Wren" (Hamilton 2009, unpubl. ms.) were used. Based on locations of existing cactus, topography, and proximity to one another, 50 locations of "clusters" of cholla would be planted. Each cluster would consist of 100 plants, in a 10 X 10 m square, with 1 plant/ m². In the spaces between the clusters, outlying cacti were planted at a density of 1 plant/ 100 m² (so roughly in the middle of each 10 X 10 m square). Clusters were placed in favorable growth locations (e.g., ephemeral drainages, proximity to skeletons of fire-killed mature cholla). Clusters were placed to provide roughly 2 clusters suitable for nesting habitat in each 2 ha (roughly 1 CACW territory size), and would not overload some areas at the expense of others (i.e., clusters were spread out to maximize the number of CACW territories we could create with 12,000 cactus. In practice, archaeological constraints and field-fitting by the contractor, plus growing out more cactus than anticipated, altered the planned configuration of cactus planting, such that 119 rather than 50 clusters were planted (Figure 4 and 5). Several clusters were planted in an location far from those originally planned, but close to occupied wren habitat on private property near the intersection of Jamacha Blvd and Campo Road (so that offspring of wrens on at the private property might have protected dispersal habitat) (Figure 6).

Weed control

Weed control in patches of planted cactus is likely to reduce competition for soil moisture, nutrients, and light, and thus enhance growth of cactus. Most of the cacti were planted in areas where we conducted weed control to combat type conversion of coastal sage scrub to non-native grassland in the wake of the Harris Fire of 2007. Therefore, weeds in the areas where we planted cactus already occurred at lower densities than they might have otherwise. Weed control efforts associated with the Harris Fire, and including the areas where cactus was planted, continued through June 2011. After the Harris Fire weed control efforts were exhausted, we continued to control weeds within a 1-m radius of each planted cactus in January and February 2013. Exotic plants in this radius were sprayed with 2% glyphosate solution when seasonal rains had stimulated growth of exotic annual weeds. Cacti are relatively resistant to glyphosate and were likely not adversely affected by any minor incidental exposure they might have received.

Monitoring

Monitoring consisted of two components: 1) monitoring of survival and growth of cacti; and 2) monitoring of colonization, distribution, and abundance of Cactus Wrens.

Cactus Growth and Survival

To monitor growth, we randomly selected 100 plants each year, and their height, maximum crown width, and crown width perpendicular to the maximum width were recorded. We monitored growth in November 2012 and in March 2014 (Table 1).

Table 1. Height and maximum crown width of planted cholla cactus on San Diego National Wildlife Refuge, Jamul, San Diego County, California, November 2012 and March 2014.

Height		November 2012	March 2014
	Mean	22.64	40.6
	Standard Error	1.034312342	1.23091491
	Median	22.5	41
	Mode	23	28
	Standard Deviation	10.34312342	12.3091491
	Sample Variance	106.980202	151.5151515
	Kurtosis	2.36047801	-0.38830675
	Skewness	1.029784239	0.099458126
	Range	61	56
	Minimum	0	12
	Maximum	61	68
	Sum	2264	4060
	Count	100	100
Maximum crown width	Mean	27.08	59.67
	Standard Error	1.625968554	2.14805785
	Median	25.5	58
	Mode	15	48
	Standard Deviation	16.25968554	21.4805785
	Sample Variance	264.3773737	461.4152525
	Kurtosis	2.539987246	-0.285347504
	Skewness	1.288916188	0.447052013
	Range	90	91
	Minimum	0	21
	Maximum	90	112
	Sum	2708	5967
	Count	100	100

Planted cacti grew substantially between November 2012 and March 2014 (Figure 7). The plants are generally healthy, beginning to form moderately dense stands, and are progressing toward suitable Cactus Wren habitat (Figure 8).

To monitor survival, we included dead cacti in our growth monitoring, assigning dead plants a value of zero. In 2012, one dead individual was recorded, and in 2014, zero dead individuals were among the 100 randomly sampled plants. Survival of the plants has been very high, probably above 99%, far in excess of the 75% that was our goal.

Wren Monitoring

Colonization of the enhanced areas has been monitored by implementation of the protocol developed by USFWS (Grant 2008). USFWS Carlsbad Ecological Services Office personnel did not detect Cactus Wrens in the habitat enhancement areas (Clark Winchell, USFWS, unpubl. data).

Cactus Wrens have been incidentally observed in some of the areas in which we have enhanced habitat (Figure 5). On June 27, 2011, an apparently dispersing juvenile was passing through the Shinohara vernal pool restoration site, where cactus had been planted. The cactus at that point was definitely not sufficiently tall to elicit a settling response in the bird, and it left the area within a day, and was not observed again. It was confirmed unbanded. Researchers with U.S. Geological Survey had banded nestling cactus wrens at the nearest known occupied site: the long-occupied territory on “Cactus Hill”, south of the eastern end of Sweetwater Reservoir (Scarlett Howell, USGS, pers. comm.). It was thought that all of the juveniles at that location had been banded, so the origin of the juvenile seen on June 27, 2011 was unclear.

On March 10, March 18, April 14, and June 4, 2014, an unbanded Cactus Wren (presumably the same bird on all occasions) occupied relict mature cholla (naturally-occurring cholla that survived the Harris Fire) in an area in close proximity to planted cholla (Figure 5). Most of the planted cholla in this area is well under 1 m tall, and not yet tall enough to serve as nesting habitat. However, the greater density of cholla created by the planting may have induced a settling response in this bird, allowing it to use relict cholla that is sufficiently tall to inhabit, but not sufficiently dense in and of itself. This wren’s settlement in an area that has not been occupied since the Harris Fire suggests that the restoration efforts are having the desired effect.

Refuge staff will continue monitoring for occupancy by Cactus Wrens and hope to continue weeding at these sites to reduce future fire risk and improve habitat conditions. In addition, we have identified additional sites that could be planted, which we plan to do with the SDNWR volunteer program.

Acknowledgments

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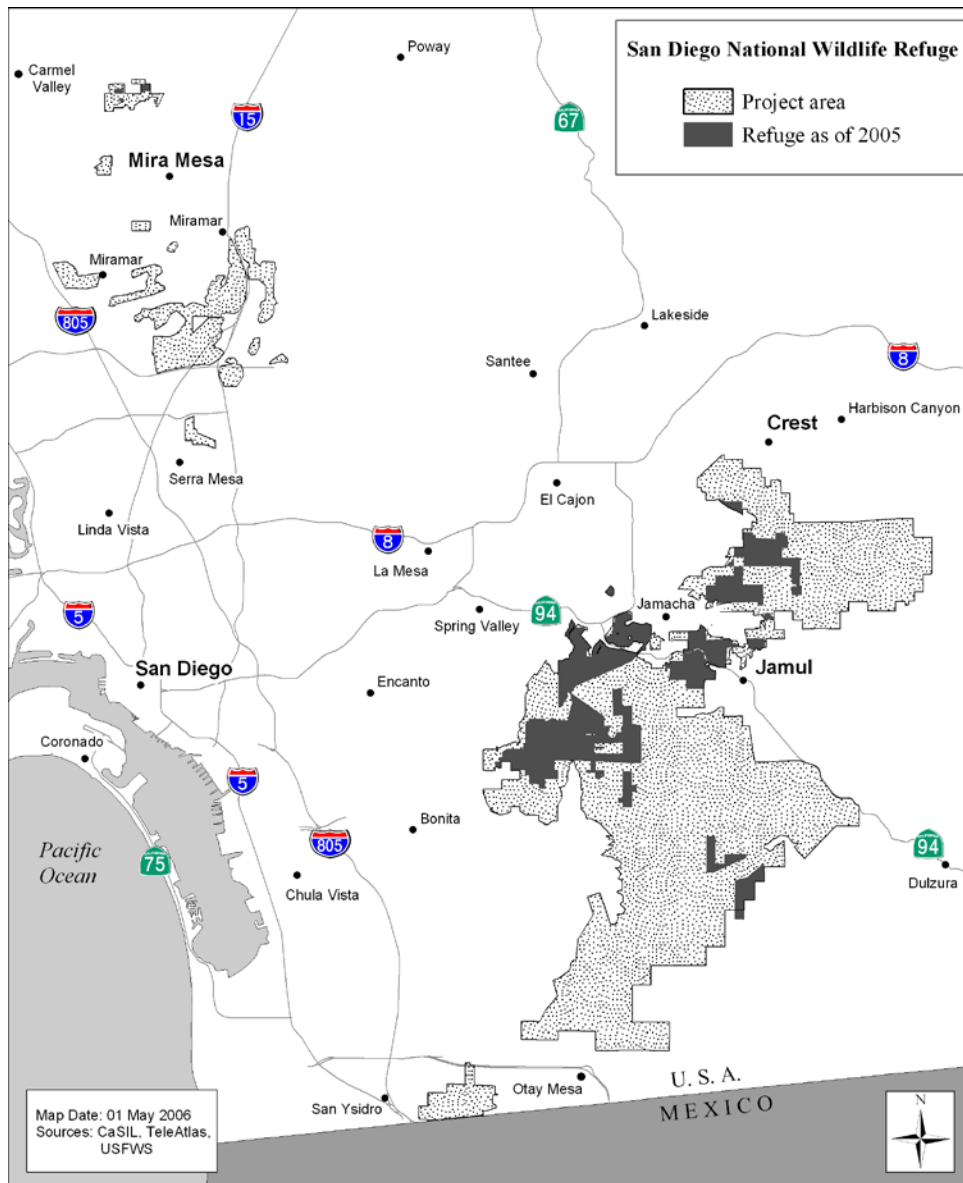


Figure 1. Location of San Diego National Wildlife Refuge.

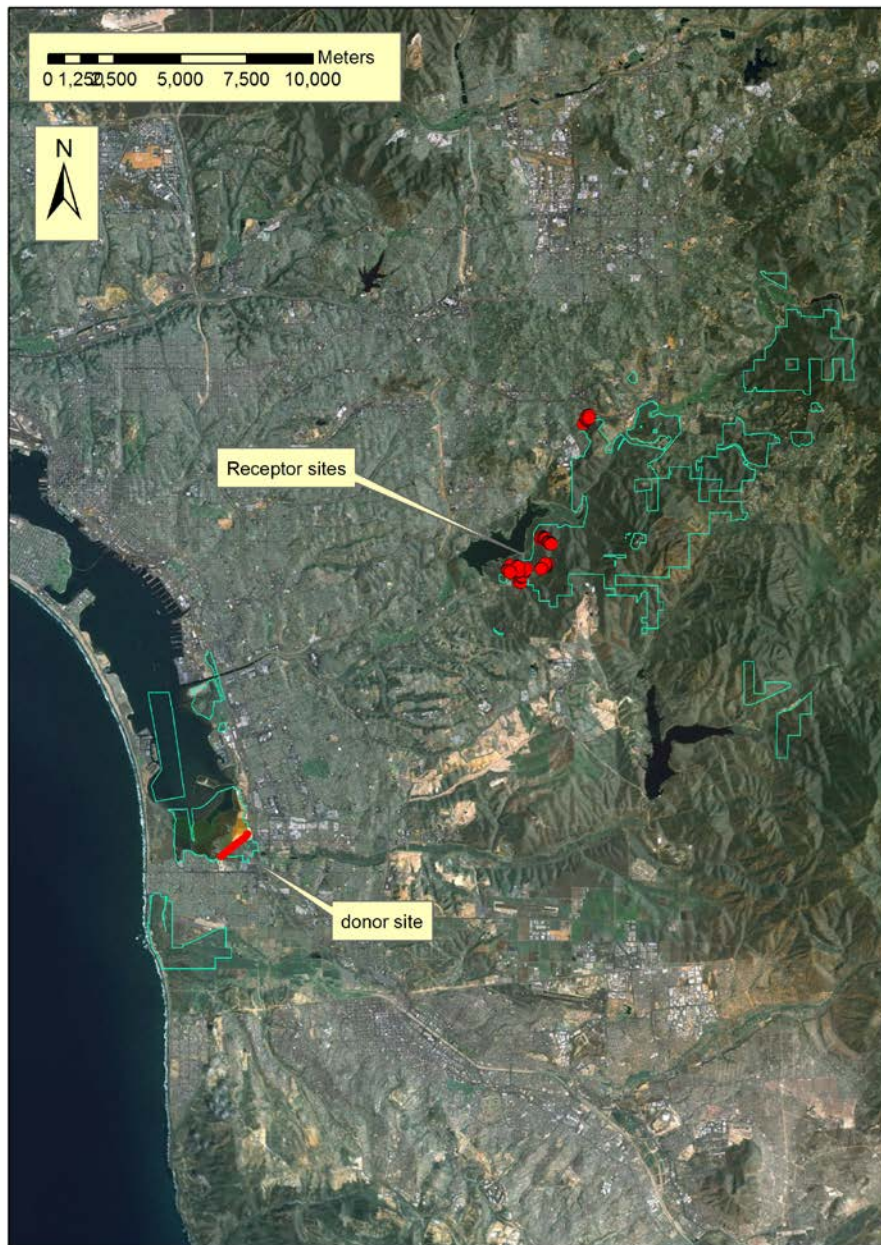


Figure 2. Locations of donor and receptor sites of salvaged cactus, San Diego County, California



Figure 3. Volunteer assistants planting coast cholla (*Cylindropuntia prolifera*) cuttings at the nursery at Rancho Jamul Ecological Reserve, Jamul, San Diego County, California.

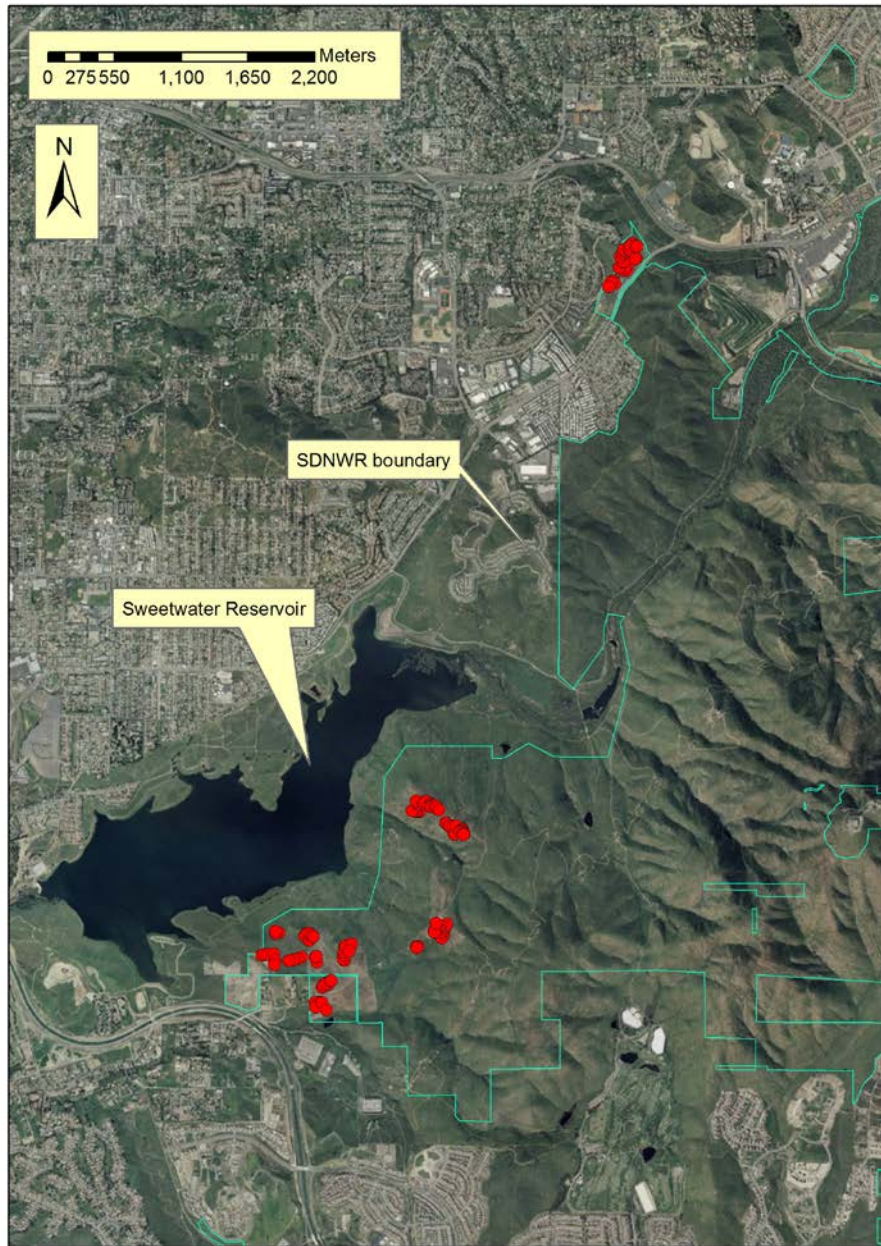


Figure 4. Locations of clusters of planted cactus, San Diego National Wildlife Refuge, Jamul, California, January-March 2011.

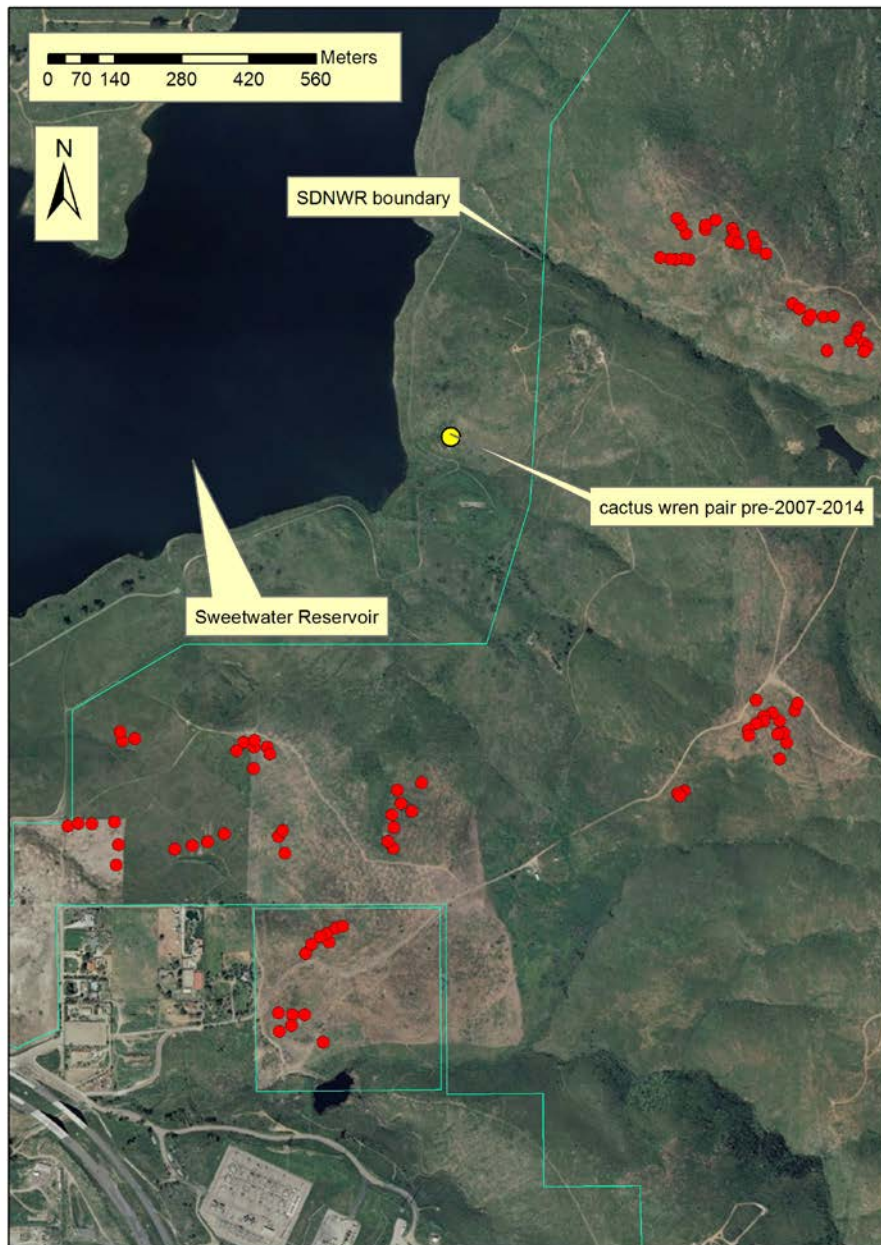


Figure 5. Locations of clusters of planted cactus south of Sweetwater Reservoir, San Diego National Wildlife Refuge, Jamul, California, January-March 2011.



Figure 6. Locations of clusters of planted cactus, “Jamacha parcel” of the San Diego National Wildlife Refuge, Jamul, California, March 2011.

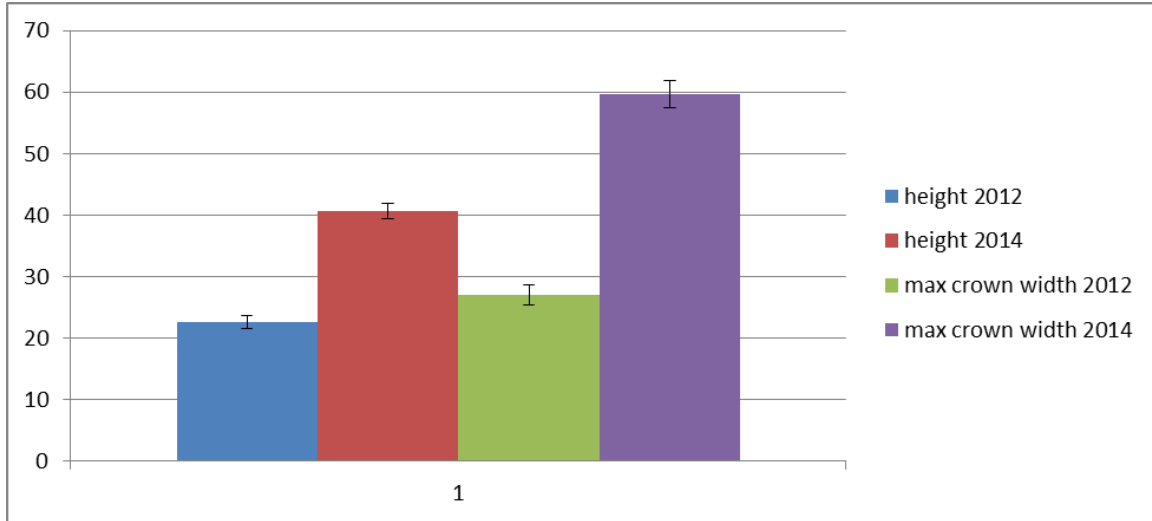


Figure 7. Comparison of height and crown width measurements (cm) of planted cactus between November 2012 and March 2014, on San Diego National Wildlife Refuge, Jamul, San Diego County, California. Error bars indicate standard error.



Figure 8. A typical stand of planted cholla, on the Jamacha parcel, San Diego National Wildlife Refuge, Spring Valley, San Diego County, California, November 20, 2013.