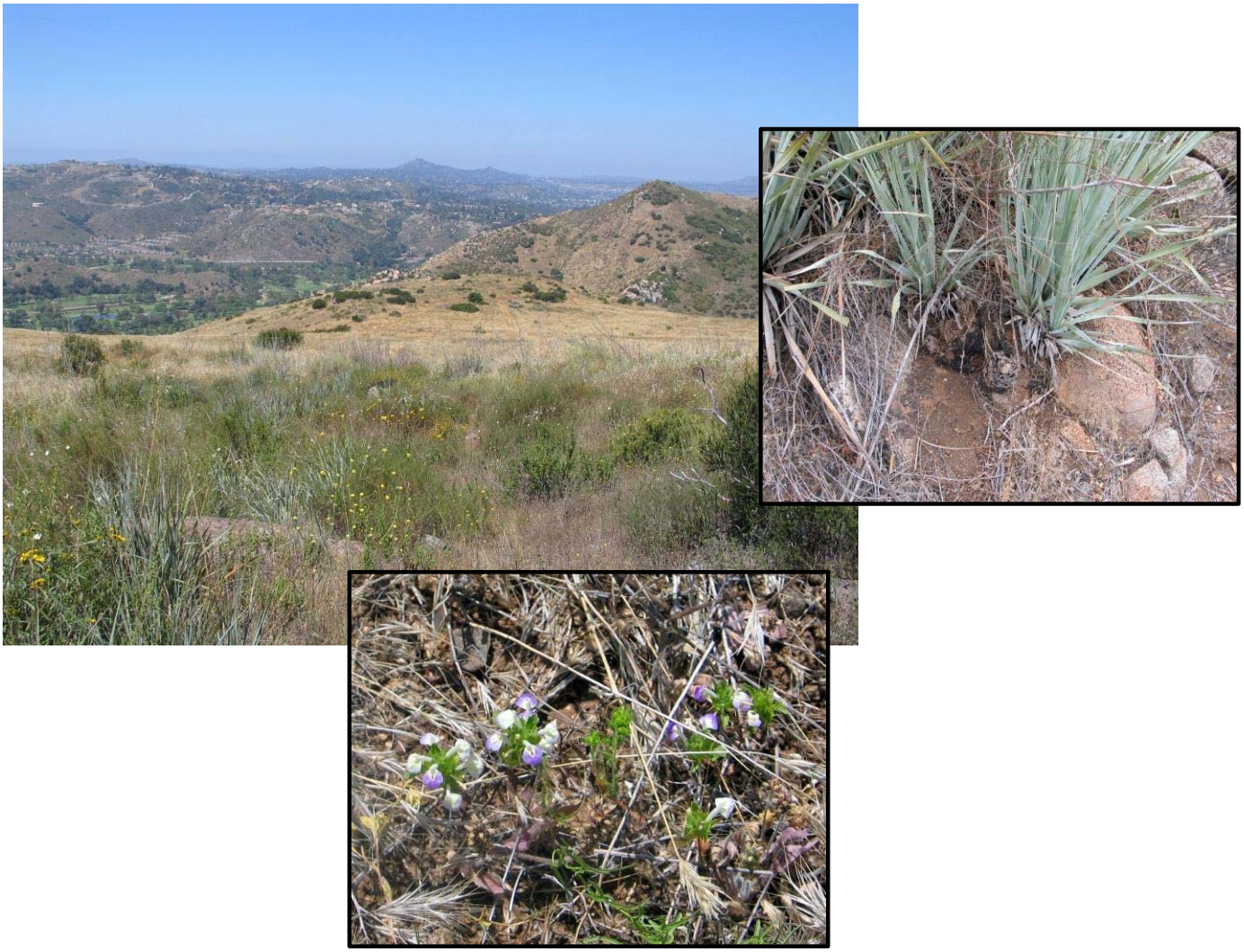
2012 Biological Monitoring Status Report Crestridge Ecological Reserve and South Crest Properties



Prepared for

Endangered Habitats Conservancy

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Executive Summary

In 2012, the Conservation Biology Institute (CBI) conducted covered species monitoring and management on the Crestridge Ecological Reserve (CER) and South Crest properties (South Crest) in San Diego County, California. Covered species monitoring focused on detecting and/or assessing the status of four MSCP covered plant species: San Diego thornmint (*Acanthomintha ilicifolia*), Lakeside ceanothus (*Ceanothus cyaneus*), variegated dudleya (*Dudleya variegata*), and Dehesa beargrass (*Nolina interrata*). Survey and monitoring strategies included presence/absence surveys, and baseline and core monitoring (including photomonitoring). One additional sensitive plant was mapped on South Crest: rush-like bristleweed (*Xanthisma junceum*). Covered species management was conducted on both CER and South Crest for San Diego thornmint.

Presence/absence surveys were conducted for San Diego thornmint, a federally threatened and state endangered species on CER and South Crest. On CER, we revisited the small population found on the slopes above Rios Canyon ('Thornmint Hill') in 2010 and 2011, and searched adjacent, suitable habitat for additional stands. San Diego thornmint was detected within the 2010/2011 stand boundary; six individuals were detected and five survived to produce flowers. We did not detect thornmint elsewhere onsite. Much of the formerly suitable habitat is now dominated by the nonnative grass, purple falsebrome (*Brachypodium distachyon*). Monitoring within this small stand included both baseline and core monitoring to document the population boundaries and current status, including threats. Recommendations include continued monitoring and weed control efforts, and possibly, population augmentation via seed.

On South Crest, surveys assessed all historic locations and potentially suitable habitat in and around Skeleton Flats. Although San Diego thornmint was not detected in historic locations, two new occurrences were detected in the low-lying hills just east of Skeleton Flats. The larger occurrence consists of approximately 950 plants and the smaller occurrence supports about 185 plants. Baseline monitoring and elements of core monitoring were conducted for these populations. Recommendations include continued monitoring and weed control efforts.

Lakeside ceanothus occurs only on CER. In 2012, we continued the photomonitoring program initiated in 2010. Monitoring was conducted at seven locations and compared to 2010 and 2011 results. In three locations, nonnative plants were identified. Recommendations include weed control at one location (photomonitoring point 2), continued monitoring of nonnative plants at the other two locations (points 5 and 6), and continued photomonitoring.

Presence/absence surveys were conducted for variegated dudleya, a sensitive plant and MSCP covered species, on South Crest. Surveys assessed all historic locations and potentially suitable habitat in and around Skeleton Flats. Eleven plants were located onsite in a location that does not coincide with the historic occurrences; many more individuals were located offsite. All plants were growing in areas heavily dominated by purple false brome. Baseline monitoring was conducted to determine population extent. Recommendations include additional presence/absence surveys and baseline monitoring to determine the maximum extent of the population on South Crest, and core monitoring to assess population status and threats. Effectiveness monitoring for historic and extant occurrences within a restoration area will be conducted as part of a separate program.

Dehesa beargrass occurs on South Crest, and core monitoring using index plots was initiated for this species in 2012. Quantitative and qualitative data collection included ramet sampling, cover estimates, habitat characterization, threat assessments, and photomonitoring. Nonnative plants were identified in all plots; Dehesa beargrass faces additional threats from fire and OHV use. Recommendations include additional monitoring at 2-year intervals, modifications to the ramet data collection sample size, collection of population structure data, and nonnative weed. One index plot occurs within a restoration area, and weed control efforts in that plot will be treated and monitored as part of a separate project.

In 2012, selected management was conducted for San Diego thornmint populations. These actions, which occurred primarily on CER and, to a lesser degree, on South Crest, consisted of reducing competition from native and nonnative plants within occupied habitat. Weed control consisted of clipping (CER) or hand-pulling selected competitive native or nonnative species. Recommendations include continued weed control in all occupied thornmint habitat for 3-5 years, at which time the need for additional weed control will be re-assessed.

A summary of covered species monitoring and management recommendations on CER and South Crest for 2013 are provided in the following table:

Covered Species Monitoring and Management Recommendations for 2013

Species	Recommendations						
	Presence/absence Surveys	**Baseline Monitoring**	**Core Monitoring**	**Core + Monitoring**	**Effectiveness Monitoring**	**Photomonitoring**	**Weed Control**
Acanthomintha ilicifolia (San Diego thornmint)	X	X[1]	X		X[4]	X[5]	X
Ceanothus cyaneus (Lakeside ceanothus)						X	X
Dudleya variegata (Variegated dudleya)	X	X[1]	X		X[4]	X[5]	X[7]
Nolina interrata (Dehesa beargrass)			X[2]	X[3]	X[4]	X[6]	X[7]

[1] Baseline monitoring will be conducted for new populations or occurrences only.
[2] Core monitoring for this species will include a threat assessment only, except as indicated under photomonitoring.
[3] Core + monitoring for this species will include collection of population structure data.
[4] Effectiveness monitoring will be conducted as part of habitat restoration monitoring for a separate project (SANDAG EMP grant).
[5] Photomonitoring will be conducted as part of baseline or core monitoring.
[6] Photomonitoring will be conducted at all 3 index plots.
[7] Weed control will be conducted as part of habitat restoration for a separate project (SANDAG EMP grant).

Introduction

This report summarizes 2012 biological monitoring activities conducted by the Conservation Biology Institute (CBI) on the Crestridge Ecological Reserve (CER) and South Crest properties (South Crest) in southern San Diego County, California (Figure 1). The CER is owned by the California Department of Fish and Game (CDFG) and managed by the Endangered Habitats Conservancy (EHC). The South Crest properties are owned and managed by EHC. Both properties support Multiple Species Conservation Plan (MSCP) covered species and sensitive habitats, and function as critical landscape linkages between the northern and southern MSCPs.

The 2012 monitoring effort focused on four MSCP covered plant species: San Diego thornmint (*Acanthomintha ilicifolia*), Lakeside ceanothus (*Ceanothus cyaneus*), variegated dudleya (*Dudleya variegata*), and Dehesa beargrass (*Nolina interrata*). Previous monitoring efforts for these species (or related resources) are listed in Table 1. Refer to annual and other reports (CBI 2009, 2011a,b, 2012) for details on these activities.

Covered species monitoring follows general guidelines in the Habitat Management and Monitoring Plan for CER (CBI and EHC 2009) and more specific guidelines in the San Diego Rare Plant Monitoring Plan (Tracey et al. 2011). Both monitoring and management are additionally informed by results and recommendations from previous monitoring efforts onsite (CBI 2009, 2011a,b, 2012). Based on the budget allocation, specific tasks for 2012 included:

- Task 1: Covered Species Monitoring
    - Presence/absence surveys for San Diego thornmint and variegated dudleya
    - Baseline and core monitoring for San Diego thornmint
    - Photopoint monitoring for Lakeside ceanothus
    - Baseline monitoring for variegated dudleya
    - Core monitoring (including index plots) for Dehesa beargrass
- Task 2: Covered Species Management
    - Invasive plant control within selected San Diego thornmint-occupied habitat

Although not part of the work scope, other sensitive and invasive species detected during field surveys were documented and are reported briefly in this document. All monitoring and management efforts are described below.

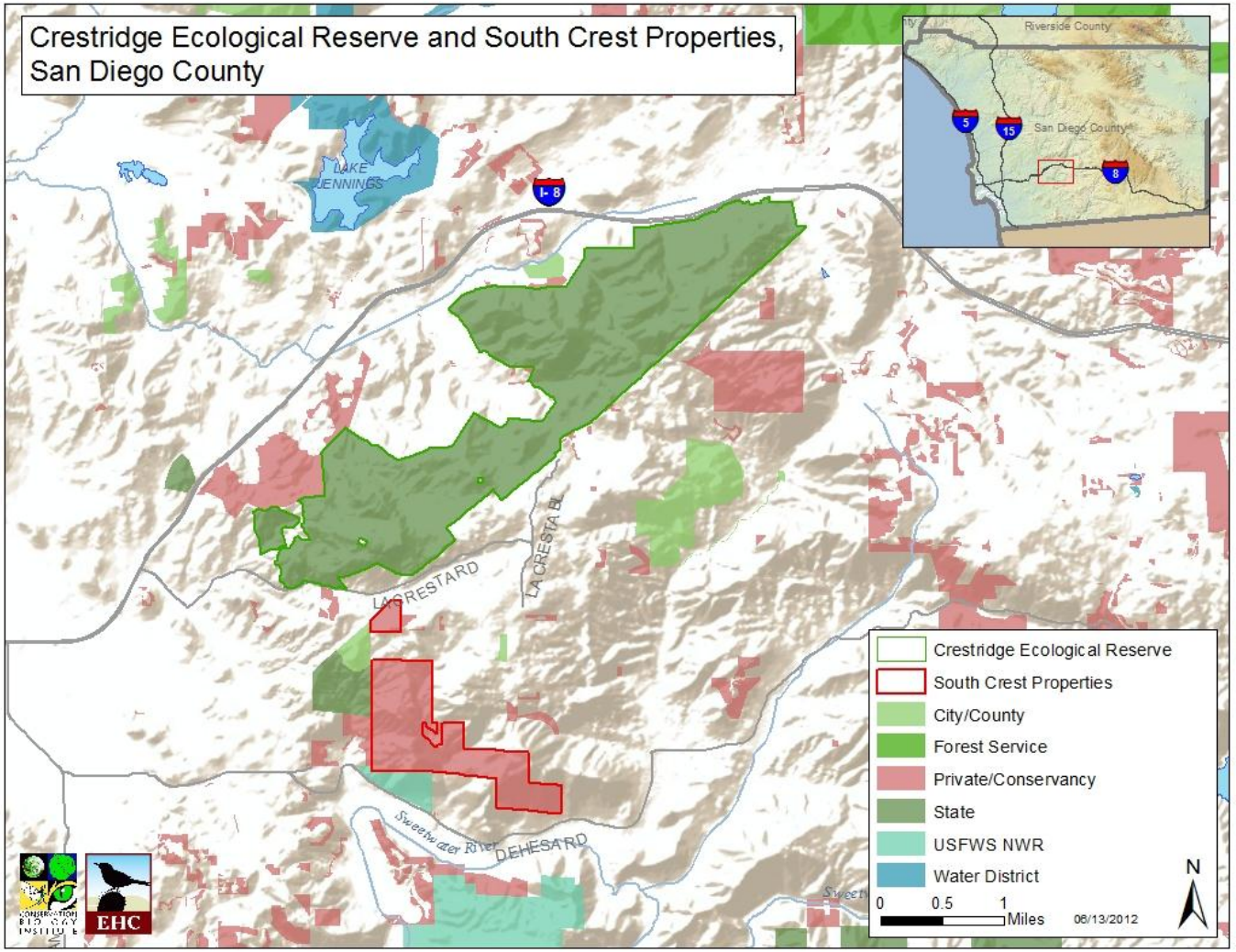

Figure 1. Project location.

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Table 1

Sensitive Plant Monitoring Activities on the
Crestridge Ecological Reserve and South Crest Properties[1]

Species	Activity	Site (Year)[1]
Acanthomintha ilicifolia (San Diego thornmint)	Presence/absence surveys	CER (2009-2011) South Crest (2011)
	Baseline monitoring	CER (2010-2011)
	Photopoint monitoring	CER (2010-2011)
Ceanothus cyaneus (Lakeside ceanothus)	Population Monitoring	CER (2009)
	Photopoint Monitoring	CER (2010-2011)
	Seed Collection	CER (2010-2011)
Dudleya variegata (Variegated dudleya)	Presence/absence surveys	South Crest (2011)
Nolina interrata (Dehesa beargrass)	Presence/absence surveys	South Crest (2011)
	Baseline and core monitoring	South Crest (2011)
---	Invasive species mapping	CER (2009-2012) South Crest (2011-2012)

[1] Includes monitoring activities conducted by CBI between 2009 and 2011 (post-2003 Cedar Fire).
[2] CER = Crestridge Ecological Reserve.

Task 1: Covered Species Monitoring

San Diego rare plant monitoring guidelines describe several covered species monitoring protocols, including baseline surveys, core monitoring, core + monitoring, and core + effectiveness monitoring (Tracey et al. 2011). In 2012, baseline surveys and differing levels of core monitoring were conducted on CER and South Crest. The four target covered species are discussed below with respect to monitoring methodology, results, and recommendations. Monitoring protocol was determined by date of detection, previous monitoring (if any), and site- and species-specific factors. A brief description of rush-like bristle weed (*Xanthisma junceum*), a sensitive but non-covered species detected onsite, is also provided. Refer to Table 2 for a description of monitoring protocols; Table 3 lists the status of covered and other sensitive species discussed in this document.

Table 2

San Diego Rare Plant Monitoring Protocols[1]

Protocols	Monitoring Purpose	Potential Monitoring Activities
Baseline Survey	Obtain an initial inventory for use in the later stages of a monitoring program	• Assign unique name • Map occurrence location • Identify general population area • Estimate population or patch size • Collect samples
Core Monitoring	Characterize plant populations and their habitat over time and space	• Detailed population mapping • Count-based or Index Plot-based population characterization • Characterize habitat
Core + Monitoring	Characterize plant populations and their habitat over time and space, document the range of plant performance, and relate environment to plant abundance and performance	• Monitor plant performance • Monitor environmental covariates
Core + Effectiveness Monitoring	Characterize plant populations and their habitat over time and space, document the range of plant performance, relate environment to plant abundance and performance, and evaluate the effectiveness of management actions	• Perform management experiments • Monitor the effects of management actions

[1] Tracey et al. 2011.

Acanthomintha ilicifolia (San Diego thornmint)

Methodology

Monitoring for San Diego thornmint was conducted on CER and South Crest and included presence-absence surveys, as well as baseline and core monitoring. When a new population was detected, baseline monitoring was implemented to obtain an initial

Table 3

Sensitive Plant Species Status[1]

Species	Site	Status[1,2]
Acanthomintha ilicifolia (San Diego thornmint)	Crestridge Ecological Reserve South Crest	USFWS: Threatened CDFG: Endangered MSCP: Covered CNPS: List 1B.1
Ceanothus cyaneus (Lakeside ceanothus)	Crestridge Ecological Reserve	USFWS: None CDFG: None MSCP: Covered CNPS: List 1B.2
Dudleya variegata (Variegated dudleya)	South Crest	USFWS: None CDFG: None MSCP: Covered CNPS: List 1B.2
Nolina interrata (Dehesa beargrass)	South Crest	USFWS: None CDFG: Endangered MSCP: Covered CNPS: List 1B.1
Xanthisma junceum (Rush-like bristleweed)	Crestridge Ecological Reserve[1] South Crest	USFWS: None CDFG: None MSCP: None CNPS: List 4.3

[1] USFWS = U.S. Fish and Wildlife Service; CDFG = California Department of Fish and Game; MSCP = San Diego Multiple Species Conservation Plan; CNPS = California Native Plant Society.
[2] See http://www.rareplants.cnps.org for CNPS list definitions.

inventory of size and location (Tracey et al. 2011). Core monitoring was also implemented to characterize plant populations and their habitat. Core monitoring will be conducted repeatedly to assess population status over time and space (Tracey et al. 2011).

Presence-absence surveys. On CER, surveys re-assessed the 2010-2011 thornmint population (CBI 2011a,b) and surveyed additional, potentially suitable habitat. On South Crest, surveys assessed all historic locations, as well as potentially suitable habitat in and around Skeleton Flats. Suitable habitat for thornmint was defined as clay or gabbro-derived soils with a unique suite of species, such as mock parsley (*Apiastrum angustifolium*), small-flowered morning-glory (*Convolvulus simulans*), Palmer's grapplinghook (*Harpagonella palmeri*), and erect evax (*Hesperevax sparsiflora*).

Field reconnaissance and surveys for thornmint were conducted by botanists Patricia Gordon-Reedy and Jessie Vinje and field assistant Curtis Battle according to the schedule in Table 4. Surveys were timed to maximize detection based on thornmint phenology. Survey methodology consisted of walking transects through potentially suitable habitat; surveyors were generally spaced no more than 2-3 meters (m) (ca. 6-10 feet [ft]) apart.

Table 4

2012 Covered Species Survey Schedule

Survey Personnel[1]	Survey Date	Species	Survey Location
JV/PGR	2/16/2012	San Diego thornmint	Crestridge Ecological Reserve (Thornmint Hill)
JV	3/28/2012	San Diego thornmint	Crestridge Ecological Reserve (Thornmint Hill)
JV/CB	5/2/2012	San Diego thornmint; Variegated dudleya	South Crest (Skeleton Flats and surrounding areas)
JV/CB	5/8/2012	Dehesa beargrass; San Diego thornmint	South Crest (Skeleton Flats and surrounding areas)
JV	5/9/2012	San Diego thornmint	Crestridge Ecological Reserve (Thornmint Hill)
JV/CB	5/15/2012	San Diego thornmint	South Crest (Skeleton Flats and surrounding areas)
JV/CB	5/23/2012	Dehesa beargrass; Variegated dudleya	South Crest (Skeleton Flats and surrounding areas)

[1] PGR = Patricia Gordon-Reedy; JV = Jessie Vinje; CB = Curtis Battle.

Baseline monitoring. Where new occurrences were detected, population size was counted directly or estimated, and locations recorded using a Garmin 60CSX Geographic Positioning System (GPS) hand-held unit. Population size and habitat information were recorded in field notes and California Native Species Field survey forms were completed (Appendix A). These forms were submitted to the California Natural Diversity Database (CNDDB) as part of the 2012 reporting process.

Core monitoring. Core monitoring data collection included occurrence size, vegetation characterization, identified threats, associated plant species and their percent cover, and any pertinent notes. Qualitative and quantitative data were recorded on San Diego

Regional Rare Plant Index Plot survey forms (Tracey et al. 2011) for all thornmint occurrences (Appendix B). Additionally, photographs of each occurrence were taken (Appendix C).

Results

CER. In 2010, 17 San Diego thornmint plants were located on Thornmint Hill (Figure 2; CBI 2011a). In 2011, only one plant was detected in this same location (CBI 2011b). In 2012, six thornmint plants were detected in this location (Appendix C, photos 6 and 7), and five survived to produce flowers, most likely due to management efforts described under Task 2 (Covered Species Management).

This small stand of thornmint is situated on a relatively steep, west-facing slope in open, disturbed coastal sage scrub. The stand is approximately 2 m^2 and occurs within a clay lens. Nonnative species found within this stand include red brome (*Bromus rubens*), which comprises about 10% of the vegetative cover, and annual plantain (*Plantago* spp.), which accounts for an estimated 5-7% of the cover. Both species appear to be in competition with thornmint and, in several cases, were completely encompassing thornmint plants. The affected thornmint plants were tall, presumably in response to the competition, and un-branched, with few leaves and a yellowish appearance due to lack of sunlight. In contrast, thornmint plants growing in full sunlight with little competition were dark green and leafy, multi-branched, and compact.

Threats to this stand include direct competition and displacement from nonnative (and possibly native) plants and potentially, a loss of gene flow due to small size and isolation. A larger stand of thornmint was documented in proximity to this occurrence in 2000, 2003, and 2004 (CBI and EHC 2009), but has not been observed in recent years and its status (extant versus extirpated) is unknown.

South Crest. In 2004, 18 thornmint seedlings were documented just south of the South Crest property boundary (REC Consultants, Inc. 2004). Surveys in 2011 failed to detect thornmint in this location (CBI 2012). The 2012 surveys also failed to locate thornmint plants at this historic site, although suitable habitat persists and supports co-occurring species. The historic site is heavily infested with purple false brome (*Brachypodium distachyon*). Thornmint may have been extirpated from this location as a result of the invasive grass infestation, or it may persist in the soil seedbank but is prevented from germinating because of the heavy thatch produced by this grass.

In 2012, two new San Diego thornmint occurrences were detected on South Crest in the low-lying hills just east of Skeleton Flats (Figure 3; Appendix C, photos 1-5). The larger occurrence (ACIL_01) supports approximately 950 plants and the smaller occurrence (ACIL_02) supports approximately 185 plants. The large occurrence is located on a

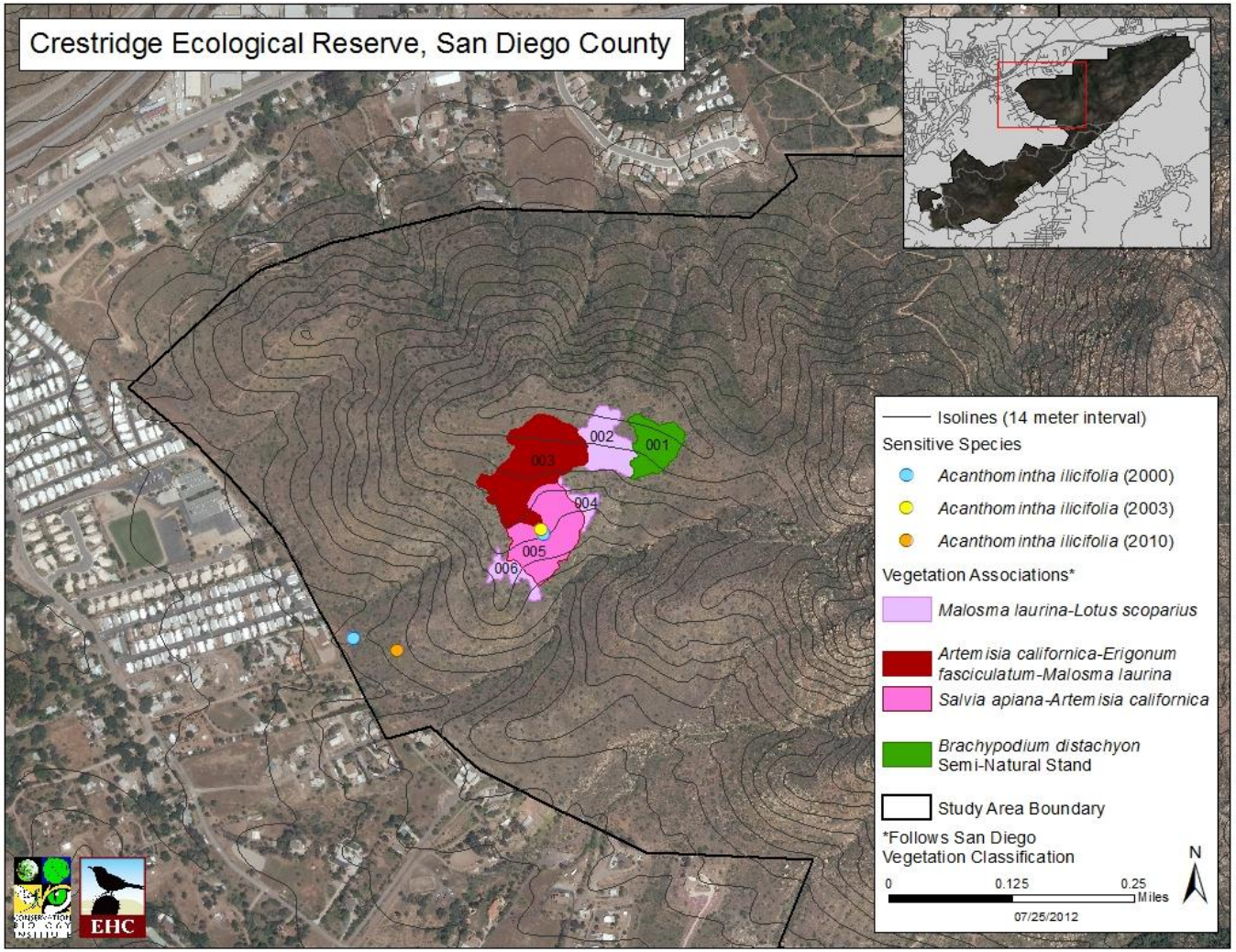


Figure 2. Location of *Acanthomintha ilicifolia* (San Diego Thornmint) on Thornmint Hill, Crestridge Ecological Reserve.

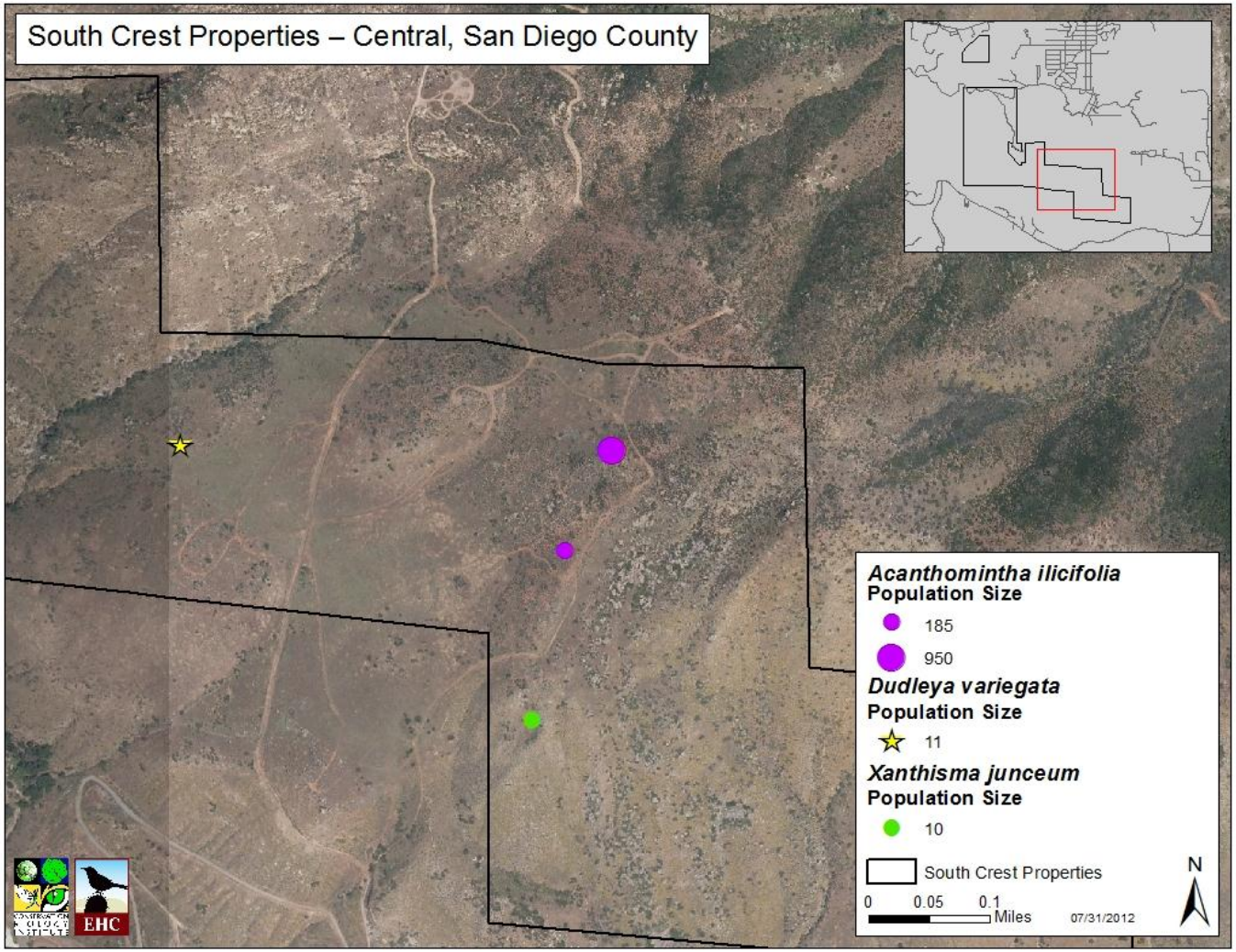


Figure 3. Sensitive plant locations, Skeleton Flats, South Crest properties.

steep, southwest-facing slope in a small opening within chaparral (*Adenostoma fasciculat*um Alliance). Plants are growing in open, exposed, gabbro-derived soils. The spatial extent of this stand is approximately 500 m^2, and it is characterized by high native plant cover, including San Diego thornmint, and low nonnative plant cover. San Diego thornmint cover is estimated at 20%, while tocalote (*Centaurea melitensis*), the dominant nonnative species, accounts for about 10% of the vegetative cover. An estimated 50-75% of occupied habitat consists of bare ground. Threats to ACIL_01 include nonnative plants (specifically, purple false brome and tocalote), deer browsing, and off-highway vehicles (OHVs). The potential for OHV impacts is considered relatively low at this time, because dense chaparral lies between the stand and a dirt road to the east.

The smaller occurrence (ACIL_02) is located to the southwest on a gentle, northwest-facing slope in open coastal sage scrub (*Gutierrezia* (*californica, sarothrae*) Provisional Alliance) (Figure 2). Soils are gabbro-derived and the relatively sparse vegetation includes native shrubs, forbs and bunchgrasses. This area is bounded on the north and west by intact habitat (southern mixed chaparral), while a dirt road lies to the east and south. Although habitat quality is good, nonnative plant cover is slightly higher and bare ground cover lower than in ACIL_01. San Diego thornmint cover is estimated at 10-15% in this stand, while tocalote, the dominant nonnative species, accounts for about 5% of the vegetative cover. Threats include nonnative plants (tocalote, smooth cat's ear [*Hypochaeris glabra*]), deer browsing, and OHVs. Because the dirt road is approximately 60 ft east of this stand and OHV use appears to be relatively low away from trails, the potential for direct impacts to this stand are considered low at this time. However, OHV use on the adjacent dirt trail was observed in spring 2012.

Recommendations

CER. San Diego thornmint surveys should continue to be conducted annually to (1) determine the extent of the population onsite (presence/absence surveys and baseline monitoring) and (2) assess population status and threats (core monitoring). Where populations are small, direct population counts should be conducted and population boundaries re-mapped to determine the maximum extent of occupied habitat. Mapping population boundaries is particularly important with annual species, which exhibit a high degree of both spatial and temporal variation. An assessment of population status should include site conditions, threats, and potential pollinators.

To date, data collection within the small thornmint stand has consisted primarily of core monitoring (Tracey et al. 2011), which includes population mapping, count-based monitoring, and habitat characterization. In addition to core monitoring, future monitoring efforts at this site should include elements of (1) core + monitoring and (2) core + effectiveness monitoring (Tracey et al. 2011). The core + monitoring protocol is

designed to document the range of plant performance and relate environmental factors to plant abundance and performance. Therefore, future monitoring should include data on survival and condition of plants, fecundity, growth, and environmental covariates, as appropriate and feasible. Core + effectiveness monitoring is designed to evaluate the effectiveness of management actions. Although the thornmint occurrence is currently too small to develop a valid experimental design as stipulated in the protocol, qualitative assessments of plant response to management actions should be recorded.

Both the existing and historic thornmint stands on CER are threatened by frequent fires and invasive plants. Invasive plant control measures are currently being implemented on Thornmint Hill as part of a SANDAG Environmental Mitigation Program (EMP) grant to control purple false brome within historic thornmint habitat. However, the small occurrence noted and monitored in 2011-2012 falls outside this project area; thus, localized, site-specific weed control measures should continue at this location, as described under Task 2 (Covered Species Management).

Depending on results of monitoring and management, augmentation may be required to bolster population size and reduce the potential for genetic erosion and/or extirpation. Because thornmint is an annual species, augmentation would occur via seed. Seed source is an important consideration in an augmentation program. Ideally, seed would be collected onsite, bulked offsite (grown in a controlled setting to increase amount of seed), and reintroduced into the site. However, if the amount of seed onsite is not adequate for a bulking program, seed might be collected from larger and more stable occurrences elsewhere in southern San Diego County, subject to genetic compatibility. Genetically distinct populations would not be appropriate for introduction purposes. The Center for Natural Lands Management is currently conducting a San Diego thornmint genetics study (to be completed late 2013) that will be useful in determining appropriate source populations. Collection of San Diego thornmint seed could require federal and/or state collecting permits, depending on land ownership at the collection location.

To summarize, specific recommendations for monitoring and managing the small population of San Diego thornmint on CER in 2013 include:

1. Conduct presence/absence surveys and baseline and core monitoring (as appropriate). Data should be collected per the San Diego rare plant monitoring protocols (Tracey et al. 2011).
2. Implement elements of core + monitoring and core + effectiveness monitoring to assess plant performance and the efficacy of weed control efforts.
3. Continue weed control efforts.
4. Assess the need for species augmentation.

South Crest. The two thornmint occurrences on South Crest appear in good condition but are threatened primarily by nonnative plants, deer grazing, and possibly, OHVs. Monitoring recommendations include:

1. Monitor on an annual basis, as described above for thornmint on CER.
2. Conduct annual weed maintenance at both locations for 3-5 years (subject to results). Maintenance should include hand-weeding or clipping of purple false brome and other nonnative grasses and forbs at ACIL_01, with a focus on those species with the greatest capacity to impact thornmint. In addition, herbicide spot treatments for annual broadleaf forbs may be utilized at both occurrences, as needed. After 3-5 years, weed control may be shortened to every other year, depending on nonnative grass and forb cover.
3. Install fencing at the northern property boundary to exclude vehicular traffic from the site.

Ceanothus cyaneus (Lakeside ceanothus)

In 2010, CBI established permanent photopoints to monitor selected populations of sensitive species through photodocumentation. The 2010 monitoring effort developed a baseline photographic record of habitat/site conditions for Lakeside ceanothus. This photomonitoring is intended to provide a qualitative record of changing habitat conditions, including invasive species, successional changes, erosion, or other disturbances that might warrant management considerations. This monitoring is not designed to provide estimates of population density or cover, nor does it replace more intensive (protocol) species monitoring. Rather, it is intended to supplement species monitoring and provide an 'early warning' system in interim years where more intensive monitoring is not conducted.

Methodology

Lakeside ceanothus occurs in the eastern half of CER; refer to the 2011 annual monitoring report (CBI 2011b) for the location of all photopoints. In 2012, photomonitoring was conducted at all points except CECY_8 due to access constraints. Photopoints were originally sited to provide an advantageous view of the plant population or stand of interest. At each photopoint location, a permanent marker – or *monument marker* – was installed in 2010. We relocated survey markers and used photographic logs (see CBI 2011a, Appendix C) to replicate approximate location and photo-direction of 2010 photographs. In 2012, photopoint monitoring was conducted on May 8 for photopoints CECY_1-4 and on May 24 for CECY_5-7.

Results

The photodocumentation record for 2012 is presented in Appendix D, and includes 2010-2012 photographs to provide a multi-year comparison of site conditions. The photo record for Lakeside ceanothus sites shows little inter-annual variability other than phenological conditions. However, visual observations did identify a few locations of concern:

- Photo 2.8. There is a small infestation of the nonnative, invasive grass Natal grass (*Melinis repens*) at this location. An individual plant can be seen in the bottom center of the photograph.
- Photo 5.4. Nonnative grasses and forbs are evident adjacent to the rock outcrops in this photo.
- Photo 6.4. Nonnative grasses and forbs are evident in the open area in the lower, right quarter of this photo.

Recommendations

Photopoint monitoring provides a relatively efficient and cost-effective method for monitoring changes in habitat and population conditions. Set-up of photomonitoring points is the most time-intensive phase of this monitoring activity. Now that points have been established, photographic documentation should be conducted at these points annually to allow for a 'rapid response' to impacts or changing habitat conditions. Photopoint monitoring should be supplemented by more detailed species monitoring at less frequent intervals (e.g., every 3-5 years; last conducted in 2009).

Based on results of the 2012 photopoint monitoring, which indicated the presence of invasive plants at several locations, we recommend the following measures:

1. Conduct weed control efforts (hand-pulling or herbicide application) at photopoint 2 to eliminate Natal grass.
2. Qualitatively assess nonnative grasses and forbs at photopoints 5 and 6; implement invasive control measures if these species appear to be expanding in extent.
3. Continue yearly photopoint monitoring until 2014 (subject to budget constraints) to produce a 5-year record of site conditions. At that time, re-assess the value of yearly monitoring and adjust the photomonitoring frequency, if warranted.

Dudleya variegata (Variegated dudleya)

Methodology

Monitoring for variegated dudleya was conducted on South Crest and included presence-absence surveys and baseline monitoring, as described for San Diego thornmint (above).

Presence-absence surveys. Surveys assessed all historic locations, as well as potentially suitable habitat in and around Skeleton Flats. Potentially suitable habitat for variegated dudleya was defined as clay soils.

Surveys for variegated dudleya were conducted by botanist Jessie Vinje and field assistant Curtis Battle according to the schedule in Table 4. Surveys were timed to maximize detection based on variegated dudleya phenology. Survey methodology consisted of walking transects through potentially suitable habitat; surveyors were generally spaced no more than 2-3 m (ca. 6-10 ft) apart.

Baseline monitoring. Where this species was detected, population size was counted directly, and locations recorded using a Garmin 60CSX Geographic Positioning System (GPS) hand-held unit. Population size and habitat information were recorded in field notes and California Native Species Field Survey Forms were completed (Appendix A). These forms were submitted to the CNDDB as part of the 2012 reporting process.

Results

Previous surveys for this species (2002/2004) located approximately 3,915 plants (REC Consultants, Inc. 2004) on South Crest and on adjacent private land. Of this total, approximately 347 plants were located on South Crest. The site burned in the 2003 Cedar Fire, and this species was not detected in 2011. In 2012, 11 plants were located on the South Crest property (Figure 3) in a location that does not coincide with the 2002/2004 occurrences. In addition, many more individuals were located offsite, on private property adjacent to and south of South Crest. All plants were growing in areas heavily dominated by purple false brome (Appendix C, photograph 8).

Recommendations

Variegated dudleya is threatened by invasive plants, altered fire regime, and recreational use (including ORVs). Baseline monitoring was conducted for this species in 2012. Because this species is somewhat cryptic and the degree of flowering fluctuates on a yearly basis, we recommend the following:

1. Conduct presence/absence surveys and baseline monitoring to determine the maximum extent of the population on South Crest.

2. Implement core monitoring within mapped occurrences to assess population status and threats. Data should be collected per the San Diego rare plant monitoring protocols (Tracey et al. 2011).

Portions of both extant and historic stands of variegated dudleya on Skeleton Flats occur within an active restoration area. Thus, effectiveness monitoring for this species, which will evaluate the effectiveness of management actions, will occur in conjunction with restoration monitoring under the separate EMP grant.

Nolina interrata (Dehesa beargrass)

Methodology

Baseline mapping of Dehesa beargrass was conducted in 2010-2011 as part of a SANDAG EMP grant (CBI 2012). The 2012 mapping effort established index plots for long-term monitoring.

Three index plots were established on South Crest to monitor Dehesa beargrass (Figure 4). An index plot is a clearly delineated area in which plants are monitored using various methods related to abundance within the plot. Additional observations (e.g., plant phenology, size, and health) may be made within index plots, depending on the level of monitoring effort. Because index plots are not random or systematic samples, they cannot be used to make inferences about the entire plant population, i.e., results are specific only to the index plot (Tracey et al. 2011).

Index plots were placed subjectively within Dehesa beargrass patches identified in 2011 (CBI 2012). Plot dimensions are 50 m x 100 m (5000 m^2), and plots are permanent (i.e., they will be revisited repeatedly). Additional attributes used to determine plot placement included soil type, distribution of purple false brome, slope aspect, fire history, and Dehesa beargrass population size. Table 5 identifies beargrass patches in each plot. Refer to CBI 2012 for further description and location information for these patches.

Index plot corners were marked using 2-ft long rebar with white PVC pipe cut to fit over the top of the rebar. All four corners were marked using the rebar-PVC pipe combination, except for Index Plot 1. In this case, the white PVC was removed from the rebar in the NE and NW corners to make it less visible and thus, less susceptible to vandalism. Each photomonitoring location was marked in the same manner using 1-ft (versus 2-ft) long rebar.

Both quantitative and qualitative data were collected in index plots using the San Diego Regional Rare Plant Index Plot survey form (Tracey et al. 2011). Data included ramet numbers, percent cover of Dehesa beargrass and other species, habitat characterization,

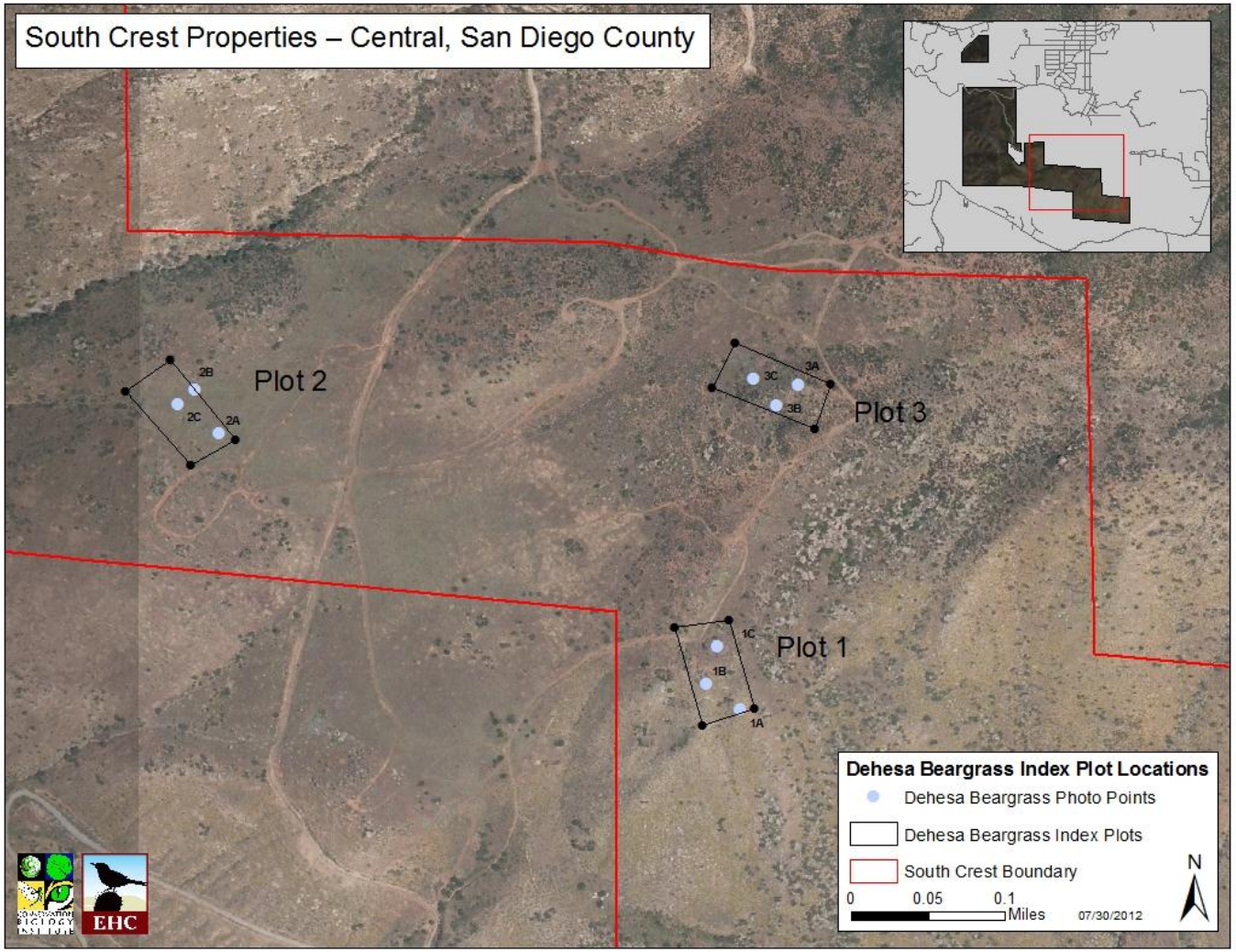


Figure 4. *Nolina interrata* (Dehesa Beargrass) index plot locations, Skeleton Flats, South Crest properties.

Table 5

Nolina interrata (Dehesa Beargrass) Patches within Index Plots

Index Plot	Patch Number[1,2]
1	94, 95, 96, 97
2	57
3	74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88

[1] Refer to CBI 2012 for patch numbers, locations, and attribute information.
[2] Index plot includes all or a portion of the identified patch.

and threats. Three photopoints were established within each plot. These photopoints depict Dehesa beargrass clusters. At each photopoint, measurements were taken on length, width, and height of beargrass clusters. The number of ramets (rosettes) was directly counted at one photopoint within each plot. San Diego Regional Rare Plant Index Plot survey forms and species lists are included in Appendix E. Photographs are included in Appendix F, with index plot corners depicted in photos 1-12 and photo plot locations shown in photos 13-21. Data collected within each index plot is summarized in Table 6.

Results

Index plot monitoring for Dehesa beargrass had 5 objectives:

1 Characterize existing habitat;
2 Sample ramets to establish baseline conditions for assessing population stability; ramets will be re-visited over time to determine if they are stable, expanding, or contracting. Dehesa beargrass is a clonal species and vegetative spread by ramets is its primary means of reproduction.
3 Determine percent cover of Dehesa beargrass in index plots. This information will be used in conjunction with ramet sampling to determine population stability.
4 Establish permanent photopoints at each index plot to qualitatively assess changes in population size or extent, habitat conditions, and disturbances over time.
5 Assess threats or stressors that may threaten the viability of Dehesa beargrass and cause negative trends in population size.

Index Plot 1

Habitat Characterization. This plot is located on gabbro-derived soils in the southern portion of Skeleton Flats (Figure 4). The northern half of the plot is on a relatively flat to

Table 6

Nolina interrata (Dehesa Beargrass) Photopoint Data

Index Plot	Photo Point	Photo Direction	Height (m)[1]	Width (m)[1]	Breadth (m)[1]	Volume (m^2)[2]	# of Ramets[3]
1	1-A	NE 6 degrees (°); 4 feet (ft) in front of pvc pipe	1.50	1.84	2.62	3.76	74
1	1-B	N 15°; 3 ft in front of pvc pipe	1.50	2.60	2.50	5.07	nc
1	1-C	SE 146° (pvc in middle of cluster)	0.93	3.30	3.60	5.75	nc
2	2-A	S 163° (yellow mason line delineates cluster)	1.05	3.00	4.10	6.72	nc
2	2-B	NW 299°; 3 ft in front of pvc pipe.	1.28	3.20	3.90	8.31	nc
2	2-C	W 253°; 3 ft in front of pvc pipe	0.85	1.50	4.30	2.85	42
3	3-A	E 82°; 5 ft in front of pvc pipe	1.00	2.90	3.60	5.43	nc
3	3-B	SE 116°; 3 ft in front of pvc pipe.	1.13	2.00	3.70	4.35	35
3	3-C	S 159°; 6 ft in front of pvc pipe.	1.04	3.30	3.80	6.78	nc

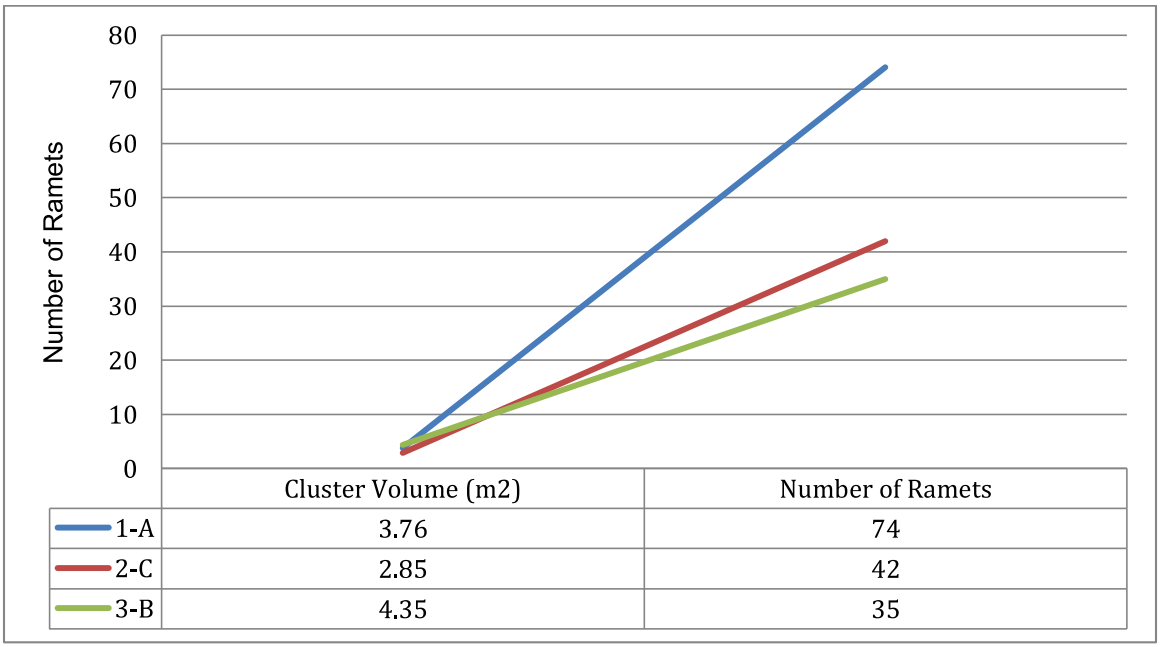
[1] Refers to cluster (height, width, or breadth).
[2] Cluster volume = A × (average patch height) for patches ≥1 m.

slightly south-facing slope, while the southern half occurs on a steep, south to southeast-facing slope. The majority of the plot burned in 2003, in either the Cedar or Dehesa fires; vegetation appears to have recovered well from both events. The plot is characterized by southern mixed chaparral in the north and coastal sage scrub in the south. Dominant native shrubs include San Diego viguiera (*Bahiopsis laciniata*), California sage (*Artemisia californica*), and sugarbush (*Rhus ovata*) (10, 5, and 3% cover respectively). Nonnative plant cover is relatively low with tocalote, smooth cat's ear, and narrowleaf cottonrose (*Logfia gallica*) comprising 10, 4, and 4% cover, respectively. Trace amounts of purple false brome were documented only in the northern half of the plot. Overall plot quality is rated as *fair-good* (Appendix E).

Ramet Sampling. Ramets were sampled at one of the three photopoints in this plot: photopoint 1-A. An estimated 74 ramets were counted in this cluster. Refer to Table 6 for cluster dimensions. The small sample size precluded an analysis of the relationship between cluster size and number of ramets; nonetheless, data collected to date is presented in Figure 5.

Figure 5

Nolina interrata (Dehesa Beargrass) Cluster Volume and Ramet Number



	Cluster Volume (m2)	Number of Ramets
1-A	3.76	74
2-C	2.85	42
3-B	4.35	35

Dehesa Beargrass Cover. Based on a visual assessment, Dehesa beargrass cover within this plot is approximately 2-3%.

Photopoint Monitoring. Refer to Appendix F for all photos related to this plot. Photopoint 1-A (Appendix F, photograph 13) shows the Dehesa beargrass cluster that

supports 74 ramets (Table 6). Appendix F also depicts photopoints 1-B and 1-C; however, no ramet data were taken for these clusters.

Threats. Identified threats include nonnative plants and a dirt road that traverses the northern portion of the plot. Nonnative plant cover is relatively low; however, the northern portion of the plot supports some nonnative grasses (i.e., red brome, purple false brome) and forbs, including two Sahara mustard plants (*Brassica tournefortii*). Sahara mustard is highly invasive and detrimental to native annuals and perennial seedlings (Cal-IPC 2005). Human-related activities, including OHV, mountain bike, or hiking along the dirt road may promote nonnative seed dispersal.

Index Plot 2

Habitat Characterization. This plot is located on clay soils on a slightly northwest-facing slope in the northeastern portion of Skeleton Flats (Figure 4). The entire plot burned in the 2003 Cedar Fire, and vegetation has not recovered fully from this event. Vegetation includes nonnative grassland in the southeast quarter and coastal sage scrub/native grassland in the remainder of the plot. Nonnative grassland is dominated by wild oats (*Avena* sp.), whereas the rest of the plot is dominated by native and nonnative grasses and coastal sage shrubs. Purple false brome dominates the plot, comprising approximately 50% of the vegetative cover. Native bunchgrasses (*Stipa pulchra* and *S. lepida*) account for an estimated 7% of the cover. Overall site quality is rated as *poor* (Appendix E).

Ramet Sampling. Ramets were sampled at photopoint 2-C. An estimated 42 ramets were counted in this cluster. Refer to Table 6 for cluster dimensions and Figure 5 for a graphic presentation of cluster volume and number of ramets.

Dehesa Beargrass Cover. Based on a visual assessment, Dehesa beargrass cover within this plot is approximately 3%.

Photopoint Monitoring. Refer to Appendix F for all photos related to this plot. Photopoint 2-C (Appendix F, photograph 18) shows the Dehesa beargrass cluster that supports 42 ramets (Table 6). Appendix F also depicts photopoints 2-A and 2-B; however, no ramet data were taken for these clusters.

Threats. Identified threats include nonnative grasses and erosion. Nonnative grasses form a thick layer of dry thatch around each of the Dehesa beargrass clusters in this plot (Appendix F, photos 16-18). In addition, a small gully in the southwest portion of this plot is directly impacting several beargrass clusters. As runoff funnels through this gully, soil erodes from gully banks, exposing beargrass roots and undermining cluster stability.

Index Plot 3

Habitat Characterization. This plot is located on gabbro-derived soils on a west-facing slope near the eastern boundary of Skeleton Flats (Figure 4). The entire plot burned in the 2003 Cedar Fire, and vegetation has recovered well from this event. The northwest quarter of the plot supports nonnative grassland dominated by wild oats and coastal sage scrub. The remainder of the plot supports chaparral dominated by woolyleaf ceanothus (*Ceanothus tomentosus*). Trace amounts of purple false brome occur within this plot. Overall plot quality is rated at *very good-excellent* (Appendix E).

Ramet Sampling. Ramets were sampled at photopoint 3-B. An estimated 35 ramets were counted in this cluster. Refer to Table 6 for cluster dimensions and Figure 5 for a graphic presentation of cluster volume and number of ramets.

Dehesa Beargrass Cover. Based on a visual assessment, Dehesa beargrass cover within this plot is approximately 1-2%.

Photopoint Monitoring. Refer to Appendix F for all photos related to this plot. Photopoint 3-B (Appendix F, photograph 20) shows the Dehesa beargrass cluster that supports 35 ramets (Table 6). Appendix D also depicts photopoints 3-A and 3-C; however, no ramet data were taken for these clusters.

Threats. Identified threats include nonnative plants. Nonnative grasses are prominent in the northwest corner of this plot and form a thick thatch layer around some of the beargrass clusters. However, most beargrass clusters grow in open chaparral in the eastern portion of the plot and are not directly affected by nonnative grasses at this time.

Recommendations

In 2012, 3 index plots were established for Dehesa beargrass on Skeleton Flats to characterize the beargrass population and its habitat over time (core monitoring). Index plot data will be used to assess whether the Dehesa beargrass population onsite is stable, increasing, or declining by monitoring population structure over a 10-year time period.

Data collection focused on several components: (1) ramet sampling was initiated to assess long-term survival and refine counting methods for this species; (2) cover estimates provided additional baseline metrics for assessing long-term survival and changes in population status; (3) photopoint monitoring provided a visual record of index plot condition; and (4) threat assessments identified existing or potential threats to the population that may require management measures. Based on this monitoring effort, the following recommendations are provided to enhance future monitoring and/or implement adaptive management measures.

1. Ramet sampling. In 2012, ramets were counted at only one photo-point location per index plot due to time constraints. In order to improve sample size, ramets should be counted at a minimum of 5 clusters within each index plot. Clusters should be randomly distributed, identified by a unique occurrence number (see CBI 2012), and permanently marked to facilitate re-location. In addition to number of ramets per cluster, data should be collected on cluster size (width, breadth, height, area, volume) to assess correlations (if any) between ramet number and cluster size. Additional ramet sampling should occur in 2014, and then at 2-year intervals unless the population (or plots) are disturbed or subject to management activities.
2. Plot re-sampling. Per recommendations provided in CBI 2012, index plots should be monitored at 2-year intervals to assess growth and collect data on vegetative production, ramet growth and mortality, and associated species. At each monitoring period, data should be analyzed to assess trends. The next index plot data collection event should be conducted in 2014. In the event of a burn, data should be collected annually for 3-5 years post-burn to detect vegetation changes and assess beargrass recovery.
3. Photopoint monitoring. Photopoint monitoring should be conducted yearly at all index plots.
4. Threat assessment. Because threats were identified for all index plots, a threat assessment should be conducted yearly.
5. Population structure data. Per recommendations in CBI 2012, population structure data (size class, frequency of lowering, sex ratios) should be collected yearly in the 3 index plots over a 10-year time period. These data will be used to assess the need for augmentation with male plants or pollen if the population is determined to be monomorphic (e.g., consists of female plants only or a low-high female-male ratio).
6. Nonnative weed control. Selected herbicide treatments are recommended within all index plots. Index plot 2 occurs within a larger restoration area and weed control efforts in that plot will be treated and monitored as part of the separate EMP grant. In index plots 1 and 3, herbicide treatments are recommended for nonnative grasses and forbs. It is anticipated that treatments will occur annually for 5 years or until assessments indicate that the target species are adequately controlled. If the Sahara mustard occurrence remains small, hand-pulling individuals prior to flowering or seed set is recommended.

Xanthisma junceum (Rush-like Bristleweed)

Rush-like bristleweed was not a survey target; however, 10 plants were detected in the southeastern portion of Skeleton Flats during covered species surveys (Figure 3;

Appendix C, photographs 9 and 10). Rush-like bristleweed is on the California Native Plant Society (CNPS) List 4.3, which includes plants that are limited in distribution or infrequent throughout a broader area in California and not very threatened in California (CNPS 2012).

Because rush-like bristleweed is not a covered species, annual surveys or specific management measures are not recommended at this time. This species was found in association with an invasive plant, Sahara mustard. All Sahara mustard plants should be removed by hand-pulling.

Task 2: Covered Species Management

Acanthomintha ilicifolia (San Diego Thornmint)

In 2012, selected management was conducted for San Diego thornmint populations. These actions, which occurred primarily on CER and, to a lesser degree, on South Crest, consisted of reducing competition from native and nonnative plants within occupied habitat. A description of methodology, results (CER only), and recommendations are presented below; refer to Appendix G for photographs of management areas.

Methodology

A number of methods are available to control competitive plants in occupied San Diego thornmint habitat, including herbicide application using backpack sprayers and weed wands, line trimmers, hand-pulling, and clipping. Clipping of competitive plants was chosen as the most appropriate method to use within San Diego thornmint habitat on CER because of the proximity of competitive plants to thornmint plants and the small size of the occupied habitat (ca. 2.5 m^2).

On CER, occupied habitat was located in the field and the boundaries marked using four pieces of 1-ft long rebar installed at four corners to form a rectangle (quadrat) with the following measurements: 1 m x 2.5 m (Appendix G; Photographs 1 and 2). A meter tape measure was used to connect all four corners to form a rectangle (quadrat). All known San Diego thornmint individuals were included within this quadrat.

The following information was collected prior to clipping:

- A photograph of the clipping area (Appendix G; Photograph 2).
- A photograph of a San Diego thornmint seedling (Appendix G; Photograph 5).
- Compass bearing from the photo location (i.e., North 77 degrees East).
- Plant species list within occupied habitat (the quadrat).

- Percent cover (obtained visually) for all species within the quadrat.
- Number of San Diego thornmint plants in the quadrat.
- Recording of time to clip the entire quadrat.

Two types of snips or scissors were used to clip the competitive vegetation (Appendix G; Photograph 3). One type (small snips) was used for small plants growing close to the soil surface and the larger scissors were used for dry grass thatch and tall competitive grasses and forbs. All living, competitive plants were clipped at the soil surface where the stem met the root. In some cases, competitive plants were hand-pulled, but this method disrupted the soil and was used infrequently. All competitive plants were clipped within the quadrat and in an area that extended approximately 0.25 m beyond the tape measure boundary to limit nonnative seed dispersal into the quadrat.

Care was taken while clipping to avoid stepping on or impacting San Diego thornmint and other native plants. All clipping was done by kneeling, sitting, or standing outside the quadrat. Clipped vegetation was placed in a plastic bag and removed from CER.

On South Crest, purple false brome was hand-weeded from ACIL_01; however, pre- or post-management data was not recorded.

Results

Six San Diego thornmint seedlings were located during the initial clipping effort, but upon return, only five plants were located. Several of the seedlings would not have been detected if clipping had not occurred because of the competitive plant species cover. These plants would likely have died from competition. Photograph 5 (Appendix G) depicts a San Diego thornmint seedling prior to clipping; Photograph 6 (Appendix G) depicts the same seedling after clipping.

Eighteen plant species were observed growing in the quadrat (Table 7). Of this total, six (32%) were nonnative plants.

The two most common plants in occupied thornmint habitat were both nonnative species: red brome at approximately 10% cover and dwarf plantain (*Plantago virginica*) at approximately 5-7% cover. The two most common native plants encountered were Palmer's grapplinghook and onion (*Allium* spp.) at about 1% cover, respectively. All other species composed less than 1% cover within occupied thornmint habitat. Photographs 7-10 (Appendix G) depict habitat within the quadrat at various stages throughout the clipping process.

The initial clipping occurred early in the growing season which made it difficult, in some cases, to identify plants to specific epithet. Additionally, the native grass, six-weeks

Table 7

Plants Detected in Occupied *Acanthomintha ilicifolia* (San Diego Thornmint) Habitat, Crestridge Ecological Reserve

Scientific Name	Common Name
Acanthomintha ilicifolia	San Diego thornmint
Acmispon [=*Lotus*] *wrangelianus*	Calf lotus
Allium spp.	Onion
Aristida adscensionis	Six-weeks three-awn
Brassica nigra[1]	Black mustard
Bromus madritensis[1]	Red brome
Calystegia macrostegia	Morning-glory
Centaurea melitensis[1]	Tocalote
Chlorogalum parviflorum	Soap-plant
Deinandra fasciculata	Fascicled tarplant
Erodium cicutarium[1]	Red-stem filaree
Filago spp.	Filago
Harpagonella palmeri	Palmer's grapplinghook
Lepidium nitidum	Shining peppergrass
Plantago erecta	Plantain
Plantago virginica[1]	Dwarf plantain
Salvia apiana	White sage
Sonchus oleraceus[1]	Prickly sow-thistle

[1] Denotes nonnative plant species.

three-awn (*Aristida adscensionis*), was identified initially as the nonnative grass, rat-tail fescue (*Festuca myuros*), and was clipped. As the season progressed and more mature specimens were located, six-weeks three-awn was identified correctly and clipping of this native plant was discontinued.

On South Crest, data were not collected on the effects of weed control on thornmint.

Recommendations

The clipping methodology is relatively precise, i.e., very few native plants were accidentally clipped and no San Diego thornmint seedlings were directly impacted. The drawback to this method is that it disrupts the soil surface, potentially opening up gaps that may be colonized or invaded by nonnative plants. In most cases, the snips had to be pushed into the ground underneath the plant to clip the stem at the root. Despite the soil disturbance generated in this process, clipping was deemed less disruptive to the soil than hand-pulling plants. Broad spectrum herbicides have been used to control competitive plants in occupied San Diego thornmint habitat in other preserves in San Diego County; however, this method does not work with grasses (CNLM 2009) and the chances of incidental impacts to native plants (including San Diego thornmint) from herbicide drift may be considered greater than impacts from clipping (J. Vinje, pers. obs.).

Labor expended clipping versus herbicide application is approximately the same in most cases, but depends on the density of San Diego thornmint and the plants targeted for control. Both methods require time to be thorough and avoid impacting native plants (including thornmint). Clipping works well in small areas, while herbicide application might be more appropriate in larger habitat patches. Ultimately, the control method used in occupied San Diego thornmint habitat should be site-specific and based on occupied patch size, thornmint density, target plant density and habit (grass versus forb), and available weed control budget. No one method appears to be appropriate for all occupied San Diego thornmint occurrences.

We assume there is an established weed seed bank within and adjacent to this small thornmint stand. In addition, this occurrence is situated on a mid- to lower slope, and may be susceptible to gravity-dispersed native and nonnative seeds from upslope. Based on 2012 clipping results and site-specific conditions, we recommend the following:

1. Clip competitive plants annually for 3-5 years (as determined by monitoring results) to reduce competition with San Diego thornmint plants.
2. Assess the effects of clipping annually *and* at the end of the 3-5-year period to determine whether clipping has benefitted thornmint and its habitat. While an increase in thornmint population size is desirable, the thornmint seed bank may be limited. In addition, thornmint is an annual species that is expected to exhibit temporal variation. Thus, an improvement in habitat may not necessarily result in an increase in population size. Qualitative and quantitative data should be collected using monitoring methods and data forms described for this species in Task 1 (Covered Species Monitoring).

On South Crest, the following management actions are recommended:

1. Hand-clip purple false brome within ACIL-01 annually for 3-5 years. Other nonnative grasses and forbs at this site should also be hand-weeded, clipped, or treated selectively with herbicide, as necessary, including tocalote, black mustard (*Brassica nigra*), sowthistle (*Sonchus* spp.), red brome, filaree (*Erodium cicutarium*), and crete weed (*Hedypnois cretica*). If hand removal and/or clipping is too time consuming, efforts should focus on purple false brome, red brome, tocalote, and crete weed as these species have the capacity to outcompete San Diego thornmint.
2. Assess the effects of hand-weeding or clipping annually *and* at the end of the 3-5-year period to determine whether clipping has benefitted thornmint and its habitat. Qualitative and quantitative data should be collected using monitoring methods and data forms described for this species in Task 1 (Covered Species Monitoring).

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