Management Priorities for Invasive Non-native Plants

A Strategy for Regional Implementation, San Diego County, California

Prepared for:

San Diego Association of Governments

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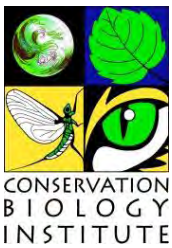
Prepared by:

Dendra Inc.



September 2012

Executive Summary

San Diego County's Natural Community Conservation Programs (NCCP) are challenged with management and monitoring of approximately 200,000 acres of conserved lands in the western region of the county, with invasive species-both plants and animals−being one of the greatest threats to ecological processes and persistence of rare species. The Conservation Biology Institute (CBI), Dendra, Inc., and California Invasive Plant Council (Cal-IPC) have been working with land managers in developing the State's first strategic plan for management and monitoring of invasive plant species on a regional level. This project has included:

- Guiding the collection of invasive plant distribution data by mapping contractors (AECOM).
- Conducting detailed impact assessments for regionally important invasive plants, using a modified form of the standard Plant Assessment Forms (PAF) developed by Cal-IPC, with transparent and detailed scoring and evaluations specific to the western San Diego region.
- Developing a strategic plan that identifies priorities for near-term management and monitoring on a regional basis.

This document incorporates the results of these efforts and serves as a multi-year framework and reference for near-term implementation of invasive plant control in the region. This document is intended to be a starting point for review and refinement, as land managers learn more about the distribution and impacts of invasive plants and how best to control them, recognizing that priorities and funding will change over time. A subsequent document will suggest an organizational framework for long-term implementation of the recommendations herein.

This strategic plan prioritizes on-the-ground projects based on invasive plant impacts, with special consideration of narrow endemic species covered by the Natural Community Conservation Planning (NCCP) programs, management goals, and feasibility of successful implementation. Discussions with land managers were and continue to be critical to this process. Plant Assessment Forms for the 55 species reviewed as part of this project are available for review and download at:

http://sdmmp.com/management/Management_MainPage.aspx.

Of these, 29 species are discussed in this document as priorities for near-term management and monitoring. Table 1 presents these species by management level, generally following the conventional categorization of invasive plant control strategies used by Cal-IPC and others. We also recommend priorities for NCCP action, based on known management efforts, conditions of the populations, and need for additional surveys, monitoring, and control efforts.

At the end of this document, we outline recommendations for next steps in implementing this strategic plan, including a process for reviewing and updating this plan, developing and maintaining a regional database, discussion of regional vs. reserve-level responsibilities, and integrating the new vegetation and invasive species mapping for the region, among other topics.

Table 1. Priority invasive species and priorities for immediate action.

Scientific Name	Common Name	San Diego PAF Score	Regional Priority[1]	Recommended Action[2]
Management Level 1 – Surveillance (region-wide)				
Cytisus scoparius	Scotch broom	3.2	Medium	Surveillance
Euphorbia terracina	Carnation spurge	5.1	Very High	Surveillance
Management Level 2 – Eradication (region-wide)				
Aegilops triuncialis	Barbed goat grass	Not reviewed[3]	High	Monitor
Ageratina adenophora	Eupatory	5.4	High	Fund management
Carrichtera annua	Ward's weed	4.2	High	Monitor
Centaurea calcitrapa	Purple star thistle	2.8	Low	Coordinate
Centaurea solstitialis	Yellow star thistle	5.9	High	Fund management
Centaurea stoebe ssp. *micranthus*[4]	Spotted knapweed	6.0	Medium	Fund management
Elymus caput-medusae[5]	Medusahead	6.1	Very High	Coordinate; fund management
Genista monspessulana	French broom	6.9	Very High	Fund management
Hypericum canariense	Canary Island St. John's wort	5.9	High	Fund management
Iris pseudacorus	Yellow flag iris	5.6	High	Fund management
Lythrum salicaria	Purple loosestrife	8.1	Very High	Fund management
Retama monosperma	Bridal broom	6.4	Very High	Fund management
Management Level 3 – Containment (management unit or watershed)				
Arundo donax	Giant reed	8.9	Very High	Fund management
Cortaderia selloana and *jubata*	Pampas grass (and jubata)	8.8	High	Fund management
Cynara cardunculus	Artichoke thistle	6.3	Very High	Coordinate; fund trial
Ehrharta calycina	Perennial veldt grass	5.9	Medium	Additional data
Ehrharta longiflora	Long-flowered veldt grass	4.5	Medium	Additional data

Scientific Name	Common Name	San Diego PAF Score	Regional Priority[1]	Recommended Action[2]
Emex spinosa	Devil's thorn	4.8	Medium	Coordinate; fund trial
Lepidium latifolium	Perennial pepperweed	7.9	Very High	Fund management; additional data
Oncosiphon piluliferum	Globe chamomile	5.1	Medium	Additional data
Spartium junceum	Spanish broom	5.2	Medium	Coordinate; fund management
Management Level 4 – Directed Management (sub-management unit or reserve)				
Agrostis avenacea	Pacific bent grass	5.6	Very High	Fund management
Brachypodium distachyon	Purple false brome	6.7	Very High	Fund management
Dittrichia graveolens	Stinkwort	5.6	High	Additional data
Foeniculum vulgare	Fennel	6.5	Very High	Fund management
Silybum marianum	Milk thistle	5.0	High	Additional data
Management Level 5 – Directed Suppression (reserve or site)				
Glebionis coronaria[6]	Crown daisy	5.3	Medium	Additional data

[1] Regional Priority is based on PAF score and management feasibility (see individual species discussions).

[2] Recommended Actions:
Additional data = additional distribution/abundance data are needed to assess impacts and/or management feasibility.
Coordinate = facilitate coordinated management of species between multiple entities and/or management units.
Fund trial = test the ability of multiple entities to effectively implement management across a management unit.
Fund management = fund management of species.
Monitor = monitor established control programs to ensure species is being managed effectively.
Surveillance = watch for occurrences of species region-wide (early detection).

[3] This species was discovered only recently in the region and was not included on the list for PAF review. However, it is being actively controlled.

[4] Formerly *C. maculosa*

[5] Formerly *Taeniatherum caput-medusae*

[6] Formerly *Chrysanthemum coronarium*

Acknowledgments

The land managers of San Diego County work tirelessly with limited funding to protect the biodiversity on lands conserved through the NCCP programs. Many people have reviewed and contributed to the information compiled herein. We are especially grateful to:

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Introduction

San Diego County's Natural Community Conservation Programs (NCCP) are challenged with management and monitoring of approximately 200,000 acres of conserved lands in the western region of the county, with invasive species-both plants and animals−being one of the greatest threats to ecological processes and persistence of rare species. The land managers for these lands represent staff of federal, state, county, and city agencies as well as nonprofit organizations, each tasked with managing and monitoring biological resources within a semi-fragmented network of conserved lands bordered by a mix of high density urban areas, rural residential communities, agricultural lands, and vacant private lands not currently being managed for natural resources. Thus, the edge effects on these conserved lands are enormous, requiring that the challenges of managing and monitoring them be addressed region-wide, with collaboration among diverse stakeholders.

The Environmental Mitigation Program (EMP) Working Group authorized the Conservation Biology Institute (CBI), Dendra, Inc., and California Invasive Plant Council (Cal-IPC) to work with land managers in developing a strategic plan for management and monitoring of invasive plant species on a regional level. This project has included:

- Guiding the collection of invasive plant distribution data by mapping contractors (AECOM).
- Conducting detailed impact assessments for regionally important invasive plants, using a modified form of the standard Plant Assessment Forms (PAF) developed by Cal-IPC (Warner et al. 2003), with transparent and detailed scoring and evaluations specific to the western San Diego region.
- Developing a strategic plan that identifies priorities for near-term management and monitoring on a regional basis.

This document incorporates the results of these efforts and serves both as a multi-year framework and reference for near-term implementation of invasive plant control in the region. This document is intended to be a starting point for review and refinement, as land managers learn more about the distribution and impacts of invasive plant species and how best to control them, recognizing that priorities and funding will change over time. A subsequent document will suggest an organizational framework for long-term implementation of the recommendations herein.

This strategic plan prioritizes on-the-ground projects based on invasive plant impacts, with special consideration of narrow endemic species covered by the NCCP programs, management goals, and feasibility of successful implementation. Discussions with land managers were and continue to be critical to this process. Plant Assessment Forms for the 55 species reviewed as part of this project are available for review and download at:

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Of these, 29 species are discussed in this document as priorities for near-term management and monitoring. We also recommend priorities for NCCP action, based on known management

efforts, conditions of the populations, and need for additional surveys, monitoring, and control efforts. Table 1 presents these species by management level, generally following the conventional categorization of invasive plant control strategies used by Cal-IPC and others. This document is organized according to these five management levels.

Invasive species respond to ecosystem modifications at a landscape level. These modifications include removal of native species for development, changes in impervious surfaces and hydrological systems, nitrogen deposition, and global climate change, among other disturbances that land managers cannot control. Many nonnative species, such as annual grasses, have become naturalized, and control of these species is beyond the feasible and financial practicalities of the NCCP programs. Thus, this document focuses on regional strategies for prioritizing control of those species that impact critical ecosystem processes, such as hydrologic regimes, and species covered by the NCCP programs, with particular focus on narrow endemic plant species.

Criteria for Prioritization

The California Department of Food and Agriculture (CDFA) lists plants as noxious weeds that are found to be *troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate*. Each species has a rating of A, B, C, or Q, based on a statewide assessment. The A, B, and C ratings are permanent and differ in the ability to effectively control the species (A = most controllable, C = least). The Q rating is for plants that should be reviewed in a timely manner and given a permanent rating. These ratings are policy guidelines that reflect CDFA's view of the statewide importance of the pest, the likelihood that eradication or control efforts would be successful, and the present distribution of the pest within the state. Some species that may not be controllable statewide may be controllable or absent at the regional scale, thus emphasizing the importance of regionally based assessments.

Selection of invasive species for this project was a multi-step process that incorporated input and review at state, regional, and local levels. Cal-IPC and Dendra compiled an initial list of 253 non-native, invasive plant species from several sources, including:

- California Invasive Plant Inventory for the Southwest Jepson Floristic Region within the California Floristic Province (Cal-IPC 2006)
- Invasive Plants of California's Wildlands (Bossard et al. 2000)
- Weed Management Area (WMA) meetings
- American Society of Landscape Architects (ASLA) San Diego Chapter Invasive Plant List (ASLA 2012)
- Los Angeles Regional Invasive Plant Guide (CWH 2007)

This list was sub-divided into multiple classes based on mapping data, distribution, and perceived threats. Initially, 75 species were prioritized for mapping and regional assessments, focusing on invasive plants known or suspected to impact NCCP resources. This list was circulated for comments at WMA meetings and e-mailed to an estimated 180 individuals through

the WMA list-serve. The list was refined further to 55 species to accommodate a comprehensive literature search, collection and synthesis of distribution data, and collection of impact information from regional land managers and other biologists. The 55 species represent those species that are actively managed by control programs in the region. Species that have become widely established in the landscape (e.g., bromes, mustards, clover) were not included.

Of the 55 species included in this project, 29 are considered for near-term management and monitoring in this strategic plan. These include all 23 species in Management Levels 1, 2, and 3 (surveillance, eradication, control). These species have a high potential for effective control based on limited distribution, management feasibility, and/or existing control programs. Invasive species that impact or potentially impact narrow endemic plant species are also considered for the early implementation program. This group includes two species from Management Level 3 and six species from Management Levels 4 and 5.

Mapping

Several types of invasive plant distribution data were used in preparing the PAFs and management recommendations. CalFlora and the Consortium of California Herbaria (CCH) provided spatial plant occurrence data. The San Diego Natural History Museum's Plant Atlas program has generated a significant number of vouchered plant specimens for the region, which is valuable in understanding plant distributions. This data set was augmented with a regionally compiled data set (various GIS invasive mapping data sets) and data generated by AECOM and California Department of Fish and Game (CDFG) survey crews in support of the vegetation classification program. Cal-IPC also held two meetings to garner expert opinion on plant occurrence data sets at the topographic quad scale. These occurrence data sets were represented on maps in the PAFs and used to develop management recommendations.

The EMP Working Group contracted for invasive plant mapping; however, these data were generally not available for this project (with the exception of Level 2 species distributions), due to schedule conflicts. Land managers are expected to add to this database over time and participate in a regional early detection program.

Management Levels

To facilitate discussions on management, the 29 species evaluated in this document were placed into five management levels based on:

- Species distribution and abundance in western San Diego County (the *region*)
- Geographic scale of coordinated implementation (region, watershed, management unit, reserve, or site)
- Management feasibility, including costs, impacts, and likelihood of success
- Current management status for the species

These levels are hierarchical, progressing from *not present* to *widely distributed* across the region, as depicted below and described in Table 2.

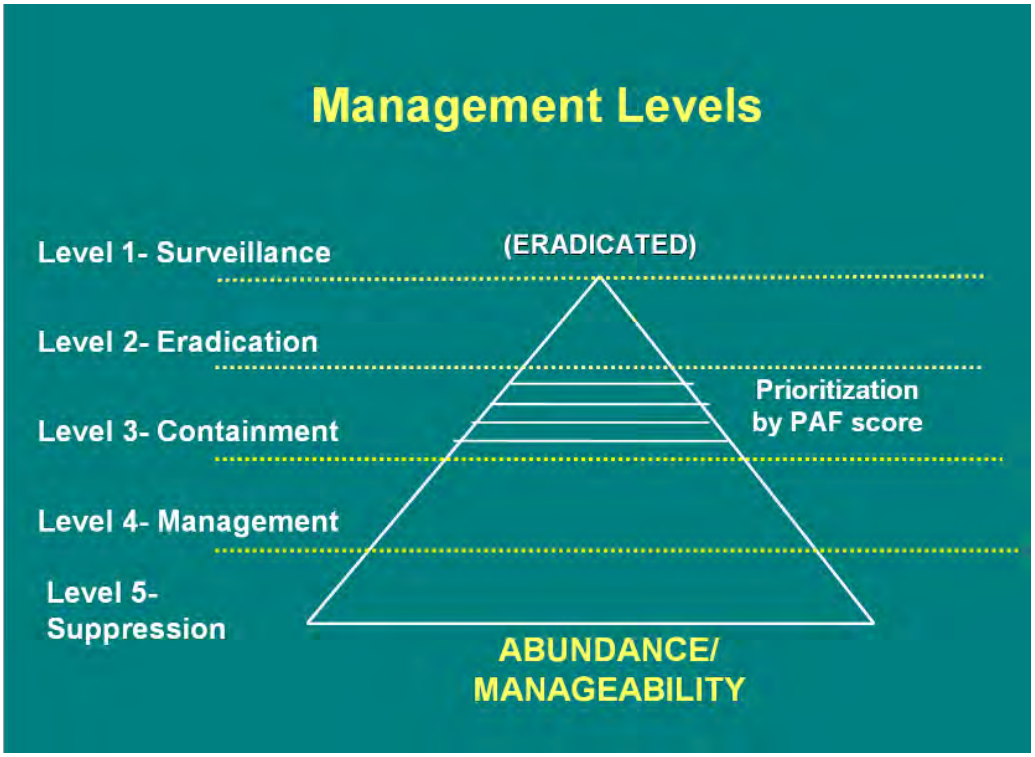


Table 2. Summary of management levels and goals.

Level	Distribution	Scale of Management[1]	Feasibility	Goal
1- Surveillance	Not present	Region-wide	High: low effort required to achieve goal	Regional surveillance, early detection, rapid response
2- Eradication	Limited; few individuals or populations	Region-wide	High: moderate effort required to achieve goal	Eradication with regionally coordinated control program
3- Containment	Variable	Watershed or management unit	Medium: Funding typically available for re-treatments or control of small populations	Eradication with coordinated programs by management unit or watershed
4-Directed Management	Wide; abundant	Sub- management unit or reserve	Medium: area may be managed effectively, with slow re-invasion	Control within reserve or sub-management unit to benefit NCCP resources
5- Directed Suppression	Wide; abundant	Reserve or site	Low: control is typically of short term benefit (rapid re-invasion) without active restoration	Suppression, typically to allow recovery of disturbed site, improve re-vegetation success, or benefit NCCP resources

[1] Region is western San Diego County (see Figure 1).

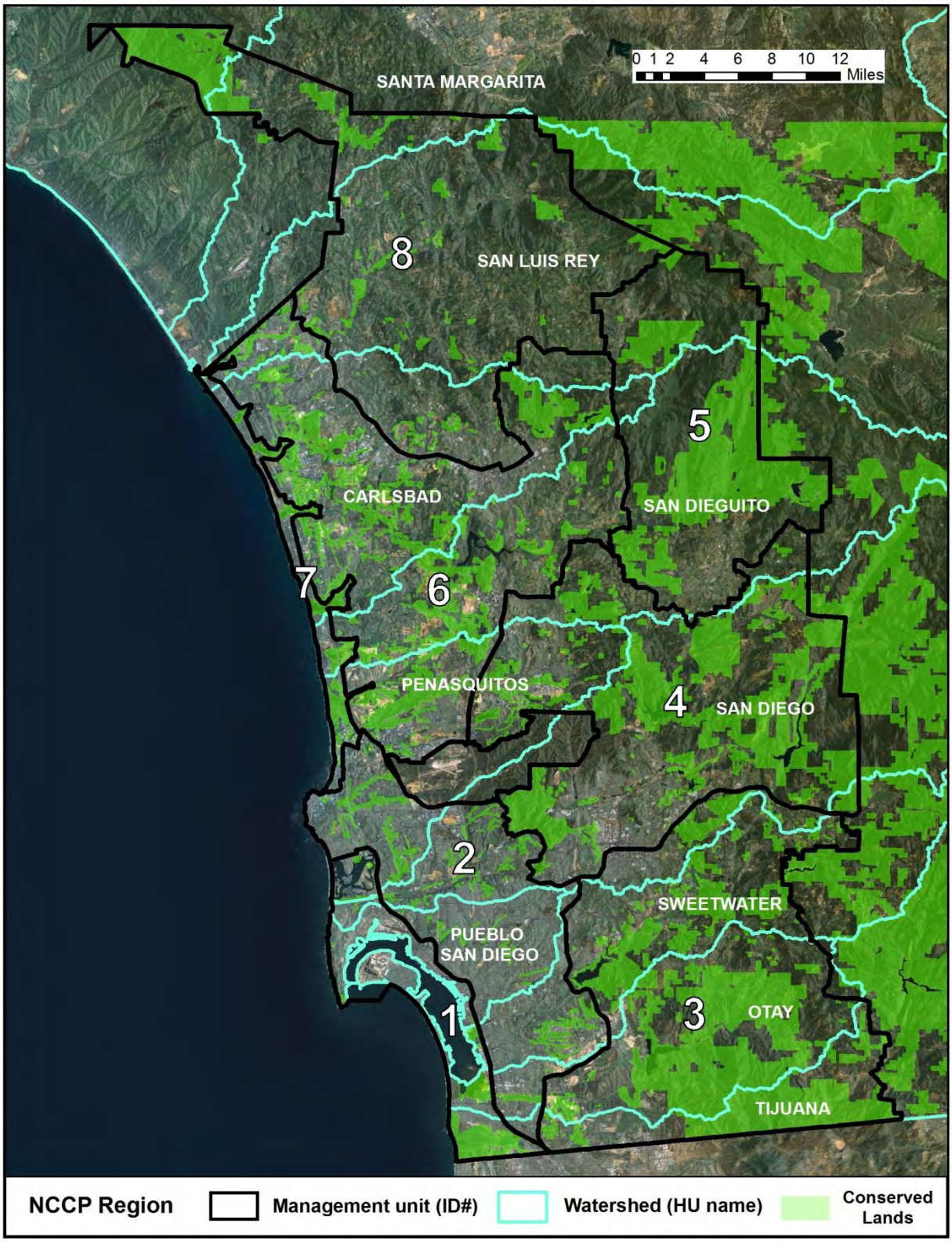


Figure 1. Management units and watersheds of the San Diego NCCP region.

Regional priorities for the San Diego region were developed using the following considerations:

- Significant impacts to NCCP species or habitats
- Effort needed to achieve the goal for a specific level (size of population and cost)
- Feasibility of controlling the plant and seed bank/rhizomes
- Length of time the species has been established in the region
- Difficulty in detecting all individuals within the region
- PAF score for the San Diego region.

Priorities for Management Levels 4 and 5 are developed at the scale of the management unit or reserve, with consideration of the specific resources impacted by the invasive species. Our recommendations for Levels 4 and 5 species were limited by available information on their spatial distributions. We hope this document will encourage monitoring for invasive plant species to better understand their impacts on NCCP resources. As species distribution and abundance data improve across the region, it may be possible to have more quantitative rules and decisions for regional, management unit, and reserve-level prioritization. Depending on the level of distribution and impact data available in the future, prioritization tools such as WHIPPET (Darin et al. 2011) or Relative Risk Models (e.g., Miller et al. 2010) may help guide management priorities at finer scales.

Level 1: Surveillance (region-wide)

Goal: Regionally coordinated early detection program with rapid response

Two highly invasive species were historically present in the region but have been eradicated and are now on a watch list. If they become re-established, they are likely to persist and cause widespread habitat conversions, as has happened in the San Francisco Bay area and the Pacific Northwest. This watch list should be available to all land managers and field biologists, included in a regional occurrence database (sites where species has been eradicated), and reviewed regularly at regional management and monitoring meetings.

The best time to control a non-native species, in terms of cost and effectiveness, is when the species has just been introduced into a system (Figure 2). Rejmanek and Pitcairn (2002), of the University of California Davis, analyzed weed eradication efforts by the California Department of Food and Agriculture (CDFA) over a 30-year period. They showed that weed eradication success decreased exponentially and the effort (time, money, etc.) increased exponentially as the size of the weed infestation increased. They also found that infestations <0.08 hectare had nearly 100% eradication success, and that infestations ≥1 hectare had nearly no eradication success.

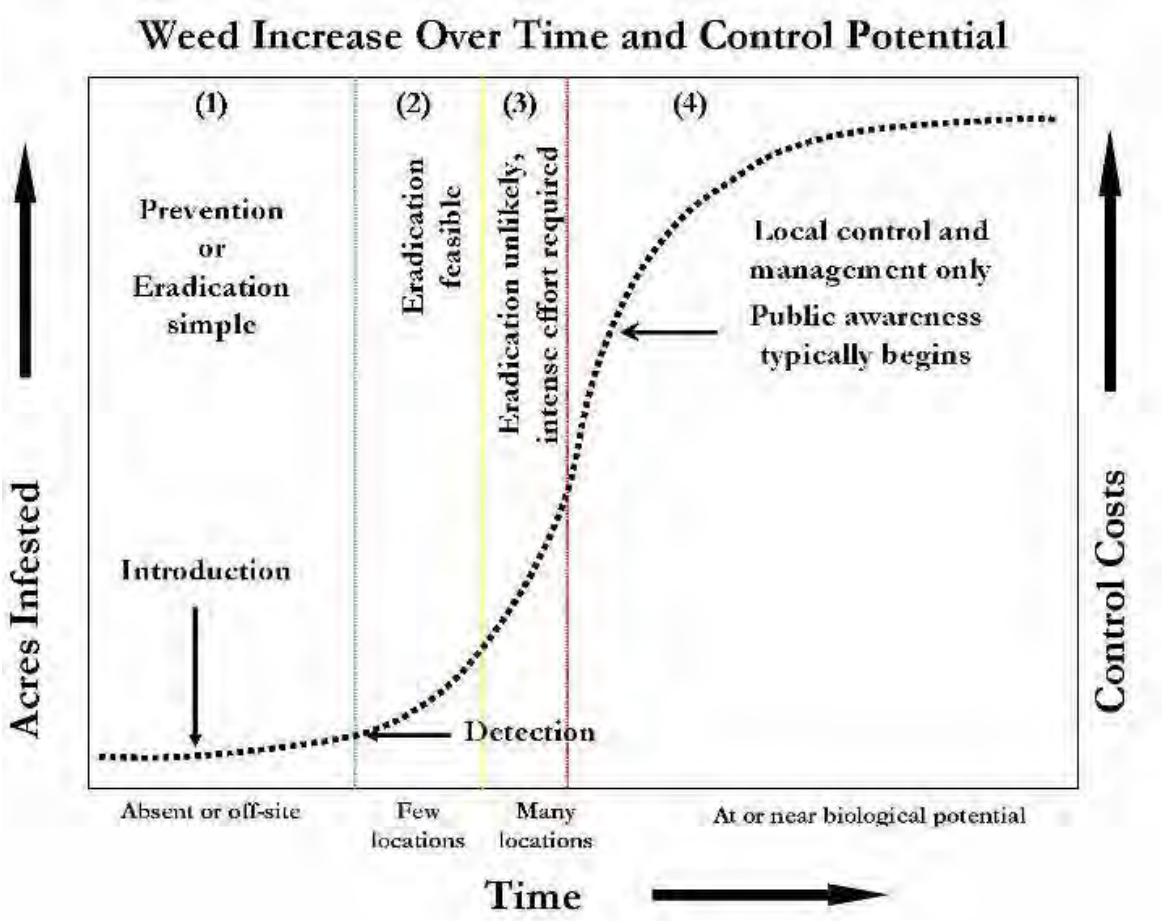


Figure 2. Process of invasion and the optimal time to initiate management activities (Siemens and Tu 2007).

Level 1 Recommendations

1. Continue to monitor past eradication sites (minimum annually).
2. Maintain an occurrence database at the regional level.
3. Coordinate an early detection program at the regional level and respond immediately once identified.
4. Review and develop new PAFs for other potential Level 1 species that should be on an early detection watch list. Potential Level 1 species may be identified through land manager observations, and CalFlora, CCH, and CalWeedmapper (Cal-IPC 2012) records (including observations/records from adjacent counties). See Appendix A.

Summary of Level 1 Species

Scientific Name	Common Name	San Diego PAF score	# of historical sites
Cytisus scoparius	Scotch broom	3.2	3
Euphorbia terracina	Carnation spurge	5.1	1

Cytisus scoparius (Scotch broom)

SD PAF score: 3.2

Current condition: This plant is listed as a C-rated Noxious Weed by CDFA. It occurs in few places in Southern California; the San Diego region may be at the edge of its suitable range. As there is little documentation that the species will cause impacts in our region, the PAF score is relatively low. The species historically was found along road edges at three locations and persisted prior to its eradication.

- Questhaven Road near Elfin Forest, north San Diego County (San Diego Natural History Museum SN#SD179414)
- Camp Pendleton along Vandergrift Road
- Camp Pendleton along Horno Road

Management information: This perennial shrub requires a multi-year commitment to ensure it has been completely eradicated. Monitoring and re-treatments may be required for up to 10 years due to long seed viability. Seeds are dispersed short distances ballistically or by ants or rainwash. Individual plants are moderately difficult to control with herbicide, and re-sprouting may occur. Plants have low leaf area for translocation of herbicide, and young plants have thin stems, making cutting stem and basal bark application of herbicide challenging. Small plants may also be pulled, depending on soil conditions.

Recommendations: Regional Priority = Medium; NCCP Action = Surveillance

Euphorbia terracina (Carnation spurge)

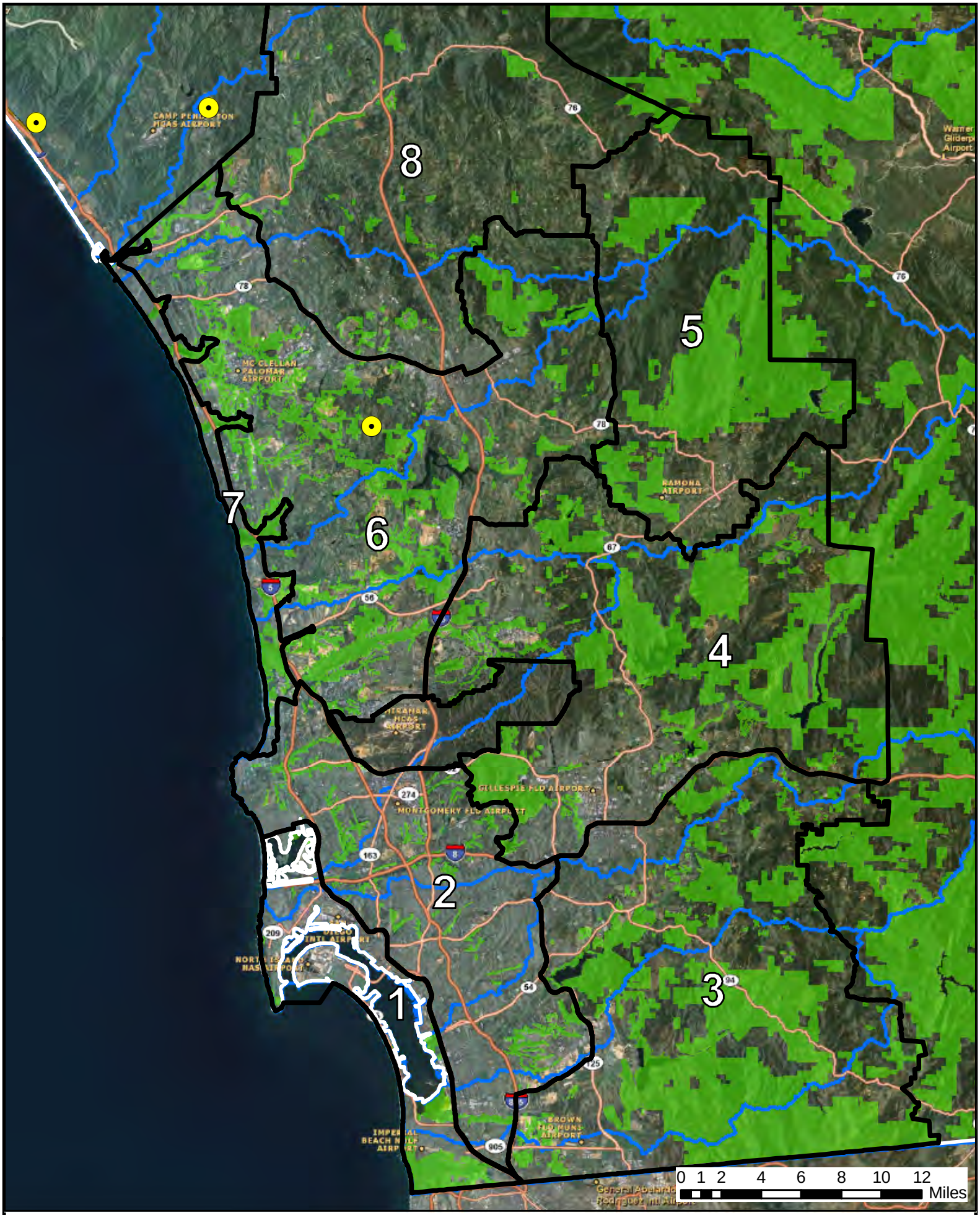
SD PAF score: 5.2

Current condition: This species is Q-rated (Quarantine) by CDFA. It has the potential to occur in a wide variety of ecotypes and communities based on its invasion of the Santa Monica Mountains, where it forms dense stands. The species would likely have moderate impacts to sensitive flora and fauna, but few impacts to abiotic ecosystem processes. Only one population has been found in the San Diego region. It has been eradicated and is being monitored.

- Mitigation site east of Highway 125 on Otay Mesa

Management information: This species is moderately difficult to control due to a persistent seed bank. Seed is primarily gravity-dispersed, falling to the ground below/near the parental plant. Animals and wind may also function as occasional dispersal agents.

Recommendations: Regional Priority = Very High; NCCP Action = Surveillance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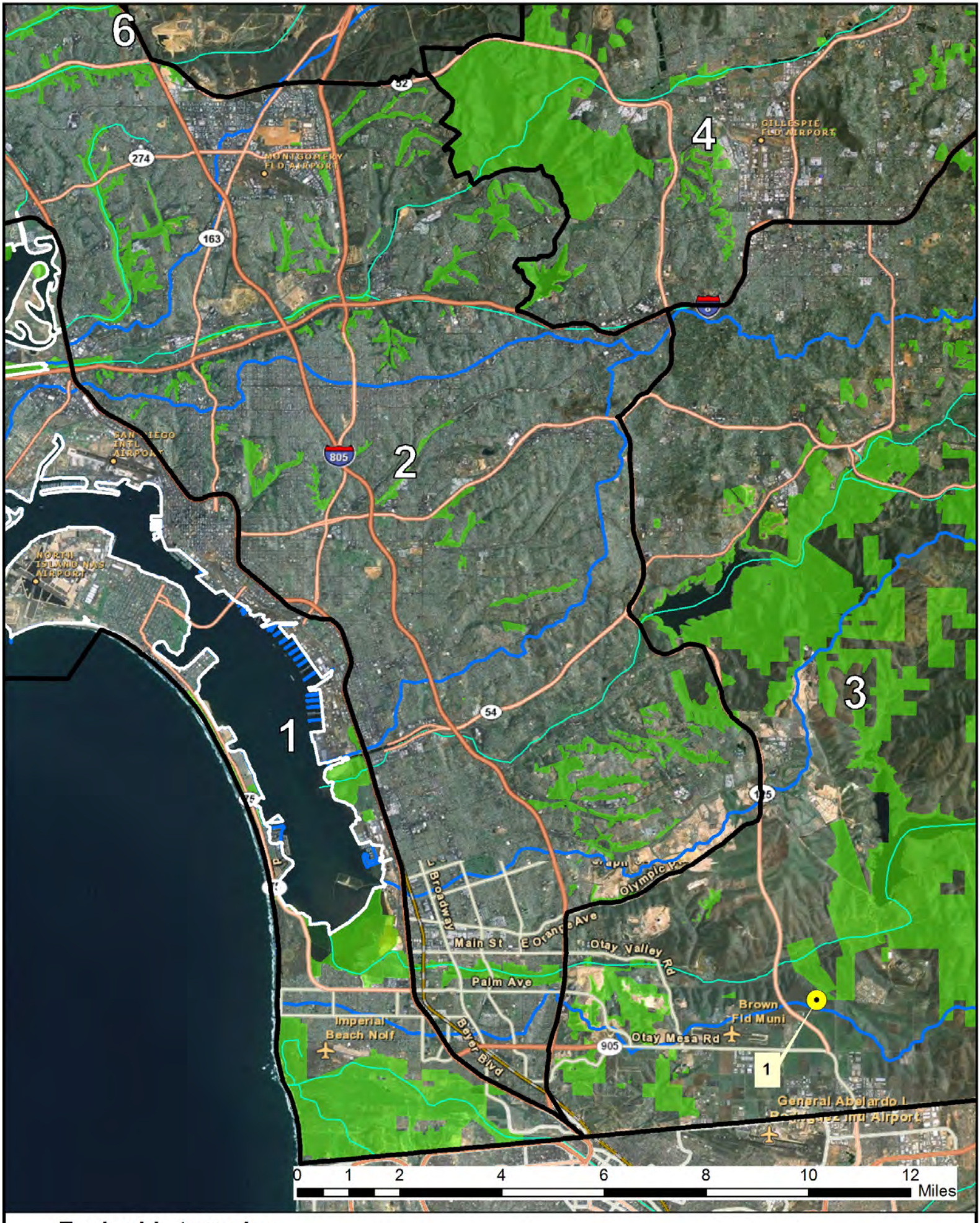
Miles
Cytisus scoparius
(Scotch broom)
Population
Management unit
Conserved Lands
Watershed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Montgomery Fld Airport
San Diego Intl Airport
North Island NAS Airport
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Otay Valley Rd
Palm Ave
Imperial Beach Nolf
Beyer Blvd
Brown Fld Muni
Otay Mesa Rd
General Abelardo L Rodriguez Intl Airport
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Miles
Euphorbia terracina (Geraldton carnation weed)
Population (with ID#)
Management unit
Conserved Lands
Watershed

Level 2: Eradication (region-wide)

Goal: Eradication with regionally coordinated control program

Level 2 species have very limited distributions within the region; therefore, eradication is a feasible goal. Once eradication has been achieved, the species is added to a surveillance list (Level 1). If the control program fails to keep the species from becoming more widely distributed, it should be managed as a Level 3, 4, or 5 species.

Summary of Level 2 Species

Scientific Name	Common Name	San Diego PAF score	# of Sites	Control Effort[3]	Difficulty
Aegilops triuncialis	Barbed goat grass	Not reviewed[4]	1	Small	Moderate
Ageratina adenophora	Eupatory	5.4	2	Small	Difficult
Carrichtera annua	Ward's weed	4.2	3	Small	Moderate
Centaurea calcitrapa	Purple star thistle	2.8	1	Small	Moderate
Centaurea solstitialis	Yellow star thistle	5.9	18	Moderate	Easy
Centaurea stoebe ssp. *micranthus*[1]	Spotted knapweed	6.0	4	Small	Easy
Elymus caput-medusae[2]	Medusahead	6.1	6	Large	Moderate
Genista monspessulana	French broom	6.9	5	Moderate	Difficult
Hypericum canariense	Canary Island St. John's wort	5.9	10	Large	Moderate
Iris pseudacorus	Yellow flag iris	5.6	6	Small	Difficult
Lythrum salicaria	Purple loosestrife	8.1	2	Small	Difficult
Retama monosperma	Bridal broom	6.4	5	Moderate	Difficult

[1] Formerly *C. maculosa*

[2] Formerly *Taeniatherum caput-medusae*

[3] Small: <$25k, Medium <$50k, Large >$50k

[4] This species was discovered recently in the San Diego region and thus not included on the initial list for PAF review.

Level 2 Recommendations

1. Continue to monitor past eradication sites (minimum annually).
2. Maintain an occurrence database at the regional level.
3. Coordinate an early detection program region-wide, and respond immediately when the species is identified in new areas.
4. Develop aggressive and coordinated eradication programs, with control activities occurring multiple times within a season to assure that all seedlings/re-sprouts are

controlled at a given site. Depending on site conditions and location, pre- and post-emergent herbicides may be used.

5. Implement initial eradication projects that bring projects to within the management capacity of existing reserves.
6. Educate managers and work crews on Best Management Practices for field work, including cleaning equipment and clothing so as not to spread to other sites (Cal-IPC 2012).
7. Develop PAFs for emerging invasive plants proposed for Level 2. Periodically review and update existing PAFs.
8. Review and develop new PAFs for other potential Level 2 species that should be on a watch list (See Appendix A).

Aegilops triuncialis (barbed goat grass)

SD PAF score: This species was discovered recently in the San Diego region and thus not included on the initial list for PAF review. It is listed as a B-rated noxious weed by CDFA, who oversees the Weed Management Areas.

Current condition: The species typically is found in grasslands. There is one population at the Fallbrook Naval Weapons Station. It is being controlled and may soon be eradicated.

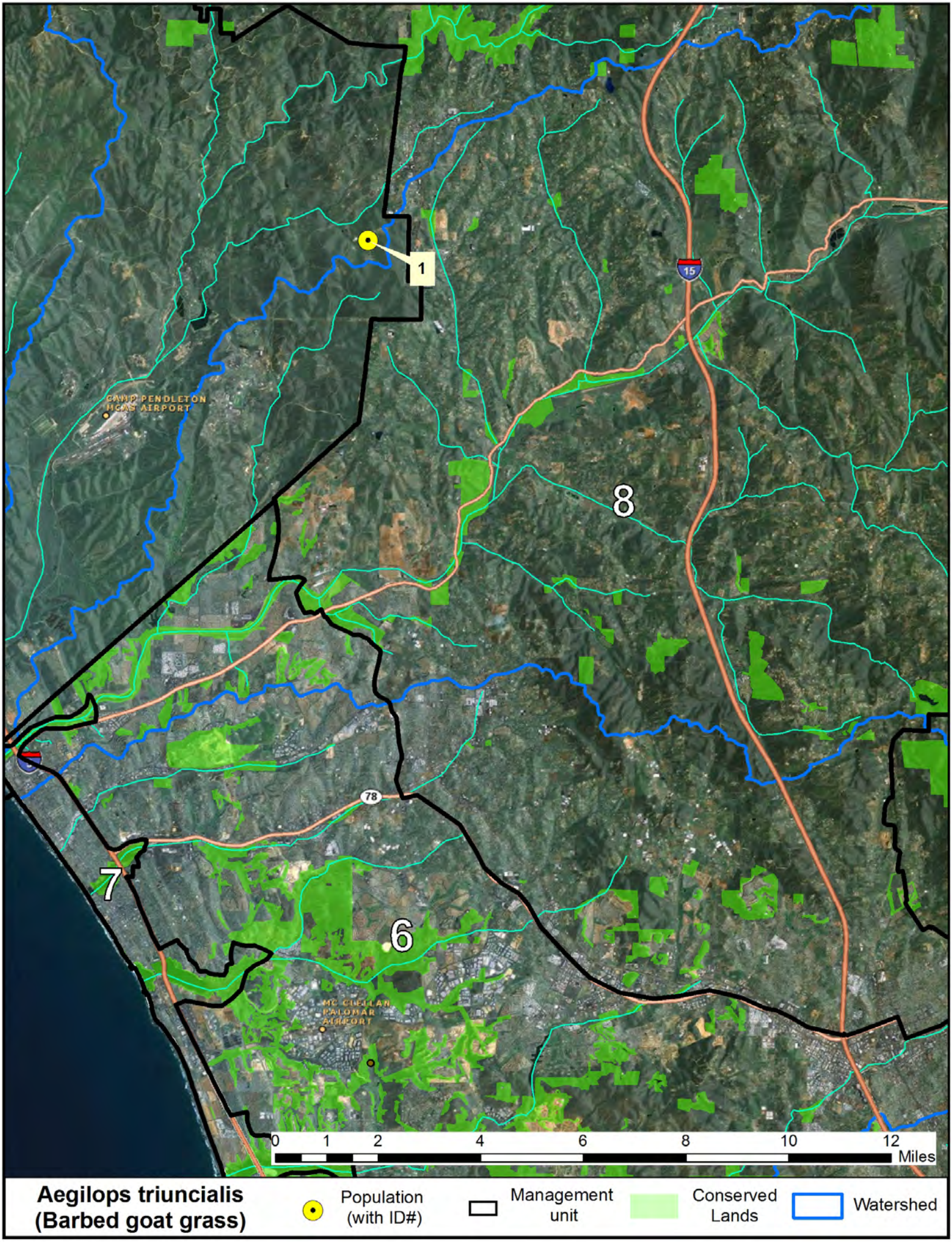
Management information: This is an annual grass with a short-lived seed bank. Seed is dispersed by animals and human-related activities. It is fairly easy to control; however, it is difficult to distinguish the species from other non-native grasses before it sets seed. For this reason, all herbaceous plant cover should be treated on infested sites.

Recommendations: Regional Priority = High; NCCP Action = Monitor

Populations of *Aegilops triuncialis* (barbed goat grass)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Fallbrook NWS[1]	<1 acre?	Under treatment	Since 2007	Funded	Fallbrook NWS

[1] Fallbrook NWS = Fallbrook Naval Weapons Stations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CAMP PENDLETON
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MC CLELLAN
PALOMAR
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Miles
Aegilops triuncialis
(Barbed goat grass)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed

Ageratina adenophora (eupatory)

SD PAF score: 5.4

Current condition: This species is listed as a noxious weed by USDA and is Q rated (Quarantine) by CDFA. Eupatory typically occurs in riparian areas, but can also be found in upland scrub. There is limited information on its impacts in our region, but it has severe impacts in other parts of the world where it has invaded and spread aggressively. This plant may be in a *lag phase* (a lower reproductive period prior to a rapid expansion) in our region.

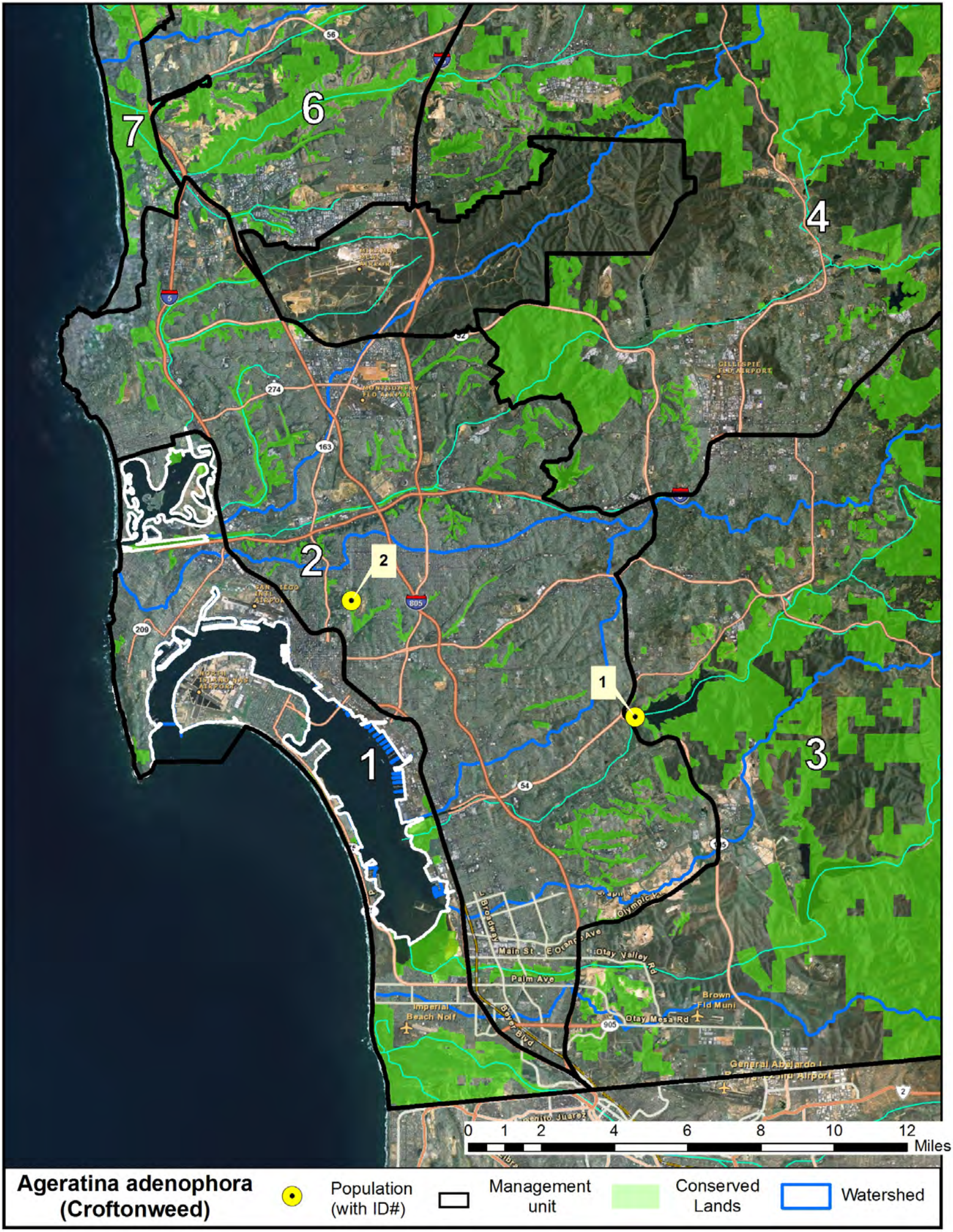
Management information: This perennial subshrub is moderately difficult to control, requiring a multi-year commitment because it produces copious quantities of seed that can survive a long time (9+ years) in the seed bank. Seed is wind-dispersed over long distances and can float on water surfaces. It can also grow from broken stems and root fragments with the crown attached, and can re-sprout after fire. Limited information on control is available, but herbicide application (glyphosate) is used in Australia.

Recommendations: Regional Priority = High; NCCP Action = Fund management

- Initiate work on populations #1 and 2 (estimated initial cost $17K, annual re-treatment cost $2.5K).

Populations of *Ageratina adenophora* (croftonweed, eupatory)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Below Sweetwater Reservoir	2 acres, 1,000-5,000 plants	Not treated	Not treated	No funding. Initial cost: ~$15K Annual retreatment: ~$2K	Sweetwater Authority
2	Florida Canyon, Balboa Park	1 acre, 300-500 plants	Not treated	Not treated	No funding. Initial cost: ~$2K Annual retreatment: ~$500	City of San Diego


7
6
4
2
2
1
1
3
0 1 2 4 6 8 10 12
Miles
Ageratina adenophora
(Croftonweed)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed

Carrichtera annua (Ward's weed)

SD PAF score: 4.2

Current condition: This species has few documented impacts, in part due to its very limited distribution (only three populations in California, all in our region). It occurs in coastal sage scrub and grasslands. All three populations have been under treatment for multiple years. This species may soon be considered eradicated (Level 1 - surveillance). EMP funding support has allowed this species to be managed now under existing management endowments.

Management information: This annual herb is a prolific seed producer, with seed viability declining sharply after 2 years. Seeds are primarily gravity- or rain-dispersed, with most seeds falling close to the parental plant. Seeds can be spread further distances by animals, runoff, or human-related activities. Mature plants are fairly easy to control with proper timing of application; however, seedlings are difficult to detect in dense coastal sage scrub and grasslands. The length of the control effort is 3-5 years. Sites should be surveyed multiple times during winter and spring to ensure treatment of all individuals.

Recommendations: Regional Priority = High; NCCP Action = Monitor

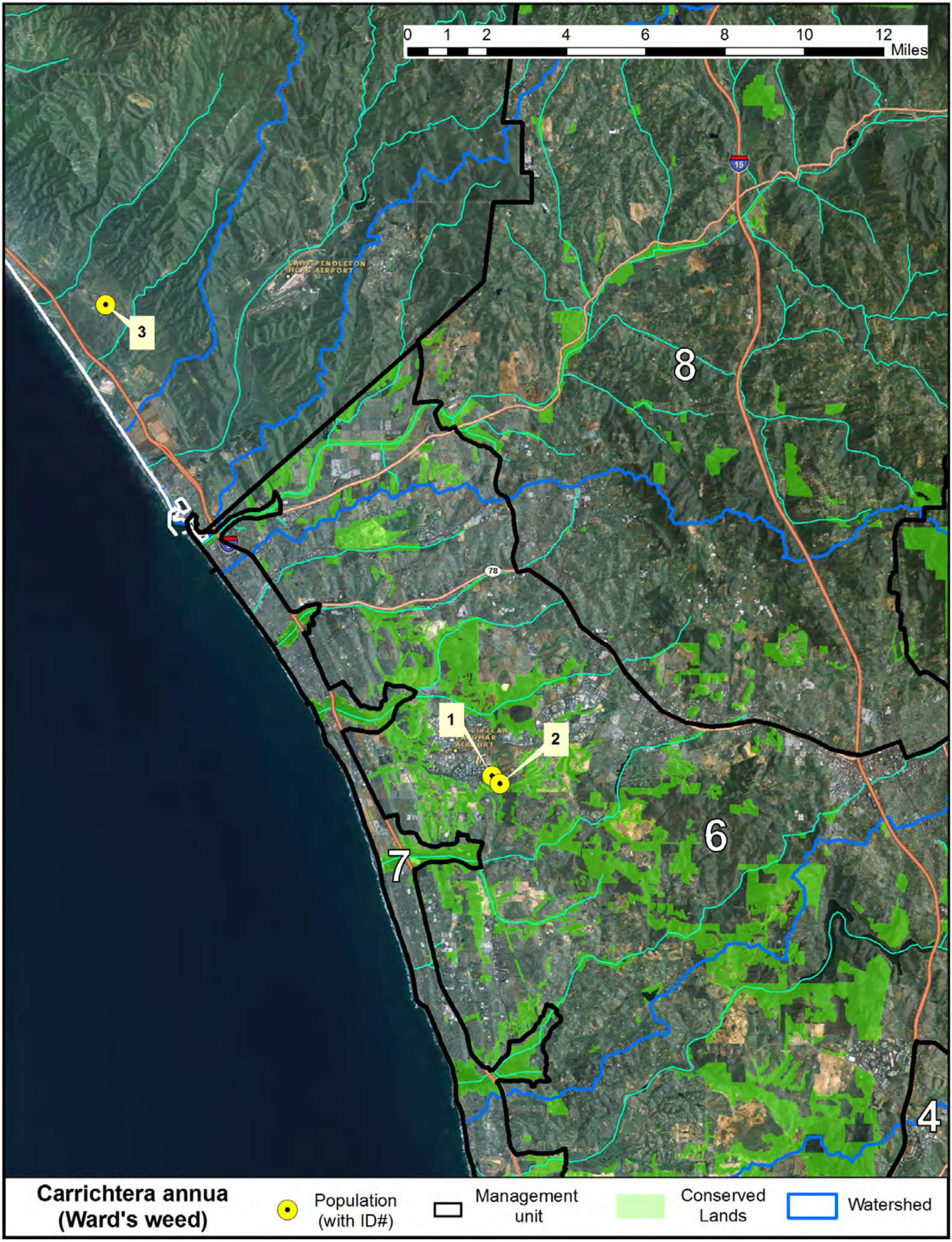
- Monitor to assure Populations #1 and 2 have been controlled to the extent that annual control costs can be accommodated within the existing management endowment (estimated annual cost $5K).

Populations of *Carrichtera annua* (Ward's weed)

#	Location	Size	Status	Duration	Funding Status	Lead
1	La Costa Greens Ecological Reserve, west of Alacante Rd., Carlsbad	Possibly eradicated	Under treatment	Since 2007	Funded under management endowment and EMP support. ~$2.5K annually	CNLM
2	La Costa Greens Ecological Reserve, west of Alacante Rd., Carlsbad	<1 ac, scattered seedlings	Under treatment; CNLM[1] herbicide control; HOA[2] manual control	Since 2010	Funded under management endowment and EMP support. ~$2.5K annually	CNLM
3	Las Flores Rd., Camp Pendleton	Possibly eradicated	Treated, monitored	Since 2009	Funded by Camp Pendleton	Camp Pendleton

[1] CNLM = Center for Natural Lands Management

[2] HOA = Homeowners Association


0 1 2 4 6 8 10 12
Miles
CAMP PENDLETON MCAS AIRPORT
15
78
8
6
7
4
1
2
3
Carrichtera annua
(Ward's weed)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed

Centaurea calcitrapa (purple star thistle)

SD PAF score: 2.8

Current condition: This plant is listed as a B Rated Noxious Weed by CDFA. It is most common in heavily disturbed sites, particularly in overgrazed pastures. The species has minor ecological impacts, but there is only one population known in the county, making control possibly feasible (dating from at least 1975, UCR17702). This population has been managed periodically in an actively grazed pasture.

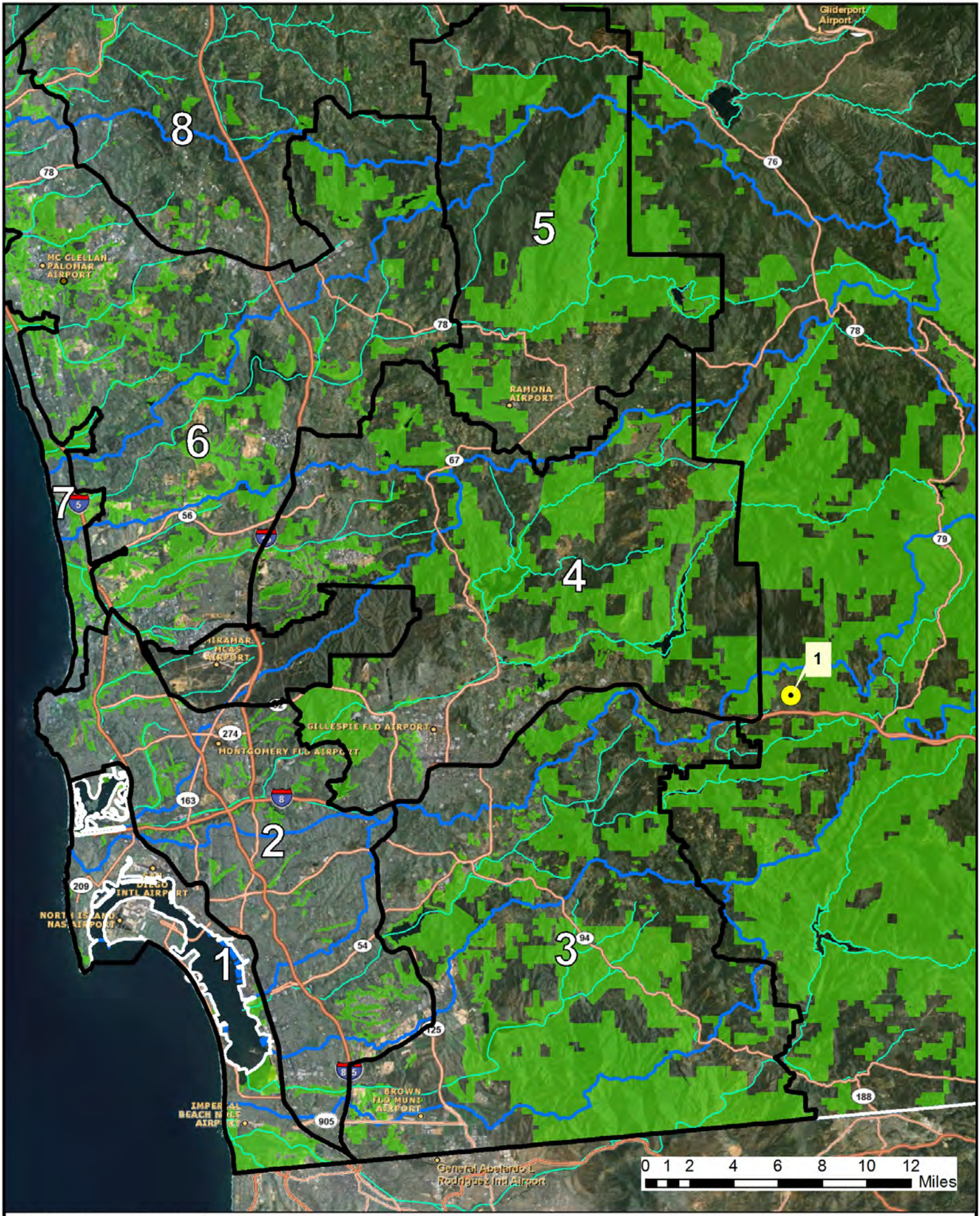
Management information: Purple star thistle is an annual/biennial with a seed bank viable for at least 3-5 years. Seed is primarily gravity-dispersed, falling largely below or near the parental plant. In addition, seeds may be dispersed moderate distances by water, wind, or human-related activities. Control is moderately difficult; dicot-specific herbicides are the most commonly used method and are most effective at the seedling and rosette stage, but this is when the plant is the most difficult to see.

Recommendations: Regional Priority = Low; NCCP Action = Coordinate

- Coordinate with Viejas tribe to initiate control program.

Populations of *Centaurea calcitrapa* (purple star thistle)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Viejas Indian Reservation	~500 acres	Not treated	Not treated	Annual control estimate: ~$20K	Viejas Indian Reservation


8
5
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Gliderport Airport
MC CLELLAN PALOMAR AIRPORT
RAMONA AIRPORT
MIRAMAR MCAS AIRPORT
GILLESPIE FLD AIRPORT
MONTGOMERY FLD AIRPORT
SAN DIEGO INTL AIRPORT
NORTH ISLAND NAS AIRPORT
IMPERIAL BEACH NOLF AIRPORT
BROWN FLD MUNI AIRPORT
General Abelardo L. Rodriguez Intl Airport
78
76
67
56
79
274
163
209
54
94
125
905
188
0 1 2 4 6 8 10 12
Miles
Centaurea calcitrapa
(Purple star thistle)
Population (with ID#)
Management unit
Conserved Lands
Watershed

Centaurea solstitialis (yellow star thistle)

SD PAF score: 5.9

Current condition: This is a C-rated CDFA noxious weed, with significant ecological impacts to flora and, to a lesser extent, fauna. It is widely distributed in much of California, occurring in a wide range of ecotypes including woodlands, scrub, grasslands, and riparian areas. Our region is at the edge of its distribution, but numerous small populations have been found. A coordinated treatment effort has made significant gains in controlling this species in the region.

Management information: This annual herb has seeds that survive in soil 3 years or more. Seeds are primarily gravity-dispersed, although wind, animals, and humans may also be effective dispersal agents. Control is generally easy and of short duration (~3 years).

Recommendations: Regional Priority = High; NCCP Action = Fund management

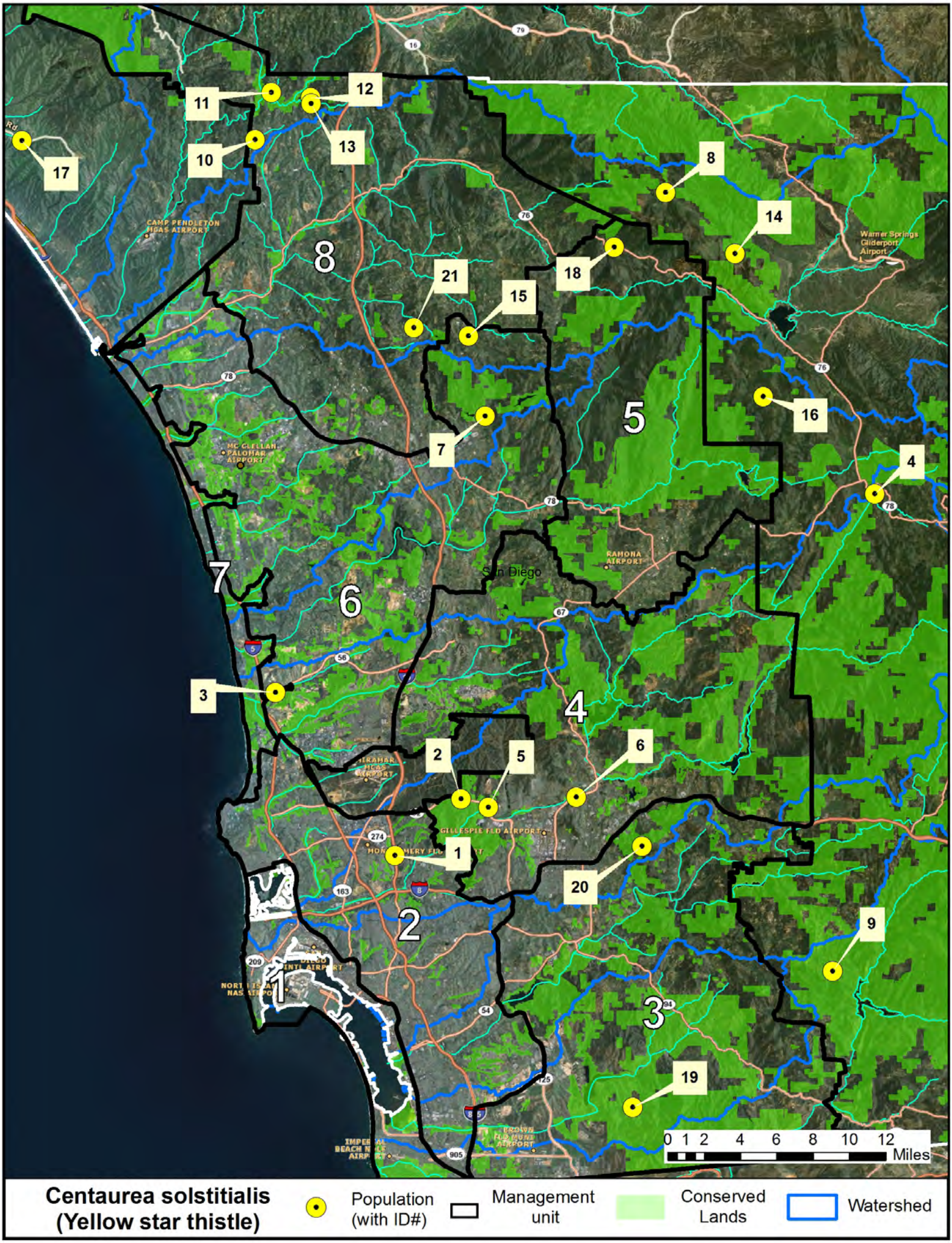
- Continue control and monitoring of all populations currently under treatment. Estimated annual cost of this entire effort is $30K
- Initiate control on population #18.

Populations of *Centaurea solstitialis* (yellow star thistle)

#	Location	Size	Status	Duration	Funding Status	Lead
1	I-15 and Aero Dr., Serra Mesa	Eradicated	Eradicated	2000-2005	Funded by EMP, ARRA, and others historically. Funding secured through 2012, but uncertain after.	County Dept. Ag.
2	Mission Trails Park	>1 acre, multiple sites	Under treatment	2009-2012	Part of City Parks management budget.	City of San Diego Parks
3	SR-56, Carmel Valley	Eradicated	Eradicated	2000-2005	See #1 above.	County Dept. Ag.
4	Wynola Estates, Wynola	2 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
5	SR-52 and Sycamore Landfill	5 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
6	Woodside Dr., Lakeside	1 acre	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
7	Lake Wolford Rd., Escondido	1 acre	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
8	Mendenhall Valley, Palomar Mtn	25 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
9	Eichenlaub Ranch, Barrett Lake	10 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
10	Downtown Fallbrook	Eradicated	Monitored	2001-2004	See #1 above.	County Dept. Ag.

#	Location	Size	Status	Duration	Funding Status	Lead
11	Rock Mtn. Rd., Sandia Creek area, Fallbrook	1 acre	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
12	Rainbow Creek North, Rainbow	1 acre	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
13	Rainbow Creek South, Rainbow	2 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
14	Will Valley, Palomar Valley	2 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
15	Emerald Crest, Valley Center	50 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
16	Mesa Grande	5 acres	Under treatment	2009-2012	See #1 above.	County Dept. Ag.
17	Camp Pendleton, multiple sites	5 acres	Under treatment	Since 2005	Funded	Camp Pendleton
18	Red Gate Rd., La Jolla Indian Reservation	1 acre, <100 plants	Not treated	Not treated	None	Need to identify

ARRA = American Recovery and Reinvestment Act 2009


Centaurea solstitialis
(Yellow star thistle)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed
0 1 2 4 6 8 10 12
Miles
San Diego
CAMP PENDLETON MCAS AIRPORT
MC CLELLAN-PALOMAR AIRPORT
RAMONA AIRPORT
GILLESPIE FLD AIRPORT
Warner Springs Gliderport Airport
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21

Centaurea stoebe ssp. *micranthus* (spotted knapweed) [formerly *C. maculosa*]

SD PAF score: 6.0

Current condition: Spotted knapweed is a CDFA A-rated noxious weed that can impact flora and, to a lesser extent, fauna. Multiple populations historically were found in mountain areas of Cuyamaca, Julian, and Wynola, outside the NCCP region, but have been controlled and are believed eradicated. Populations in Warner Springs and Palomar Mountain are under treatment.

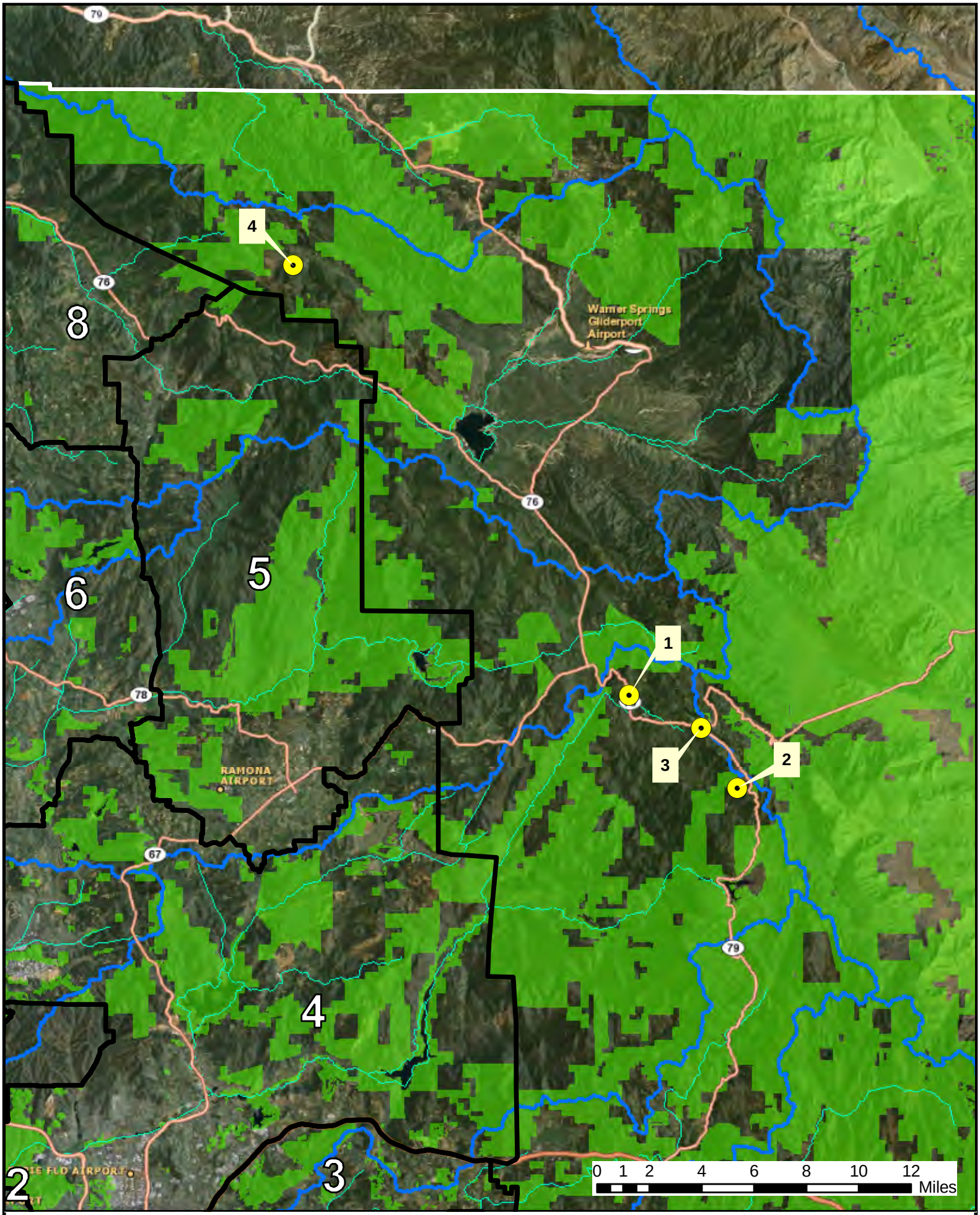
Management information: This annual herb is easy to control with proper timing of application, and the length of control effort is 3-5 years. Multiple applications (four to five) each year are best to assure that all germinating plants are controlled before they set seed. Most seeds and seed heads are gravity-dispersed, falling near the parental plant; however, longer-distance dispersal may be effected by wind, water, and animals.

Recommendations: Regional Priority = Medium; NCCP Action = Fund management

- Continue treatment at all four populations. Estimated annual cost $10K.

Populations of *Centaurea stoebe* ssp. *micranthus* (spotted knapweed)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Wynola on Hwy. 79.	0	Appears to be eradicated.	2006 and annual check since then	Funded by CDFA: $10K annually for all sites; funding secured through 2012.	County Dept. Ag.
2	Multiple sites in Julian: post office, Porter Lane	0	Appears to be eradicated	2005 - 2012	See above.	County Dept. Ag.
3	Toyon Mtn Rd., near Harrison Park (north of Lake Cuyamaca)	0	Probably eradicated, although nearby sites possible	1999 - 2012	See above.	County Dept. Ag.
4	Bergman Ranch (County Route S6 @ milepost 49), Palomar Mountain	14 acres	Being controlled	1998 - 2012	See above.	County Dept. Ag.



Centaurea stoebe ssp. micranthus (Spotted knapweed)

Population (with ID#)

Management unit

Conserved Lands

Watershed

Elymus caput-medusae (medusahead) [formerly *Taeniatherum caput-medusae*]

SD PAF score: 6.1

Current condition: CDFA lists this species as a C-rated noxious weed. It has the ability to convert grasslands and woodland understory into mono-specific stands of medusahead, creating a thick thatch layer that decomposes slowly and has a high silica content. All known populations are east of the NCCP region, but are expanding rapidly, if not contained.

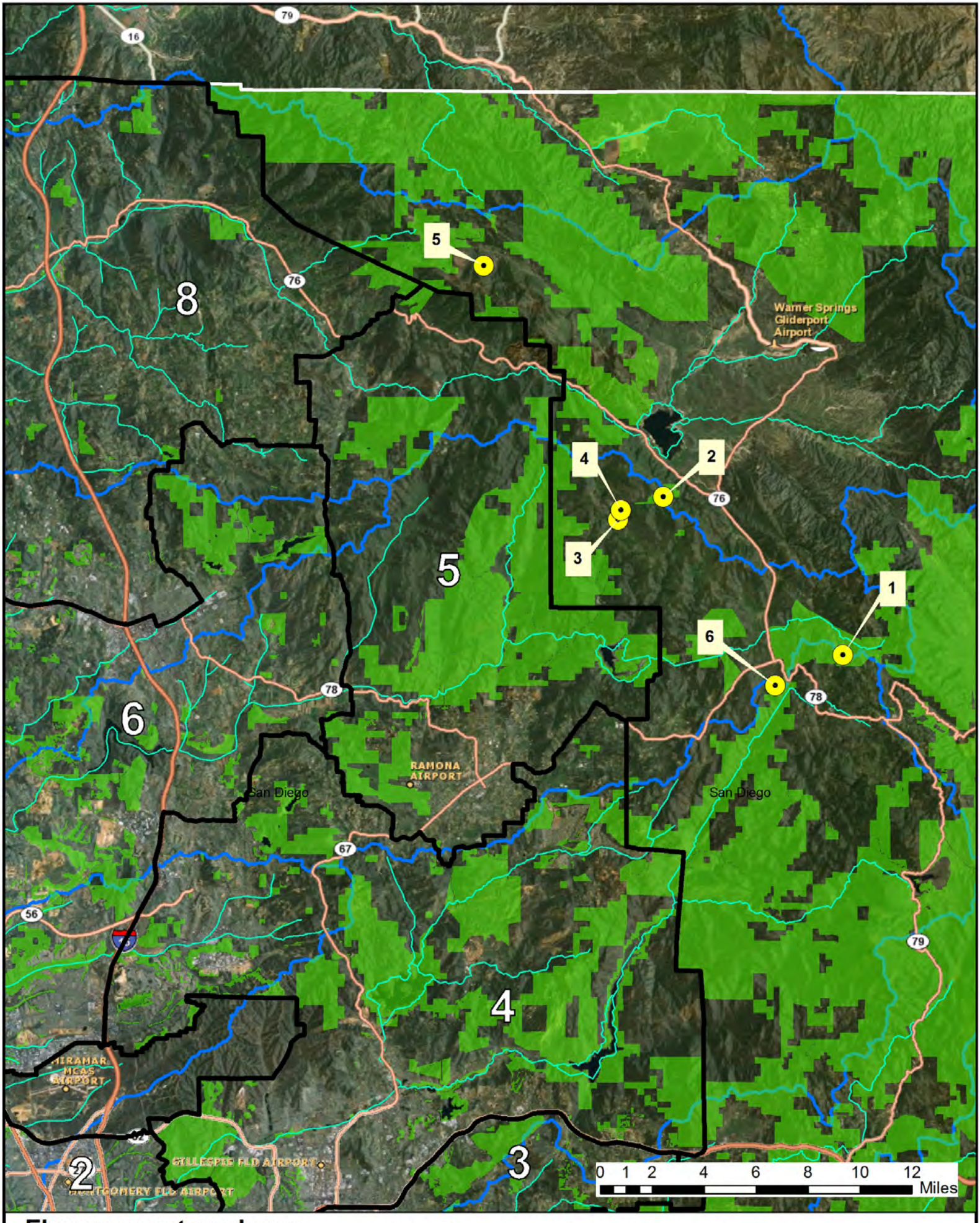
Management information: Established populations of this annual grass are difficult to control due to the dense thatch (litter) layer that develops. Seeds are short-lived (1-2 years) and can germinate and grow in the thatch layer. This thatch layer, which excludes other vegetation, often needs to be broken up (mowing, mowing/grazing, plowing/disking and prescribed burning prior to seed set). Chemical application is easier on newer, small populations with a less developed thatch layer. Control is moderately difficult; scattered plants can be difficult to detect when mixed in with other grasses. Long-awned seeds cling to animals, machinery, vehicles, and other dispersal agents and can be transported long distances.

Recommendations: Regional Priority = Very High; NCCP Action = Coordinate; fund management

- Initiate treatment and monitoring of populations #1, 2, 4, 5. Estimated annual cost $4K.
- Continue monitoring population #2.
- Assess the scale and feasibility of control at population #6, and initiate treatment accordingly. Estimated initial cost >$50K.

Populations of *Elymus caput-medusae* (medusahead)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Santa Ysabel Reserve, SR-78/79	~1 acre, <1000 plants	Not treated	Not treated	Initial cost <$1K. Annual re-treatment <$1K; not funded.	County Dept. Parks and Rec.
2	Wheatley Conservation Easement, Mesa Grande	5 acres, dense	Since 2011	Since 2011	Annual control cost ~$8K; funded by TNC 2011-2012, USFWS from 2013-2015.	TNC in 2011-2012, UC Cooperative Extension 2013-2015
3	26198 Mesa Grande Rd, Mesa Grande	~1 acre, <1000 plants	Not treated	Not treated	Annual control cost <$1K	Need to identify
4	26398 Mesa Grande Rd, Mesa Grande	~1 acre, <1000 plants	Not treated	Not treated	Annual control cost <$1K	Need to identify
5	Bergman Ranch, Palomar Mountain	3 areas: a) ~10 acres, b) 1 acre, c) <1acre	Not treated	Not treated	Annual control cost <$1K	Need to identify
6	Multiple properties around Santa Ysabel	~1,000 acres	Not treated	Not treated	Initial cost >$50,000	Need to identify


Elymus caput-medusae
(Medusahead)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed
0 1 2 4 6 8 10 12
Miles
1
2
3
4
5
6
8
Warner Springs
Glider port
Airport
RAMONA
AIRPORT
San Diego
San Diego
MIRAMAR
MCAS
AIRPORT
GILLESPIE FLD AIRPORT
MONTGOMERY FLD AIRPORT
79
16
76
78
67
56
52

Genista monspessulana (French broom)

SD PAF score: 6.9

Current condition: French broom is listed as a C-rated noxious weed by CDFA. This species has the ability to impact abiotic ecosystem processes (fire), as well as flora and fauna. It invades a broad range of vegetation types in both upland and riparian habitats. Three moderately-sized populations in the region could be controlled with a coordinated effort. However, all are located along riparian areas and may be dispersing downstream, making control difficult.

Management information: This perennial shrub requires a multi-year commitment to ensure eradication. Monitoring and re-treatments may be required for 10-15 years due to long seed viability. Seed pods burst to eject seed up to 4 meters from the parental plant; longer-distance dispersal may occur via water, soil movement, and animals. Individual plants are moderately difficult to control with herbicide, and re-sprouting may occur. Plants have low leaf area for translocation of herbicide, and young plants have thin stems, making cutting stem and basal bark applications of herbicide challenging. Small plants may be pulled depending on soil conditions.

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

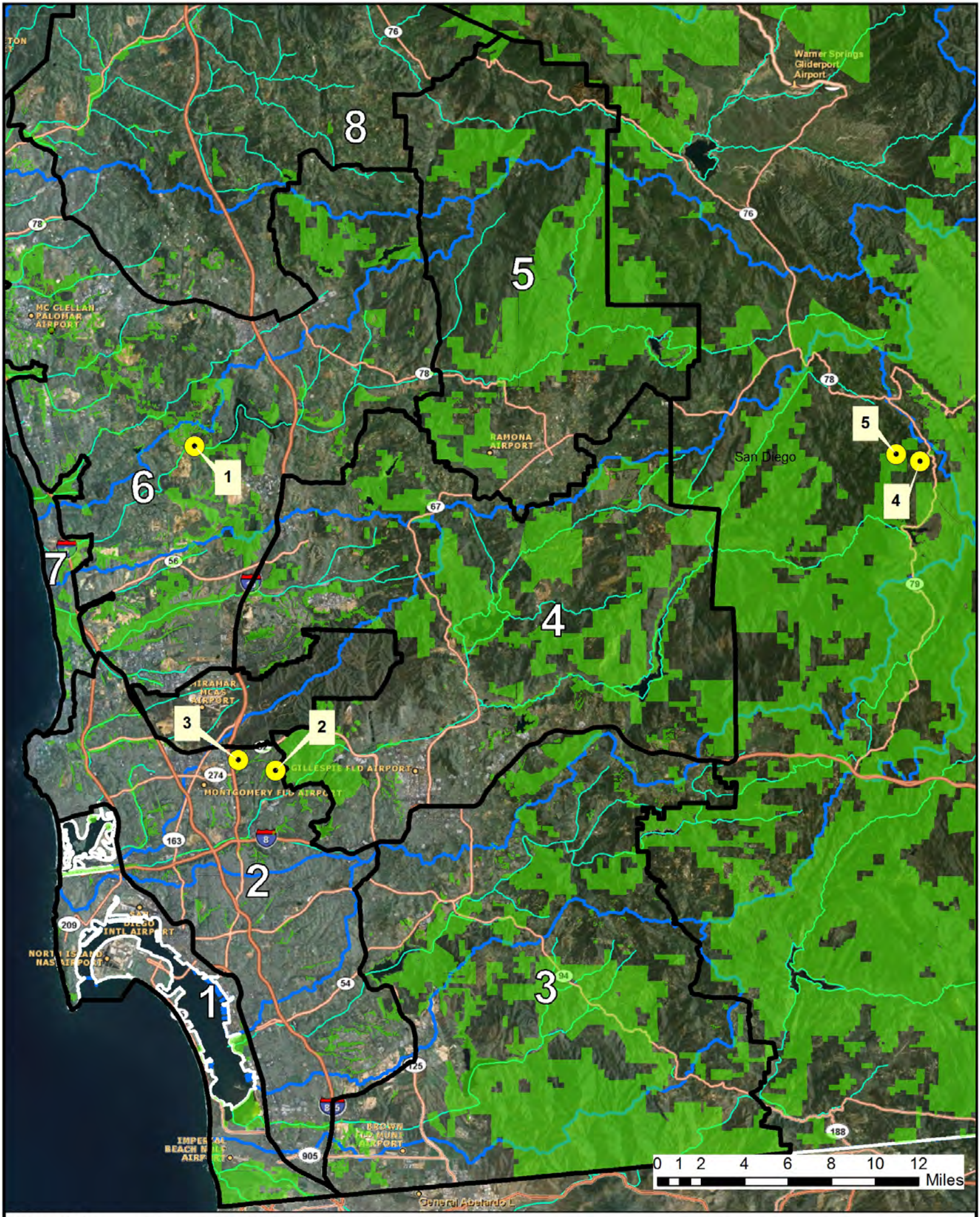
- Continue treatment and monitoring of populations #1 and 2.
- Initiate work on populations #3, 4, and 5.

Populations of *Genista monspessulana* (French broom)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Off Del Dios Hwy, below Lake Hodges Dam into Crosby Estates, San Dieguito River	>300 scattered plants along ~ 0.5-1 mile of river	Treated with current funding.	Since 2010	Annual cost estimate: $2K. Could be funded under current NRCS/River Parkways projects.	SDRVC or San Dieguito River Park
2	Camp Elliott (west side of Mission Trails Park	Scattered over ~150 acres, about 3,000 plants	Treated with current funding.	Since 2010	Annual cost estimate: $10-20K.	City of San Diego
3	Clairemont Mesa Blvd., south of SR-52, east of I-15.	<1 acre, 25 plants along road	Not treated	Not treated	Annual cost estimate: <$1K. Unfunded.	City of San Diego
4	Julian Estates, west of Hwy 79, Julian	~10 acres, 3,000-5,000 plants in patches	Not treated	Not treated	Initial annual cost estimate ~$10K. Annual re-treatment ~$1K. Unfunded.	Need to identify
5	Heise County Park, around Campsite #23, Julian	<10 acres, 3,000-5,000 plants in patches	Not treated	Not treated	Initial cost estimate ~$10K. Annual re-treatment ~$1K. Unfunded.	County Dept. Parks and Recreation

NRCS = Natural Resources Conservation Service

SDRVC = San Dieguito River Valley Conservancy


Genista monspessulana
(French broom)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed
0 1 2 4 6 8 10 12
Miles
San Diego
Warner Springs
Glider port
Airport
MC CLELLAN
PALOMAR
AIRPORT
RAMONA
AIRPORT
MIRAMAR
MCAS
AIRPORT
GILLESPIE FLD AIRPORT
MONTGOMERY FLD AIRPORT
NORTH ISLAND
NAS AIRPORT
BROWN
MUNI
AIRPORT
General Abelardo L.
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Hypericum canariense (Canary Island St. John's wort)

SD PAF score: 5.9

Current condition: This species typically invades coastal scrub and grassland habitats. It forms dense stands over time. Although abiotic impacts have not yet been documented, this species has the potential to alter vegetation structure and displace native species. Populations can expand rapidly and dominate invaded habitats (as seen in the three larger populations).

Management information: This perennial woody shrub produces a large quantity of seed that could be viable up to 5 years. It is primarily gravity-dispersed, but long distance dispersal occurs via vehicles and human activities and along drainages. Plants are moderately difficult to control, with re-sprouting observed. Control of the seed bank and re-sprouting adults will require an effort >5 years in duration.

Recommendations: Regional Priority = High; NCCP Action = Fund management

Without aggressive, coordinated management, this species will soon reach the point where it is no longer controllable within the region. Estimated initial cost $145K, annual re-treatment $17K.

- Initiate treatment and monitoring on populations # 2b, 4, 9, and 10. Estimated annual cost: $4K.
- Monitor populations #1, 2a, 5, 6, 7, and 8 to assure work is occurring.

Populations of *Hypericum canariense* (Canary Island St. John's wort)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Lusardi Creek, Black Mountain	<1 acre in 200-acre area, mostly seedlings	Re-treatments	Since 2008	Funded: <$3K	City of San Diego
2	Lake Murray, La Mesa: a) City of SD b) San Diego Public Utilities	a) <1 acre in 200- ac area, mostly seedlings b) ~5 acres, 5,000-10,000 scattered plants	a) Re-treatments b) Not treated	a) Since 2009 b) not treated	a) Funded: <$2K b) Unfunded: Initial cost: ~$30K Annual re-treatment ~$5K	a) City of SD b) San Diego Public Utilities
3	MCAS Miramar	Eradicated	Eradicated	Completed	N/A	MCAS Miramar
4	Florida Canyon, Balboa Park	~10 acres	Not treated	Not treated	Unfunded: Initial cost: ~$50K Annual re-treatment ~$5K	City of San Diego
5	Naval Base Point Loma Fuel Yard	1 acre, many sites	Ongoing	Since 2008	Funded	Naval Base Point Loma
6	Naval Base Point Loma @ Steam Plant Rd	1 acre, many sites	Ongoing	Since 2008	Funded	Naval Base Point Loma

#	Location	Size	Status	Duration	Funding Status	Lead
7	Naval Base Point Loma @ Loma Gatchell Rd.	1 acre, many sites	Ongoing	Since 2008	Funded	Naval Base Point Loma
8	Borderfield State Park32	<1 acre, 50 plants	Will be initiated in 2012-2013	Not treated	Funded	State Parks
9	Mission Center Rd. above Friars Rd., North Mission Valley	~1 acre 500 plants	Not treated	Not treated	Unfunded: Initial cost ~$15K; Annual re-treatment ~$2K	City of San Diego
10	Manning St, Tecolote Canyon	~5 acres 5,000-10,000 plants	Not treated	Not treated	Unfunded: Initial cost ~$50K; Annual re-treatment ~$5K	City of San Diego


RAMONA AIRPORT
MIRAMAR MCAS AIRPORT
GILLESPIE FLD AIRPORT
MONTGOMERY FLD AIRPORT
SAN DIEGO INTL AIRPORT
IMPERIAL BEACH NOLF AIRPORT
BROWN FLD MUNI AIRPORT
General Abelardo L. Rodriguez Intl Airport
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Miles
Hypericum canariense
(Canary Island St. John's wort)
Population (with ID#)
Management unit
Conserved Lands
Watershed

Iris pseudacorus (yellow flag iris)

SD PAF score: 5.6

Current condition: Yellow flag iris is listed as a C-rated noxious weed by CDFA. It is restricted to freshwater wetlands, although it can potentially occur in alkaline/brackish marsh. It invades marshes, pond edges and other saturated wetland areas.

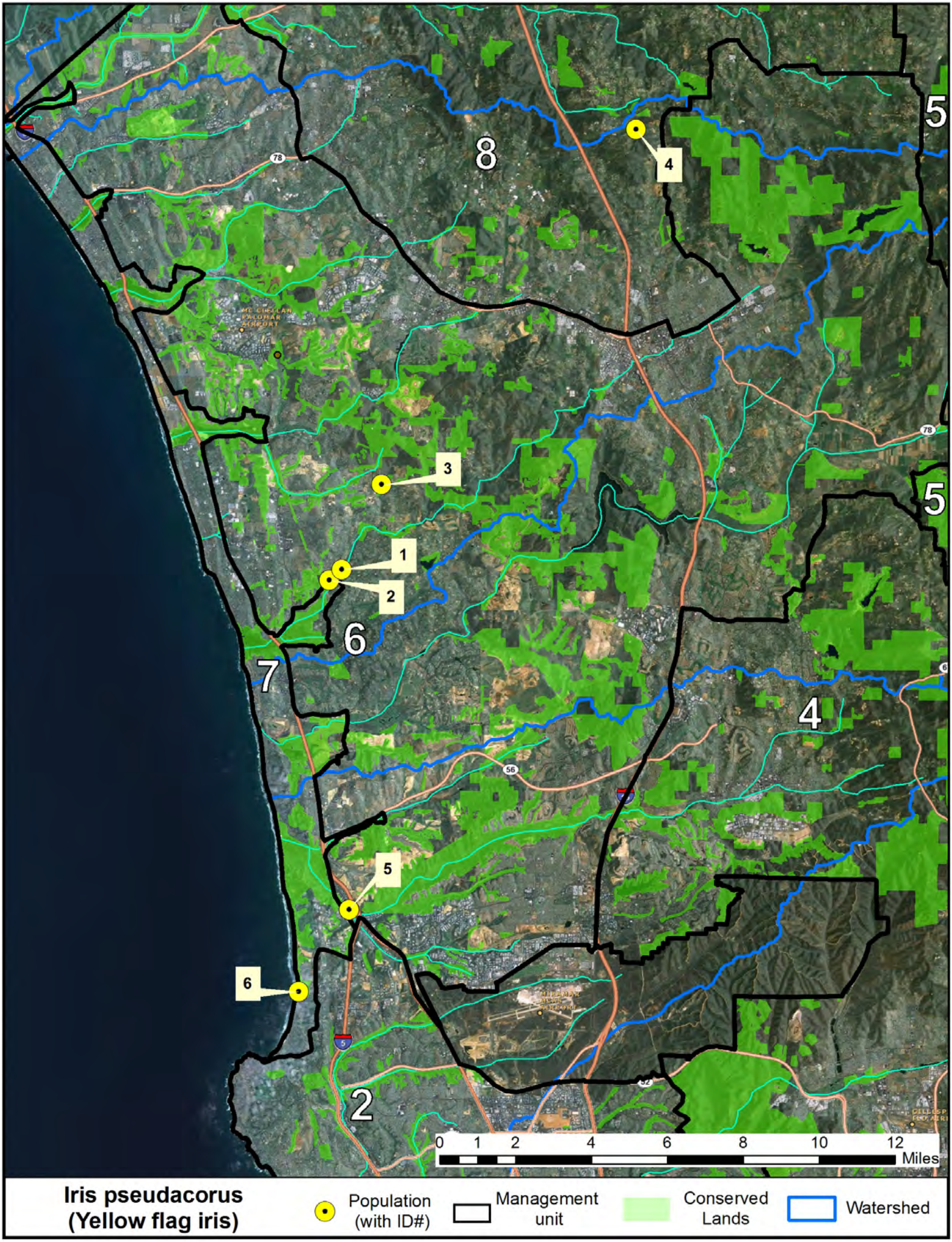
Management information: This perennial herb typically occurs in dense vegetation in wet areas and edges of open water, which can make detection, treatment, and access difficult. It disperses by seed and rhizome fragments. Seeds remain viable in soil for >3 years, and rhizomes can persist for 10 years. Seeds can remain viable after floating in seawater for 31 days, so can spread via fresh or saltwater. Once plants are found and accessed, treatments are typically effective and of short duration (~3 years).

Recommendations: Regional Priority = High; NCCP Action = Fund management

- Initiate treatment and monitoring on populations # 2, 4, 5, and 6. Estimated annual cost $2K.
- Monitor populations # 1 and 3 to assure work is occurring

Populations of *Iris pseudacorus* (yellow flag iris)

#	Location	Size	Status	Duration	Funding Status	Lead
1	La Bajada, Escondido Creek, Encinitas	1.5 miles, <1 acre	Treated	Since 2009	Funded: through 2014 (EMP) Annual cost ~ $2K	San Elijo Lagoon Conservancy
2	4289, 4269, 4261, and 4257 Manchester Ave, upper San Elijo Lagoon, Encinitas	50 plants	Unwilling landowner	Not treated	Unfunded: Annual cost ~$500	Need to identify
3	Corner of Lone Hill Lane and Long Jack Rd., Encinitas	25 plants	Treated	Since 2011	Funded: through 2014 (EMP) Annual cost ~$500	San Elijo Lagoon Conservancy
4	Lotus Pond Lane, north Escondido	30 plants	Not treated	Not treated	Unfunded: Annual cost ~$500	Need to identify
5	West of I-5, Los Peñasquitos Canyon	8 plants	Not treated.	Not treated	Unfunded: Annual cost ~$500	Need to identify
6	North Torrey Pines, UCSD Reserve, La Jolla	8 plants	Not treated	Not treated	Unfunded: Annual cost ~$500	UCSD Reserve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78
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Miles
Iris pseudacorus
(Yellow flag iris)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed

Lythrum salicaria (purple loosestrife)

SD PAF score = 8.1

Current condition: This species is listed as a B-rated Noxious Weed by CDFA. It has impacted both abiotic ecosystem processes and flora and fauna in other parts of the U.S. and may exert similar impacts in the region. It occurs in fresh and brackish water wetlands and has the potential to impact NCCP covered species.

Management information: This perennial herb requires a multi-year commitment to ensure eradication. It can produce up to 2 million seeds per plant, and seeds are viable for 3 or more years. Seeds are primarily wind-dispersed. Seeds and plant fragments can also disperse by water and animals; new plants can generate from these fragments. Once seed has dispersed into riparian areas, the entire corridor must be searched for plants. Plants grow in dense, emergent vegetation and can be difficult to see; thus, this species is most readily detected when flowering. Individual plants are not difficult to control with herbicide in spring applications.

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

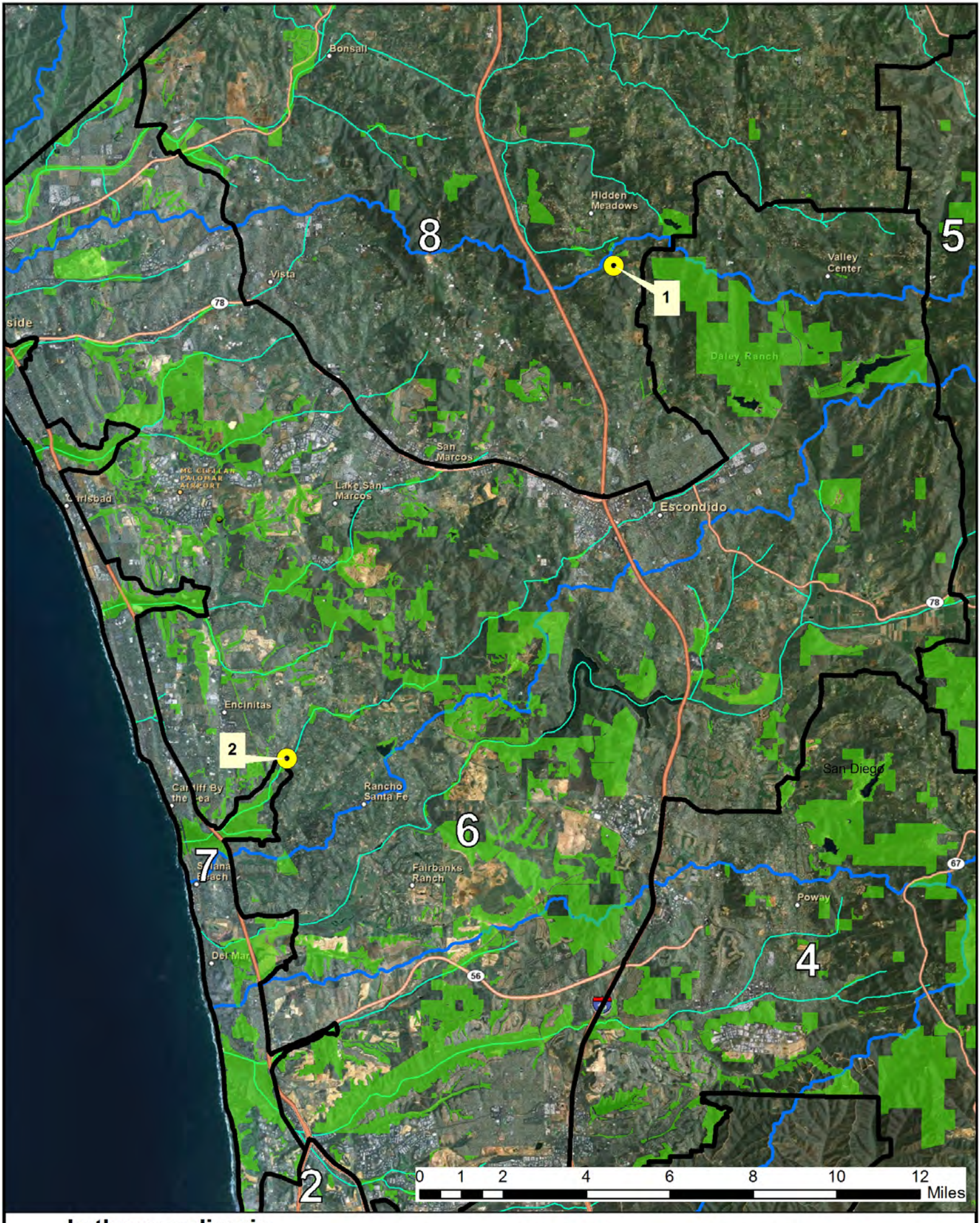
Total annual cost ~$11.5K:

- Control population # 1, starting 2013.
- Control population # 2, starting 2015.

Populations of *Lythrum salicaria* (purple loosestrife)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Lotus Pond Lane, Reidy Creek, Escondido	3 ponds	1 eradicated, 1 treated, 1 not treated (no access)	Since 2002	Funded: through 2012 (EMP) Annual cost ~$3.5K	County Dept. Ag.
2	La Bajada, Escondido Creek, Encinitas	1.5 miles, <1 acre	Under control	Since 2002-05 CDFA, 2006-current SELC	Funded: through 2014 (EMP) Annual cost ~$8K	SELC

SELC = San Elijo Lagoon Conservancy


Bonsall
Hidden Meadows
Valley Center
Vista
Daley Ranch
San Marcos
Lake San Marcos
Carlsbad
Escondido
Encinitas
Rancho Santa Fe
San Diego
Fairbanks Ranch
Poway
Del Mar
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67
0 1 2 4 6 8 10 12
Miles
Lythrum salicaria
(Purple loosestrife)
Population (with ID#)
Management unit
Conserved Lands
Watershed

Retama monosperma (bridal broom)

SD PAF score: 6.4

Current condition: Bridal broom is listed as a B-rated noxious weed by CDFA. This species may impact flora and fauna in grassland and scrub habitats. On Fallbrook Naval Weapons Station, a large invasion was considered a threat to habitat of the federally endangered Stephen's kangaroo rat and federally threatened California gnatcatcher (Jacobsen 2000), but this population has been nearly eradicated. The population adjacent to the Groves mitigation site in Bonsall has the potential to spread and impact a large population of *Ambrosia pumila*, as both species grow in sparsely vegetated areas.

Management information: This large perennial shrub requires a multi-year commitment to ensure eradication. Monitoring and re-treatments may require up to 15 years due to long seed viability. Individual plants are moderately difficult to control with herbicide, and re-sprouting may occur. Seeds are gravity-dispersed, but long-distance dispersal occurs via animals, which can carry seed a significant distance from the parental plant.

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

Initial cost $35K, annual re-treatment cost $4K:

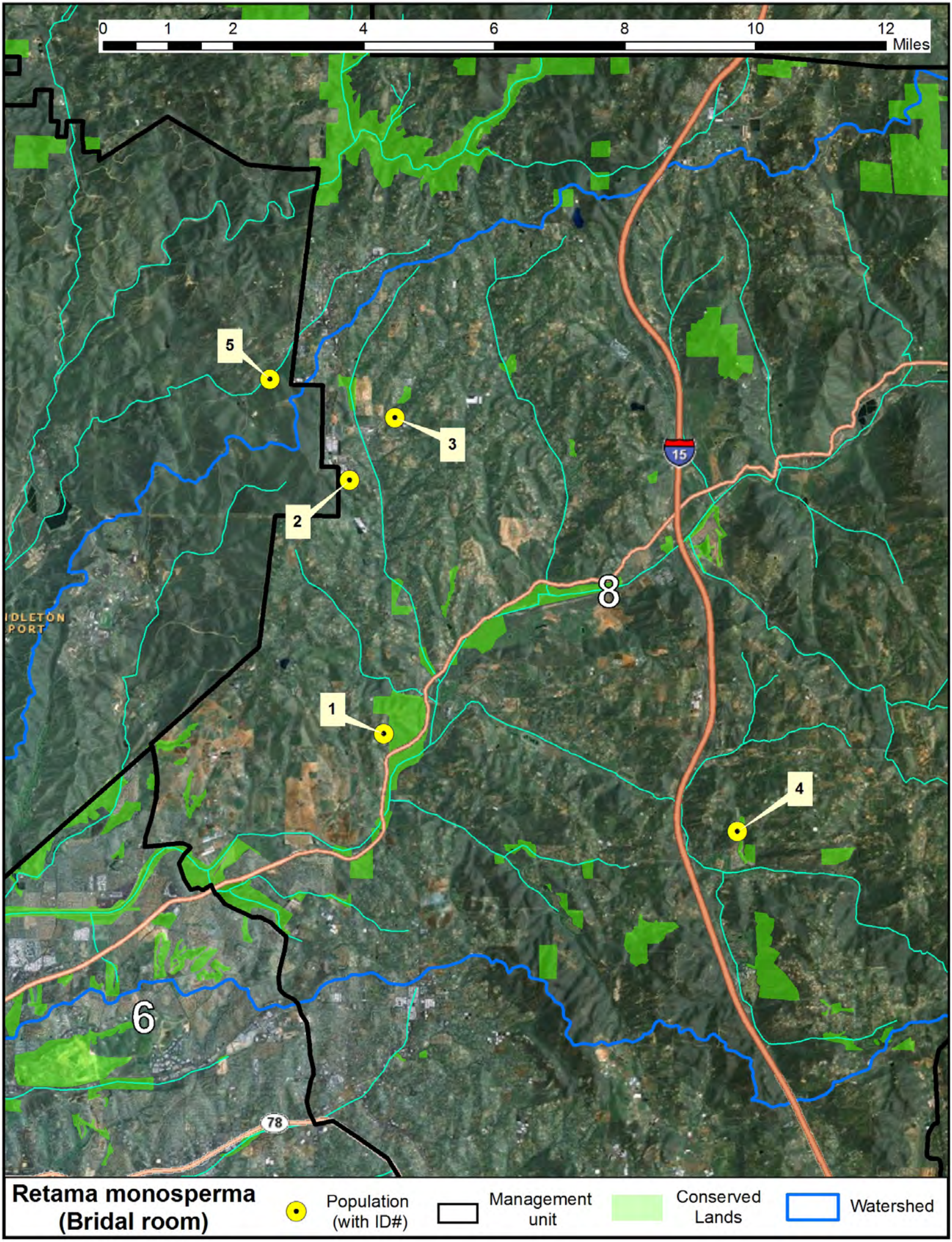
- Re-initiate treatment and monitoring on populations #2 and 3.
- Initiate treatment and monitoring on populations #1 and 4.

Populations of *Retama monosperma* (bridal broom)

#	Location	Size	Status	Duration	Funding Status	Lead
1	Adjacent to the Groves mitigation site, Bonsall.	~4 acres	Not treated. No escapes observed.	Not treated	Unfunded: Initial cost ~$30K. Annual re-treatment ~$1.5K	Mission RCD
2	Olive Hill Rd., east of Fallbrook NWS	3 acres, 500 scattered plants, seed bank well developed.	Initial treatment in 2004, with 2 years of re-treatments	Initial treatment in 2006 with 2 years of re-treatments	Unfunded: Annual re-treatment ~$1K	Mission RCD
3	Creek View Lane (off Stage Coach Rd), Fallbrook.	5 acres, 10 scattered plants	Initial treatments in 2006, with one re-treatment.	Initial treatment in 2006, with 1 re-treatment	Unfunded: Annual re-treatment ~$500	Mission RCD
4	Circle R Drive, Castle Creek	1 acre	None. Old planted grove. No escapes observed.	None	Unfunded: Initial cost ~$5K Annual re-treatment ~$1K	Mission RCD
5	Fallbrook NWS	500 acres, scattered	Controlled since ~1996, re-treated annually, still with seedlings	Initial control ~1996, re-treated annually	DOD funded	DOD

Mission RCD = Mission Resource Conservation District

DOD = Department of Defense


0 1 2 4 6 8 10 12
Miles
5
3
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15
8
1
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6
78
Retama monosperma
(Bridal room)
Population
(with ID#)
Management
unit
Conserved
Lands
Watershed

Level 3: Containment (management unit or watershed)

Goal: Eradication with coordinated programs by management unit or watershed.

Much of the management need at this level is for re-treatment following initial treatments for existing programs. Re-treatment costs are presented as annual effort for the management unit in its entirety as opposed to per-acre costs. The best estimates can be provided by past re-treatment costs. New projects should also be undertaken to see if landscape level control is achievable for additional species (particularly upland species). New programs will also build capacity and relationships in the management units.

Level 3 Recommendations

1. Support existing programs implementing eradication or containment by management unit or watershed.
2. Acquire regulatory approvals and authorization (right-of-entry) from property owners.
3. Support development of landscape level control for additional invasive non-native species (trials).
4. Assess success of both existing and new programs.

Summary of Level 3 Species

Scientific Name	Common Name	PAF score	# areas[2]	Control Effort	Difficulty	Funding Needed[3]
Arundo donax	Giant reed	8.9	12	Large	Difficult	Yes
Cortaderia selloana and *C. jubata*	Pampas grass, jubata grass	8.8	3	Large	Moderate	Yes
Cynara cardunculus	Artichoke thistle	6.3	1	Trial	Moderate	Yes
Ehrharta calycina[1]	Perennial veldt grass	5.9	0	Additional data	Moderate	NA
Ehrharta longiflora[1]	Long-flowered veldt grass	4.5	0	Additional data	Moderate	NA
Emex spinosa	Devil's thorn	4.8	2	Trial	Moderate	Yes
Lepidium latifolium	Perennial pepperweed	7.9	13	Medium	Difficult	Yes
Oncosiphon piluliferum[1]	Globe chamomile	5.1	0	Additional data	Moderate	NA
Spartium junceum	Spanish broom	5.7	3	Trial	Moderate	Yes

[1] Should be considered for Level 3 status through collection of additional data.

[2] Management areas with coordinated or proposed trial work. These may be watersheds, management units, or landscape-level control/containment.

[3] Funding need is marked as NA where additional information or assessment is needed prior to initiating trials.

Arundo donax (giant reed)

SD PAF score: 8.9

Current condition: Giant reed is listed as a B-rated noxious weed by CDFA. It has demonstrated the ability to severely impact both abiotic ecosystem processes as well as NCCP species such as arroyo toad, least Bell's vireo, and southwestern willow flycatcher. Of particular concern is its ability to introduce fire into wetland systems. Giant reed is typically found in freshwater wetlands, although it also occurs in estuaries and beach/dune habitats. It is widely distributed and abundant throughout most of the region (Santa Margarita, San Luis Rey, Carlsbad Watershed Hydrologic Unit (HU), San Dieguito River, San Diego River); however, several watershed-based eradication programs are active, and several now have low levels of infestation.

Management information: Giant reed is a perennial, rhizomatous, large grass that requires a multi-year commitment (>10 years) for complete eradication. This species spreads when fragments of stems and rhizomes break off in flood events and are carried downstream. Viable seed has not been observed in populations found in North America. Because of its dispersal properties and the potential for re-infestation, it is particularly important that watershed-based treatments implement a top-down control program, with upstream sites treated prior to downstream areas to the degree feasible. Monitoring and re-treatment require up to 15 years due to continued re-sprouting from rhizomes. Control of mature stands frequently requires removal/reduction of large amounts of biomass. Large infestations, complex control procedures, and the need to obtain landowner permission require coordinated programs to maximize long-term effectiveness. Initial costs of controlling mature stands are typically >$10K per acre. This cost historically has been covered by non-EMP funding sources. Herbicide re-treatment can be done with a backpack at a lower cost compared to initial control work, making this effort compatible with EMP funding structure. Infested riparian areas that have been burned should be prioritized for treatment to take advantage of cost savings (e.g., reduced biomass removal/reduction) and improved site accessibility. This approach was used in the San Dieguito River watershed after the 2007 fires.

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

Due to the high cost of initial control, EMP funding support should be directed toward re-treatment of previously treated areas. Re-treatment funding will increase the likelihood of obtaining federal and state grants for watershed programs (typically for initial work with grant durations of 3 to 5 years).

- Re-treat watersheds # 1-5 and 9. Estimated annual cost $210K.
- Re-treat watersheds #7, 8, and 11. Estimated annual cost $10K.
- Coordinate permit acquisition and implementation in watersheds #6, 10, and 12.

Populations of *Arundo donax* (giant reed)

#	Watershed	Treated	Permits	Funding Status[2]	Annual Cost[2]	Size of Effort	Priority[3]	Lead[4]
1	Santa Margarita	>95%	Yes	EMP thru 2012	$10K	Small	Very High	Mission RCD
2	San Luis Rey	>85%	Yes	EMP thru 2012	$50K	Very large	Very High	Mission RCD
3	Carlsbad HU	>95%	Yes	EMP thru 2014	$30K	Medium	Very High	SELC
4	San Dieguito	>50%	Yes	IRWMP thru 2014	$50K	Very large	Very High	SDRP/ SDRVC
5	San Diego River	>40%	Yes	EMP thru 2014	$30K	Medium	High	SDRC
6	Los Peñasquitos Canyon[1]	>40%	No	N/A	N/A	N/A	Medium	City SD
7	Peñasquitos – Rose Cyn	<10%	In process	Reassess after 2015	N/A	N/A	Medium	CLC
8	Upper Tijuana	<20%	Unknown	Unfunded	$10K	Small	Medium	County[5]
9	Lower Tijuana[1]	>40%	Yes	Unfunded	$40K	Large	High	SWIA
10	Sweetwater[1]	<10%	Unknown	Unfunded	N/A	N/A	Medium	SA[5]
11	Otay[1]	<10%	Unknown	Unfunded	N/A	N/A	Medium	County[5]
12	Pueblo[1]	<10%	No, but in process	Unfunded	N/A	N/A	Low	City SD[5]

[1] Control is not watershed based (top down) in these watersheds.

[2] Re-treatment costs only. N/A = not watershed based and/or no coordinated re-treatment program.

[3] Priority:

Very High = Watershed based **and** well established (>5 years work)

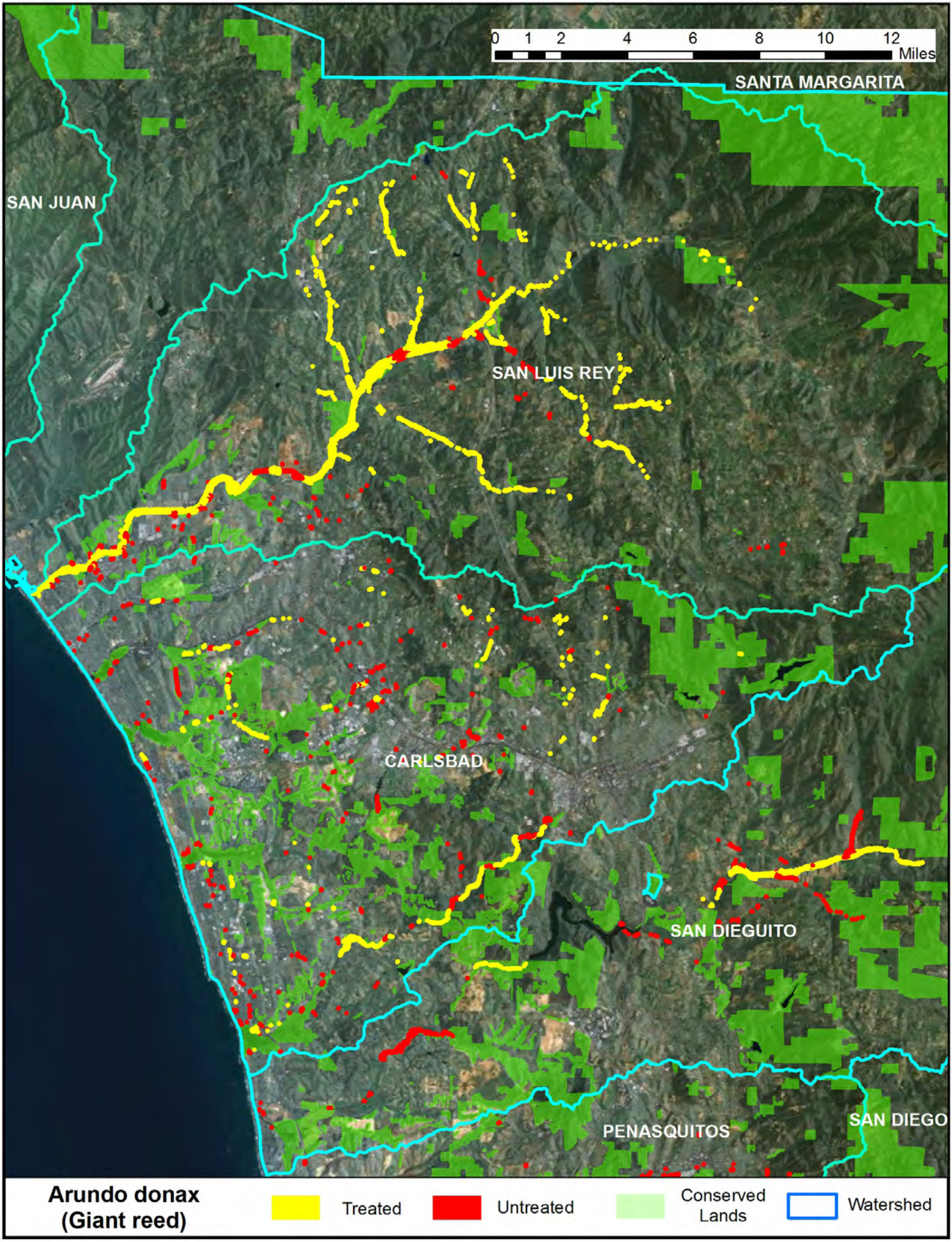
High = Watershed based **or** well established

Medium = scattered work has occurred

Low = little work has occurred

[4] Abbreviations: Mission RCD = Mission Resource Conservation District, SELC = San Elijo Lagoon Conservancy, SDRP = San Dieguito River Park, SDRVC = San Dieguito Valley Conservancy, SDRC = San Diego River Conservancy, CLC = Chaparral Lands Conservancy, SA = Sweetwater Authority, SWIA = Southwest Wetlands Interpretive Association.

[5] Potential lead, no current watershed based coordination.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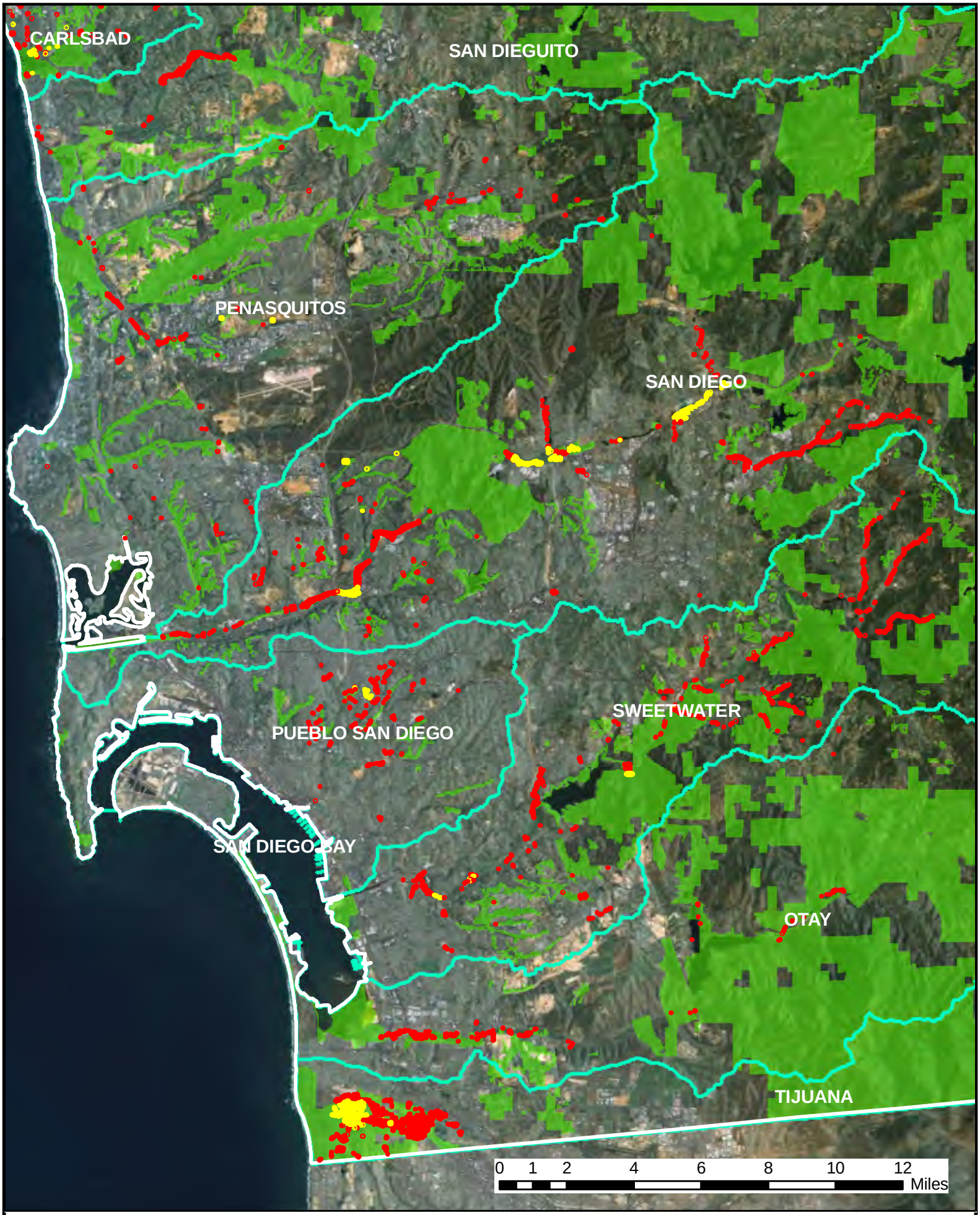
Miles
SANTA MARGARITA
SAN JUAN
SAN LUIS REY
CARLSBAD
SAN DIEGUITO
PENASQUITOS
SAN DIEGO
Arundo donax
(Giant reed)
Treated
Untreated
Conserved Lands
Watershed



Arundo donax (Giant reed)

Treated | Untreated | Conserved Lands | Watershed

Cortaderia selloana and *C. jubata* (pampas grass and jubata grass)

SD PAF score: 8.8

Current condition: These species have demonstrated the ability to impact abiotic processes as well as flora and fauna in both riparian and upland systems. Pampas grass is widely distributed and abundant through much of the region, particularly in the coastal zone. Jubata grass is uncommon in our region, but is similar to pampas grass and is treated as the same in this management recommendation. Only one watershed-based program has initiated landscape level control (Carlsbad HU), although others are initiating programs in the future (Rose Creek and San Diego River). Pampas grass plantings in urban areas are a problematic seed source that makes landscape-level eradication challenging. Reducing populations to the level where control can be achieved on a specific reserve may be the only achievable land management goal.

Cortaderia jubata has been cited as a direct threat to short-leaved dudleya (*Dudleya brevifolia*) (Cal-IPC 2004). In San Diego County, this species infests riparian habitats and may out-compete sensitive plant species and reportedly obstructs wildlife movement in seeps, riparian, and ephemeral wet areas in Carlsbad, Oceanside, and San Marcos (e.g., Carlsbad Oaks North, Buena Vista Creek, Calavera Hills, Encino Creek, Rancho La Costa Habitat Conservation Area, Wilmont Ranch Habitat Conservation Area) (McConnell pers. obs. 2011, Vinje pers. obs. 2011).

Management information: This perennial grass is long-lived (15-20 years) and a prolific seed-producer. Seeds are lightweight and primarily wind-dispersed. However, seeds are short-lived (<1 year). Control has been conducted in sub-units of coastal watersheds. For maximum control, the entire sub-unit must be treated simultaneously, as wind-dispersed seed may spread in any direction. Although typically treated within a hydrological unit, top-down watershed control is not required. Control frequently requires cutting or mowing plants either before or after herbicide treatment. Plants are easy to kill if there is good herbicide coverage, typically requiring 1-2 years (cost ~$3K/acre, depending on size and density of the infestation, and if biomass reduction is required). Re-treatment costs are lower than the initial treatment costs.

Recommendations: Regional Priority = High; NCCP Action = Fund management

- Re-treat and monitor areas already treated (estimated annual cost $40K).
- Support development of landscape level control for additional areas where there is both need and the ability to manage the areas in perpetuity.
- Assess success of both existing and new programs.

Populations of *Cortaderia selloana* and *C. jubata* (pampas grass)

#	Watershed	Treated	Permits	Funding Status[2]	Annual Cost[2]	Size	Priority	Lead[4]
1	Carlsbad HU	>60%	Yes	EMP thru 2014	$40K	Large	Very High	SELC
2	San Diego River[1]	<1%	Yes	N/A	N/A	N/A	Low	SDRC
3	Los Peñasquitos, Rose Canyon[1]	<1%	In process	N/A	N/A	N/A	Low	CLC

[1] Control is planned, but has not yet occurred.

[2] Re-treatment costs only. N/A = initial work is planned but has not yet occurred.

[3] Priority:

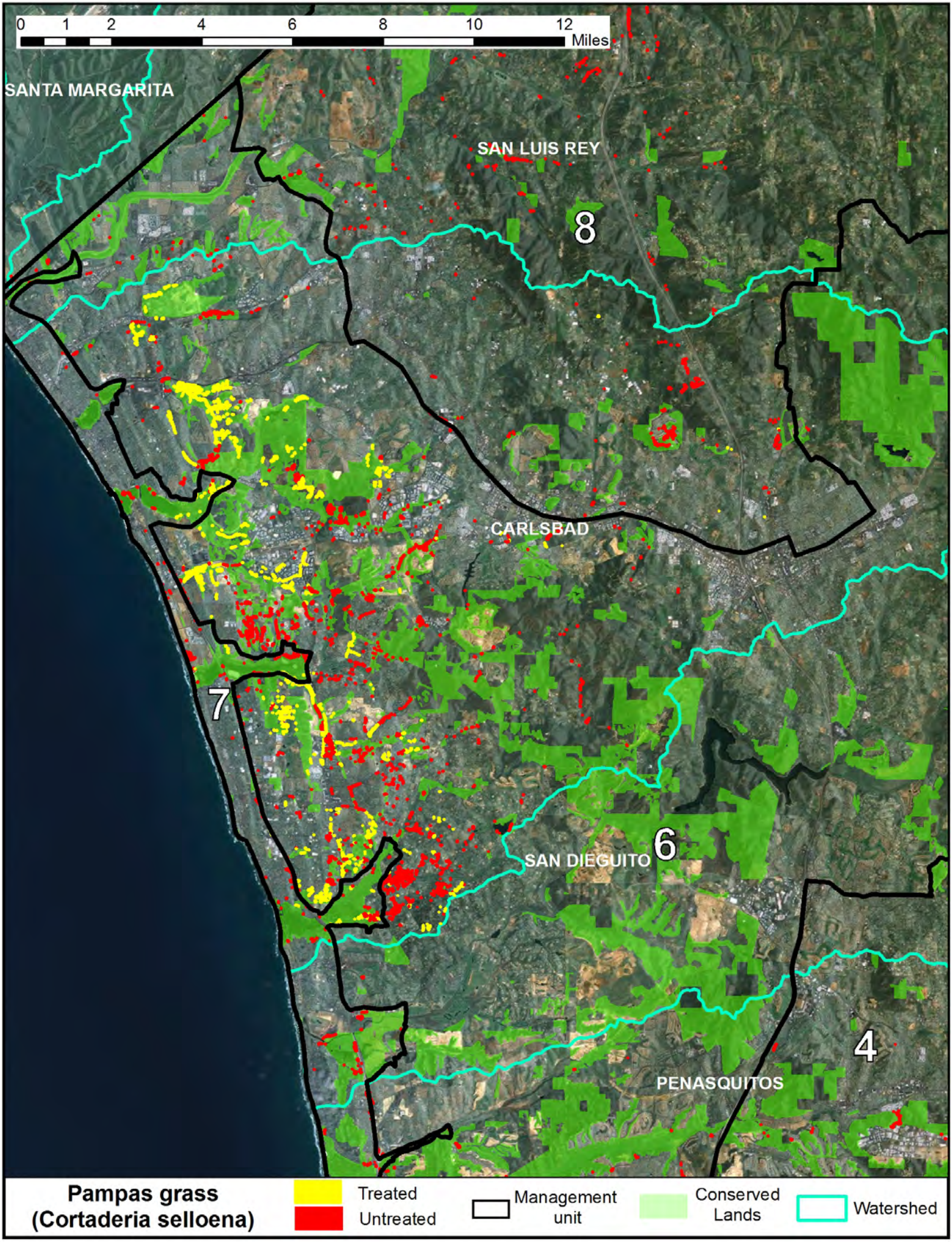
Very High = Watershed based **and** well established (>5 years work)

High = Watershed based **or** well established

Medium = scattered work has occurred

Low = little work has occurred.

[4] Abbreviations: SELC = San Elijo Lagoon Conservancy, SDRC = San Diego River Conservancy, CLC = Chaparral Lands Conservancy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Miles
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SAN LUIS REY
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CARLSBAD
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SAN DIEGUITO
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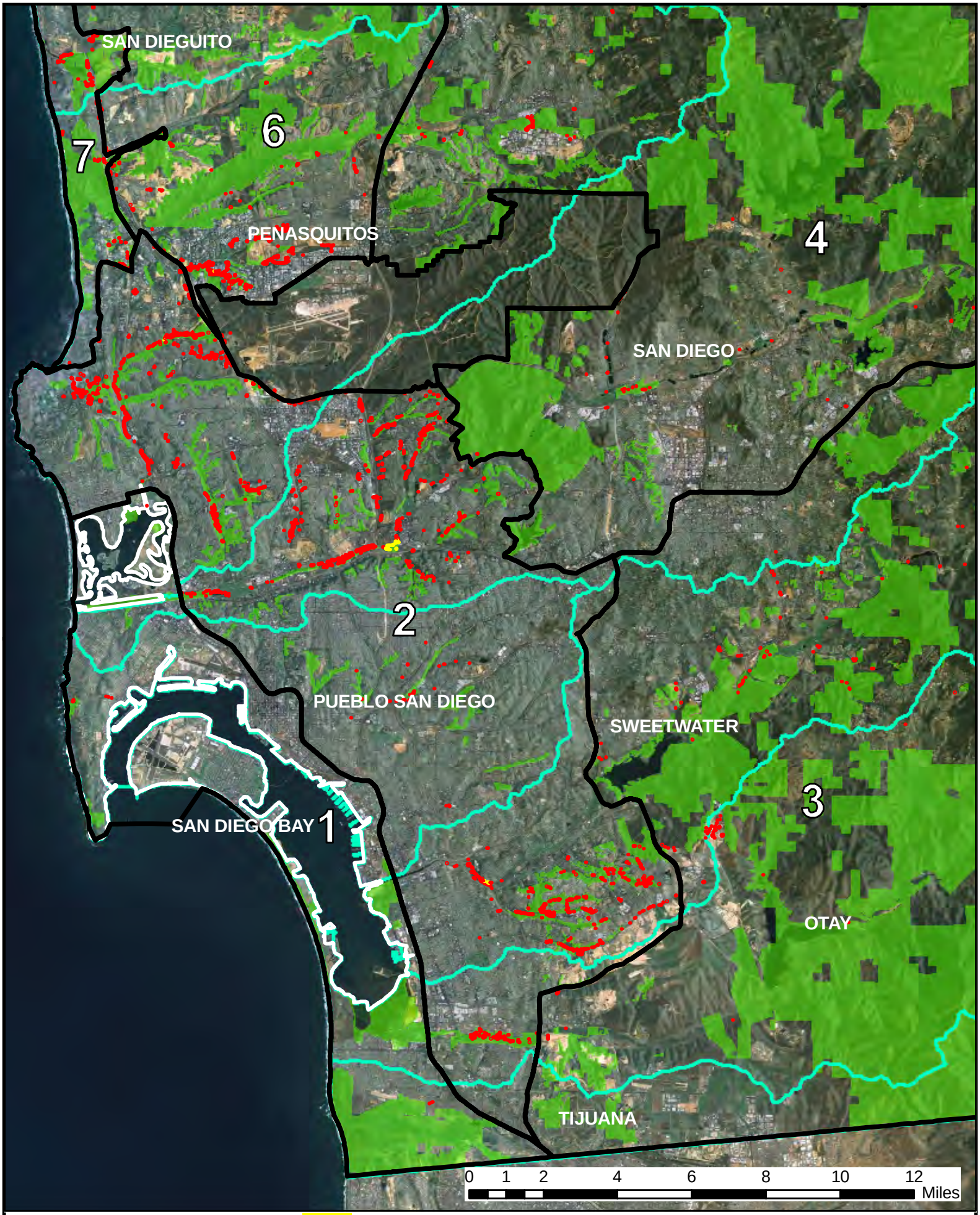
PENASQUITOS
Pampas grass
(Cortaderia selloena)
Treated
Untreated
Management unit
Conserved Lands
Watershed


SAN DIEGUITO
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SAN DIEGO
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PUEBLO SAN DIEGO
SWEETWATER
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SAN DIEGO BAY
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OTAY
TIJUANA
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Miles
Pampas grass
(Cortaderia selloena)
Treated
Untreated
Management unit
Conserved Lands
Watershed

Cynara cardunculus (artichoke thistle)

SD PAF score: 6.3

Although this is a Level 3 species, because of its significant impacts to covered and narrow endemic species, it is discussed later in this document, with the Level 4 and 5 species.

Recommendations: Regional Priority = Very High; NCCP Action = Coordinate; fund trial

Emex spinosa (devil's thorn)

SD PAF score: 4.8

Current condition: This species occurs in many portions of the region's coastline, but may be too widespread to allow control over large portions of the coast. Plants are also found inland, but typically occur in disturbed areas with low resource values. This species has no documented impacts on abiotic ecosystem processes, but in beach and southern foredune habitats it has impacted covered species such as Nuttall's lotus (Burrascano 2005, 2011) and California least tern (Peugh 2005). It also occurs in non-native grasslands and sensitive scrub communities (e.g., maritime succulent scrub, coastal bluff scrub).

Management information: This annual herb requires a long-term control effort because of its persistent seed bank (>7 years). Most seeds are gravity-dispersed, falling close to the parental plant. However, seeds can also be wind- or water-dispersed, and the seed pods can be dispersed by animals or human-related activities.

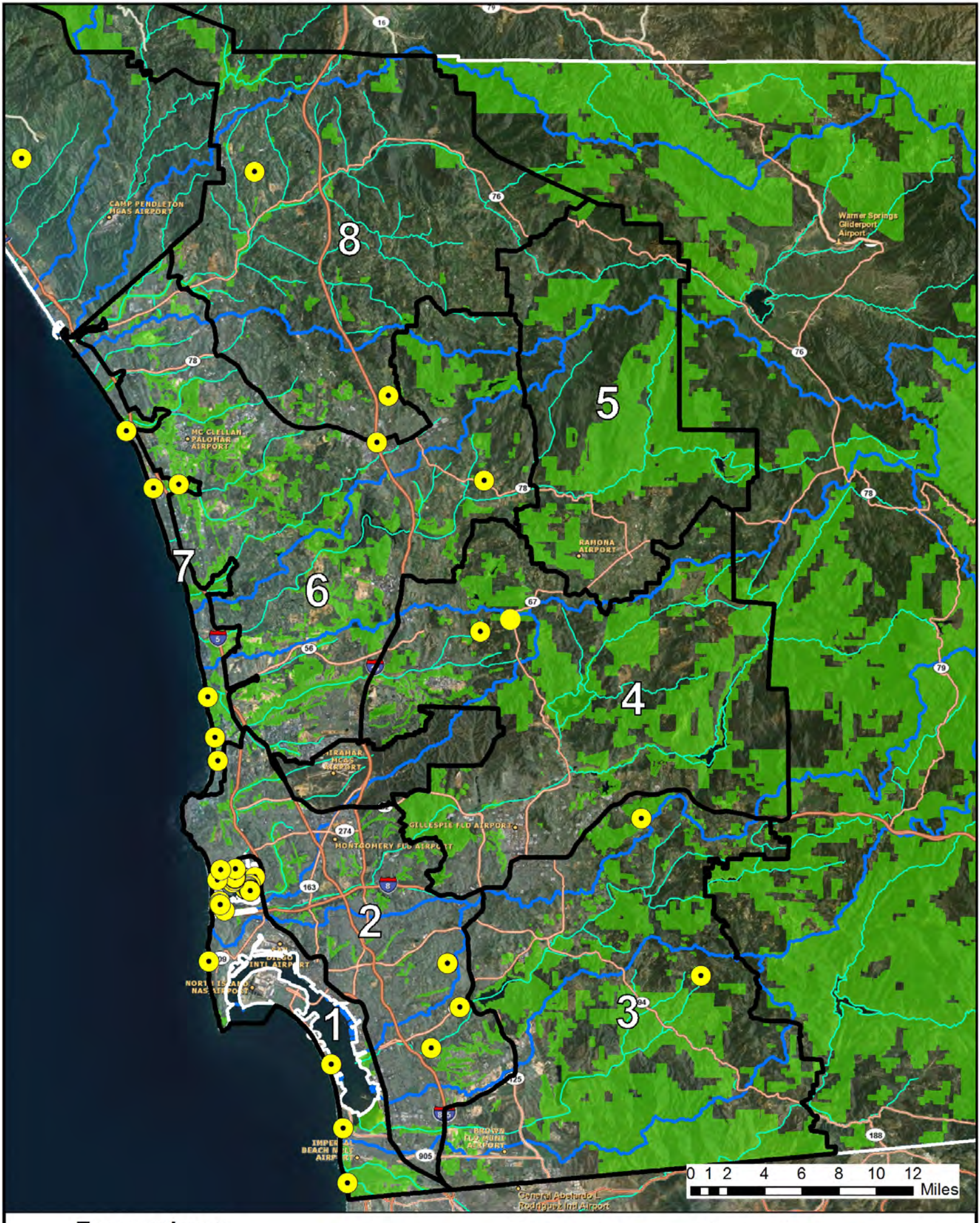
Recommendations: Regional Priority = Medium; NCCP Action = Coordinate; fund trial

Evaluate the possibility of coordinated control along portions of the coast. This species is actively managed in some areas, particularly around sensitive coastal resources (least terns and endemic plants). Trial funding of a portion of a management unit may be useful to evaluate if coordinated control is possible or of benefit.

- Survey for this plant in the vicinity of covered species along the coast (e.g., least terns and endemic plants).
- If necessary, develop a coordinated control and monitoring program for Management Units #1 and/or #7.

Populations of *Emex spinosa* (devil's thorn)

Management Unit	Size	Permits	Lead
1	Medium	May apply	Need to identify
7	Medium	May apply	Need to identify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CAMP PENDLETON MCAS AIRPORT
MC CLELLAN-PALOMAR AIRPORT
Warner Springs Gliderport Airport
RAMONA AIRPORT
MIRAMAR MCAS AIRPORT
GILLESPIE FLD AIRPORT
MONTGOMERY FLD AIRPORT
NORTH ISLAND NAS AIRPORT
BROWN FLD MUNI AIRPORT
General Abelardo L. Rodriguez Intl Airport
0 1 2 4 6 8 10 12
Miles
Emex spinosa (Devil's thorn)
Population
Management unit
Conserved Lands
Watershed

Lepidium latifolium (perennial pepperweed)

SD PAF score: 7.9

Current condition: Perennial pepperweed is listed as a B-rated noxious weed by CDFA. It is widely distributed throughout the region (in every watershed), with the ability to negatively impact abiotic processes as well as flora and fauna (e.g., arroyo toad, least Bell's vireo, southwestern willow flycatcher). In Carlsbad, this species is growing with San Diego marsh elder (*Iva hayesiana*) and southwestern spiny rush (*Juncus acutus* ssp. *leopoldii*), and would likely displace those species if not being controlled (Vinje 2011). Pepperweed could also pose a threat to habitat of the endangered salt marsh harvest mouse, California clapper rail, and California black rail (Howald 2000). Scattered patches and individual plants may not be detected easily.

Management information: Pepperweed is a prolific seed producer, and seeds spread by wind, water, soil movement, and possibly, waterfowl. Seed viability is less than 3 years. Rhizome fragments can sprout and have the ability to float and disperse through water or soil movement. Turf farms in the San Dieguito River watershed may also be distributing material in the region, as there is pepperweed on the Encinitas golf course. This perennial herb is hard to control due to deep-rooted rhizomes, waxy leaf surfaces, accumulated dead biomass, and a brief optimal treatment window in early summer when plants are green but have not flowered. Large patches of plants are detectable where access is good, but successful control projects often require searching through thick vegetation to find all plants. Sites often require reduction of old biomass to allow better application of herbicide and typically require >5 years to achieve control, with an additional 4-5 years for monitoring. Riparian corridors are frequently too dynamic and too densely vegetated to allow 100% control. A more achievable goal may be to suppress reproduction and establishment of large infestations. Infested riparian areas that have burned should be prioritized immediately for treatment. Pepperweed re-sprouts before any other vegetation, thus allowing fast and efficient mapping and treatment (as observed after the San Dieguito River fires in 2007).

Recommendations: Regional Priority = Very High; NCCP Action = Fund management; additional data

Due to the wide distribution of this plant, a mix of watershed/management groups have been working on this species in addition to significant work by the County Department of Agriculture.

- Re-treat and monitor areas in watersheds #1-11. Estimated annual cost $120K.
- Continue to monitor and evaluate control strategies. Further refine priorities based on resources and funding.

Populations of *Lepidium latifolium* (perennial pepperweed)

#	Watershed	Permits	Funding Status[1]	Annual Cost	Size	Priority[1]	Lead[2]
1a	Santa Margarita (County line to Camp Pendleton)	Yes	Not treated	~$5K	Small	High	Mission RCD
1b	Santa Margarita (Camp Pendleton)	Yes	DOD funded	DOD funded	Medium	High	Camp Pendleton
2	San Luis Rey	Yes	Various - ending 2012	~$10K	Medium	High	Mission RCD, Co. Dept. Ag.
3	Carlsbad HU	Yes	Various - ending 2012	~$12K	Medium	High	SELC, Co. Dept. Ag.
4	San Dieguito	Yes	Various - ending 2012	~$55K	Very large	Very High	SDRP/SDRV, Co. Dept. Ag.
5	San Diego	Yes	Various - ending 2012	~$5K	Small	Very High	SDRC, Co. Dept. Ag.
6a	Los Peñasquitos – Peñasquitos Creek	Yes	Various - ending 2012	~$5K	Small	Very High	Co. Dept. Ag.
6b	Los Peñasquitos – Rose Canyon	Yes	Various - ending 2012	~$5K	Small	Very High	Co. Dept. Ag.
7	Upper Tijuana	Yes	Various - ending 2012	~$5K	Small	High	Co. Dept. Ag.
8	Lower Tijuana	Yes	Various - ending 2012	~$5K	Small	High	SWIA, Co. Dept. Ag.
9	Sweetwater	Yes	Various - ending 2012	~$5K	Small	High	SA, Co. Dept. Ag.
10	Otay	Yes	Various - ending 2012	~$5K	Small	High	Co. Dept. Ag.
11	Pueblo	Yes	Various - ending 2012	~$5K	Small	High	Co. Dept. Ag.

[1] Priority:

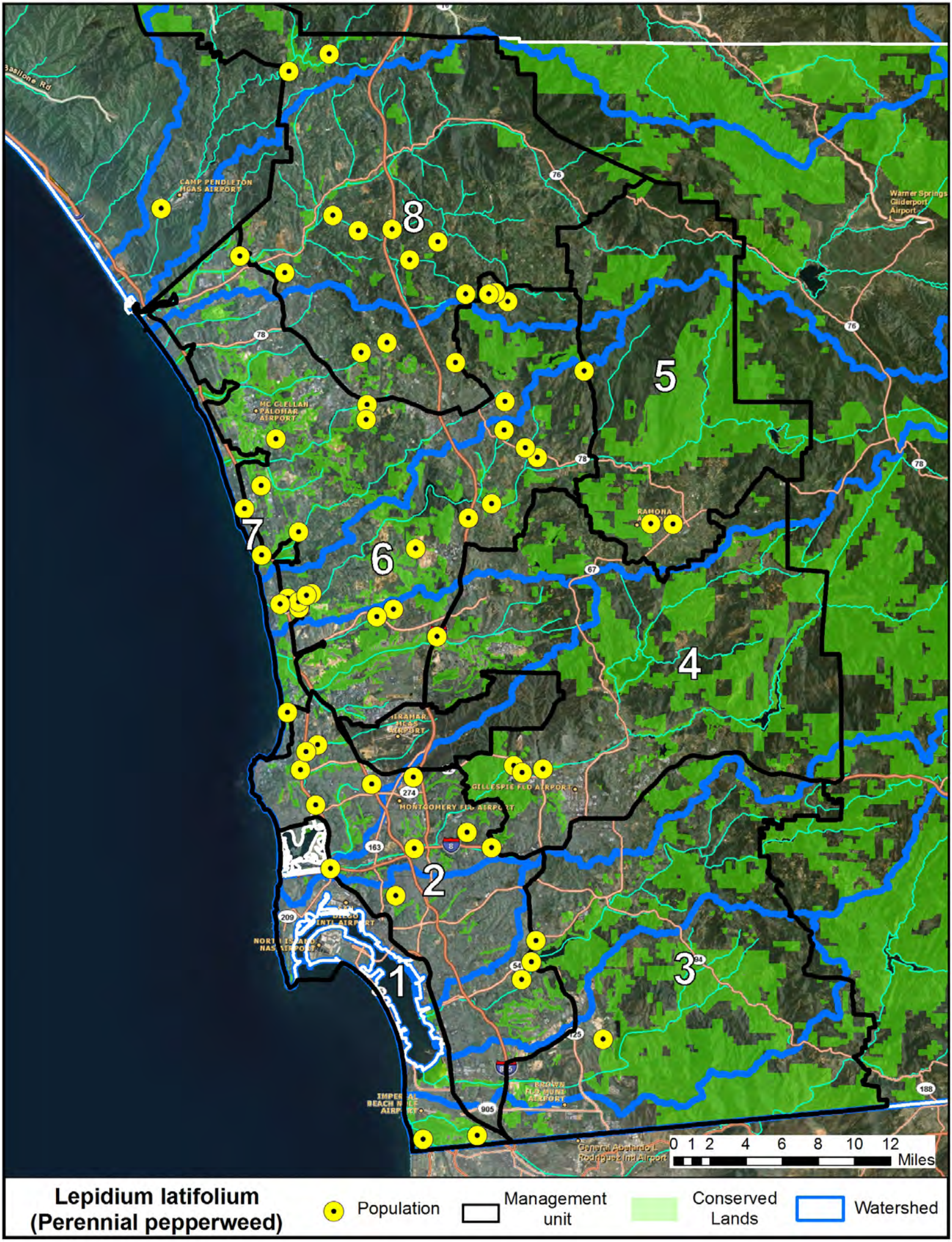
Very High = Watershed based **and** well established (> 5 years work)

High = Watershed based **or** well established

Medium = scattered work has occurred

Low = little work has occurred

[2] Abbreviations: Mission RCD = Mission Resource Conservation District, SELC = San Elijo Lagoon Conservancy, SDRP = San Dieguito River Park, SDRVC = San Dieguito River Valley Conservancy, SDRP = San Diego River Park, SA = Sweetwater Authority, SWIA = Southwest Wetlands Interpretive Association.


Lepidium latifolium
(Perennial pepperweed)
Population
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CAMP PENDLETON MCAS AIRPORT
MC CLELLAN PALOMAR AIRPORT
MONTGOMERY FLD AIRPORT
GILLESPIE FLD AIRPORT
BROWN FLD MUNI AIRPORT
RAMONA
Warner Springs Glideport Airport
General Abelardo L. Rodriguez Intl Airport

Spartium junceum (Spanish broom)

SD PAF score = 5.2

Current condition: This species is listed as a C-rated noxious weed by CDFA. It typically occurs in upland scrub vegetation, particularly higher elevation interior portions of the region. It prefers disturbed areas and is common along roadsides, but will invade into natural disturbance zones, such as landslides and post-fire sites. The two largest infestations are along Highway 8 between Alpine and Pine Valley and along Highway 67 between Poway and Ramona. A number of smaller satellite populations also exist.

Management information: This perennial shrub is a prolific seeder which creates a seed bank that is viable for at least 5 years. Seeds are primarily gravity-dispersed, falling near the parental plant, but may be moved further away by erosion, rainwash, and possibly, ants. Plants are moderately difficult to kill, with significant re-sprouting. Biomass may need to be cut or mowed where stands are dense and large. A long-term control effort is required to deal with the seed bank.

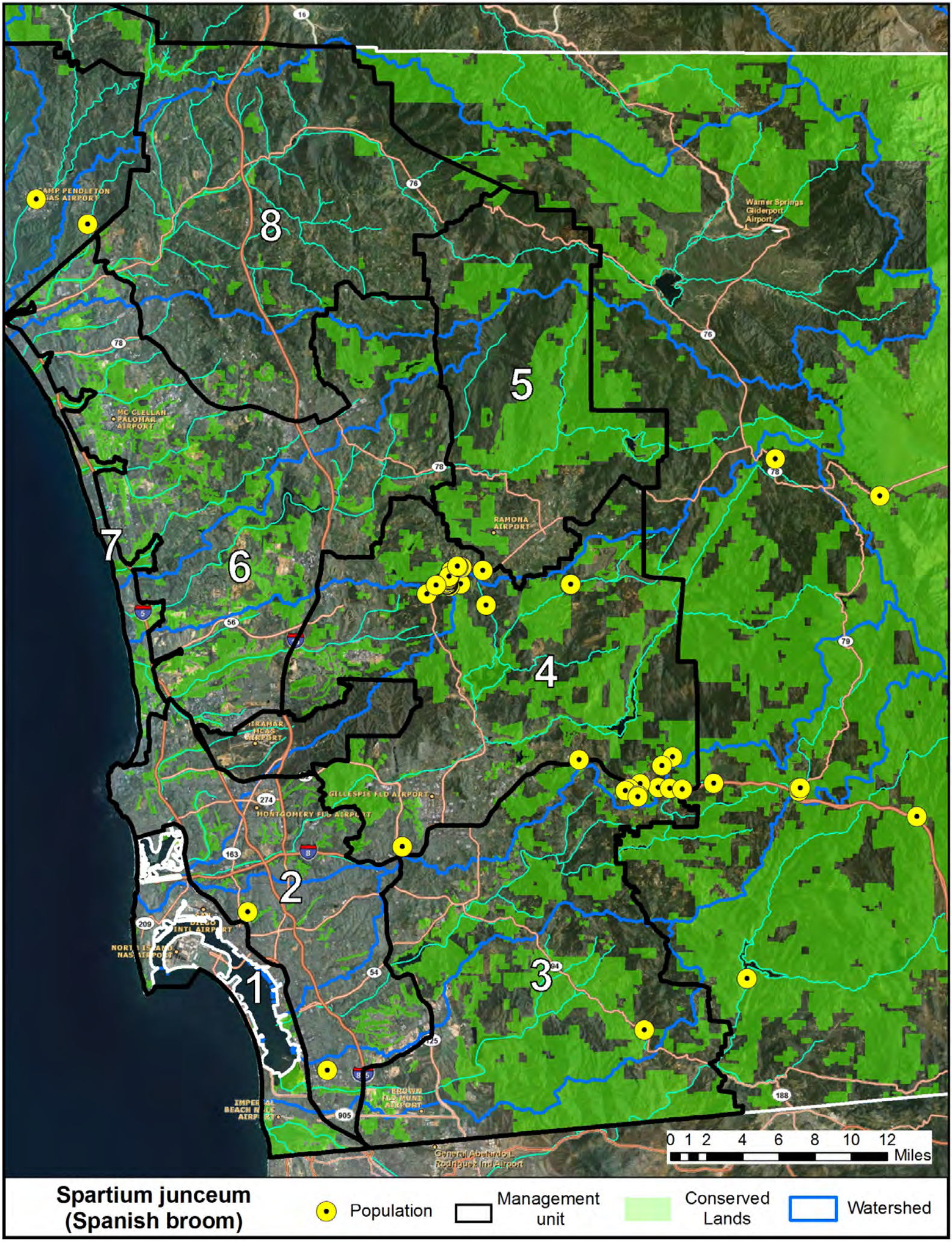
Recommendations: Regional Priority = Medium; NCCP Action = Coordinate; fund management

Initiate coordinated control within management unit and build capacity of these programs to carryout landscape level control by funding one or two management units as a trial to achieve sub-regional control. Additional coordination will need to occur with USFS and possibly BLM as these federal landowners would need to initiate control on their lands for regional implementation to be effective.

- Coordinate and develop programs for Management Unit #3 and east of region. Estimated annual cost $15k (need better acreage estimate).
- Coordinate and develop a program for Management Unit #4, starting with outliers and initiating work in phases. Estimated annual cost $50K (need better acreage estimate).

Populations of *Spartium junceum* (Spanish broom)

Management Unit	Size of Control Effort	Active Permits	Cost	NCCP Priority	Lead
3	Small	May apply	$5K	High	Need to identify
4	Large	May apply	$50K	Medium	Need to identify
East	Medium	May apply	$10K	High	Need to identify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Miles
Spartium junceum
(Spanish broom)
Population
Management unit
Conserved Lands
Watershed

Species that should be evaluated further for possible inclusion in Management Level 3

Ehrharta calycina (perennial veldt grass)

SD PAF score: 5.9

Due to its limited distribution in the region, this species should be evaluated further for inclusion in Level 3. CalTrans construction along the I-5 corridor will reduce its distribution to a degree. Trial funding of a portion of a management unit may be useful to evaluate if coordinated control is possible or of benefit.

Recommendations: Regional Priority = Medium; NCCP Action = Additional data

Ehrharta longiflora (long-flowered veldt grass)

SD PAF score: 4.5

Due to its limited distribution in the region, this species should be evaluated further for inclusion in Level 3. Trial funding of a portion of a management unit may be useful to evaluate if coordinated control is possible or of benefit. Because of its significant impacts to covered and narrow endemic species, it is discussed later in this document, with the Level 4 and 5 species.

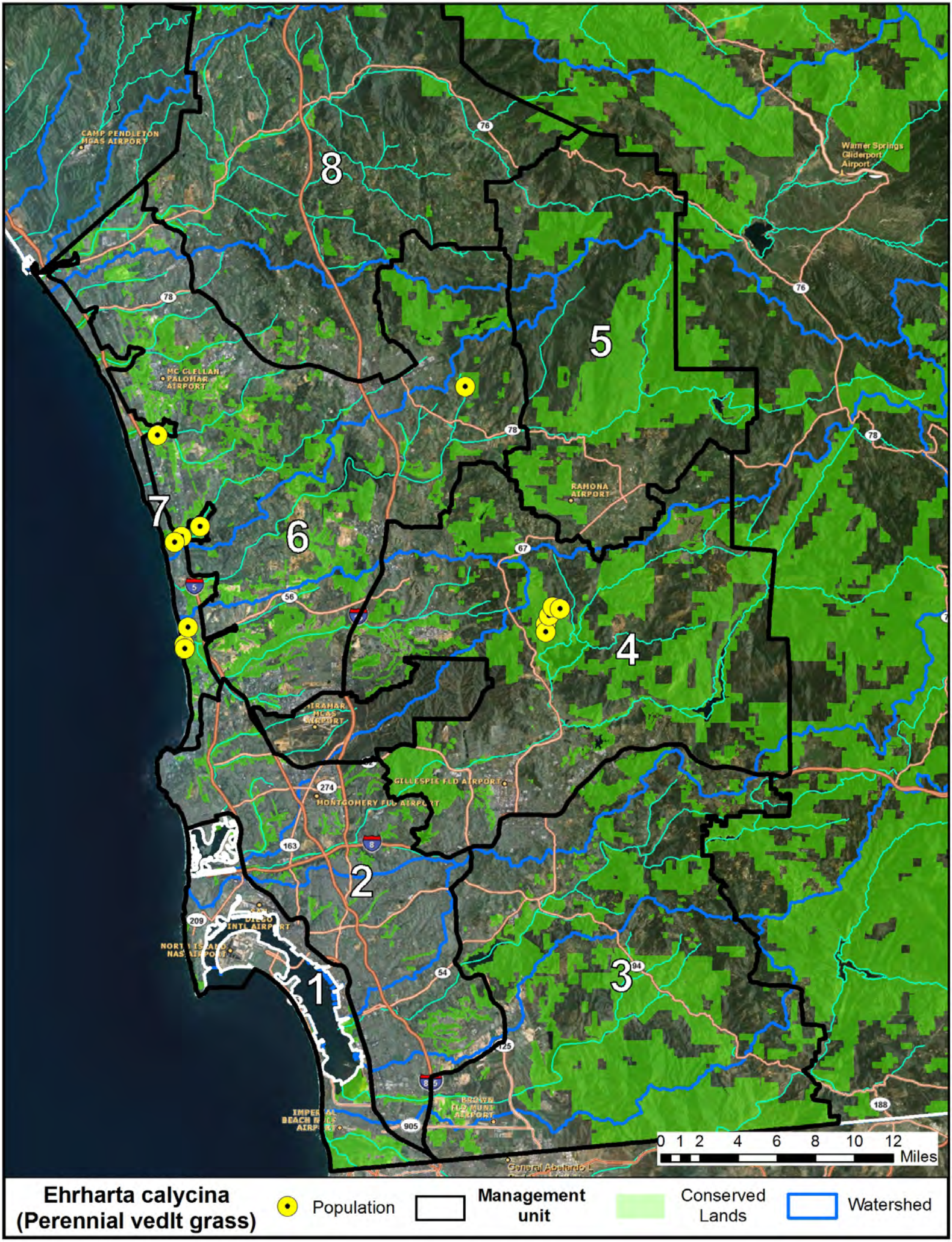
Recommendations: Regional Priority = Medium; NCCP Action = Additional data

Oncosiphon piluliferum (globe chamomile)

SD PAF score: 5.1

Due to its limited distribution in the region, this species should be evaluated further for inclusion in Level 3. Trial funding of a specific portion of a management unit may be useful to evaluate if coordinated control is possible or of benefit.

Recommendations: Regional Priority = Medium; NCCP Action = Additional data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NORTH ISLAND NAS AIRPORT
IMPERIAL BEACH NAVAL AIRFIELD
BROWN FLD MUNI AIRPORT
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0 1 2 4 6 8 10 12
Miles
Ehrharta calycina
(Perennial vedlt grass)
Population
Management unit
Conserved Lands
Watershed

Level 4: Directed Management (sub-management unit or reserve)

Level 5: Suppression (reserve or site)

Goal: Increase the probability of successful treatment and restoration projects, with the goal of protecting and enhancing populations of covered and narrow endemic species to ensure their persistence.

Several invasive species which may not be considered a high priority for management action based on PAF score alone are a concern because of their impact to NCCP covered species, particularly *narrow endemic species*, which are particularly vulnerable as a result of their restricted distribution. Selection of species analyzed in this section is based on ecology and life history information in the PAFs, and spatial distribution and field observations provided by San Diego County land managers and others. The list is by no means comprehensive, and the accompanying maps lack recently discovered populations. Information on spatial distribution and impacts is needed for all invasive species that impact covered and narrow endemic species. This document treats only those covered species that are considered narrow endemics.

Eight of the invasive species reviewed have been identified in the literature or by land managers or other biologists as impacting or potentially impacting narrow endemic species (Bauder et al. 2002, Bauder 1988, Burrascano 2011, DiTomaso and Healy 2007, Erskine-Ogden and Rejmanek 2005, Giessow 2011, Gordon-Reedy 2011, Kelly 2000, 2005, Martin 2011, McConnell 2011, 2012, Miller 2011, Mission Trails Regional Park 2011, O'Brien 2005, Potts et al. 2008, Pryor 2012, Roche 1991, Schneider 2005, Sindel 1997, Vinje 2011, Zedler and Black 2004, and others). Most of these invasives are annuals or herbaceous perennials that do not exact the ecosystem-level changes observed with many invasive shrubs or trees. Because the PAF scoring includes multiple components related to ecosystem processes, these annuals and herbaceous perennials typically score lower than species in shrub/tree functional groups, regardless of impacts observed by practitioners in the field. For this reason, we provide a separate assessment of the relative impacts of invasive species on narrow endemic species. In most cases, these invasive species must be managed at the reserve level, but all such management actions would benefit from coordinated implementation within the management unit.

Risk assessment models have been developed that qualitatively, semi-quantitatively, and quantitatively assess the impacts of invasive species on native or rare species (Landis 2004, Allen et al. 2006, Miller et al. 2010). Because of the lack of spatially explicit data, it is not possible to quantitatively assess impacts of the eight identified invasive species (hereafter referred to as *stressors*) on narrow endemic species at this time. However, by using a 2-step approach that identifies (1) co-occurrence of stressors and narrow endemic species and (2) probable impacts (based on the ecology and life history) of stressors on narrow endemic species, we can identify both the narrow endemic species most at risk and the relative level of risk. Understanding where impacts may be the most severe provides a tool for prioritizing

limited management funds and identifying additional research needs. We acknowledge that this assessment is based on incomplete knowledge about the effects of stressors on narrow endemic species and, thus, should be refined as new information becomes available.

Miller et al. (2010) provide a conceptual model adapted from Landis (2004) and Colnar and Landis (2007) to illustrate a risk assessment for invasive species impacts on rare or endangered species (Figure 3). This model (with minor adaptations) is useful in describing our evaluation process.

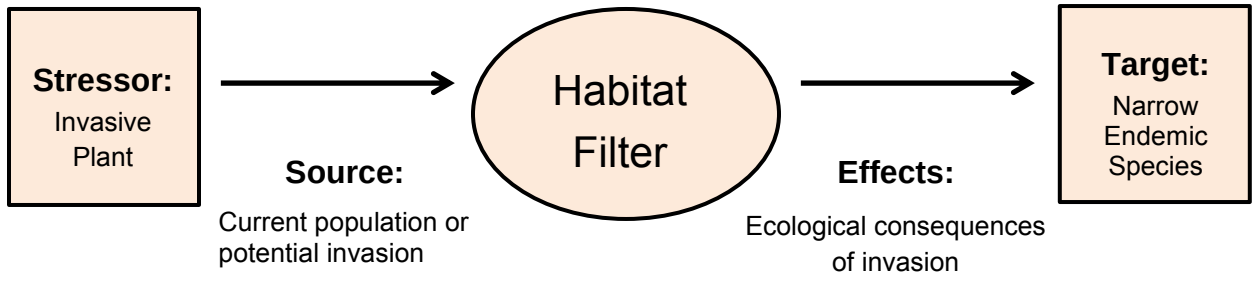


Figure 3. Components of a risk assessment for invasive species impacts on narrow endemic species (adapted from Miller et al. 2010, Colnar and Landis 2007, Landis 2004).

Summary of Invasive Plants (Stressors) Identified as Impacting Narrow Endemic Species

Scientific Name	Common Name	San Diego PAF Score	Management Level
Agrostis avenacea	Pacific bent grass	5.6	4
Brachypodium distachyon	Purple false brome	6.7	4
Cynara cardunculus[2]	Artichoke thistle[2]	6.3	3
Dittrichia graveolens	Stinkwort	5.6	4
Ehrharta longiflora[2]	Long-flowered veldt grass	4.5	3
Foeniculum vulgare	Fennel	6.5	4
Glebionis coronaria[1]	Crown daisy[1]	5.3	5
Silybum marianum	Milk thistle	5.0	4

[1] Formerly *Chrysanthemum coronarium*

[2] Included in this section because of known impacts to narrow endemic species.

Table 3 includes only those narrow endemic species for which stressors have been identified. Refer to City of San Diego (2004) and County of San Diego (2006) for comprehensive lists of narrow endemic species in the region.

Table 3. Edaphic or habitat affinities of stressors and narrow endemic species.

Edaphic or Habitat Association	Invasive Species (Stressor)	Narrow Endemic Species (Target)
Clay/Gabbro Soils	*Brachypodium distachyon* *Cynara cardunculus*	*Acanthomintha ilicifolia*
	Brachypodium distachyon *Cynara cardunculus* *Foeniculum vulgare* *Silybum marianum*	*Brodiaea filifolia*
	Brachypodium distachyon *Cynara cardunculus* *Glebionis coronaria*[1]	*Dudleya variegata*
	Brachypodium distachyon *Cynara cardunculus*	*Deinandra conjugens*
	Brachypodium distachyon	*Nolina interrata*
Riparian/floodplain	*Brachypodium distachyon*	*Ambrosia pumila*
Vernal Pools	*Agrostis avenacea* *Brachypodium distachyon* *Dittrichia graveolens* *Glebionis coronaria*[1]	*Navarretia fossalis* *Pogogyne abramsii* *Pogogyne nudiuscula*
Coastal Sage Scrub	*Brachypodium distachyon*	*Ambrosia pumila*
Chaparral	*Ehrharta longiflora*	*Ceanothus cyaneus*

[1] Formerly *Chrysanthemum coronarium*

Co-occurrence alone does not necessarily indicate a detrimental impact. Miller et al. (2010) identified four specific consequences of invasions – or *effects* – that may result in detrimental impacts to rare plants:

- Altered resource allocation
- Altered vegetation structure
- Altered recruitment of native species
- Formation of monotypic stands that exclude other species

These effects have been assessed for each invasive species through the PAF process. We extricated the applicable effect score (or threat rating) from the PAF as a way to define impacts to narrow endemic species. Table 4 indicates which of these effects have been documented for each stressor, and Table 5 depicts these same effects as numeric scores, following the PAF scoring system (0-3). Comparing combined scores provides a relative assessment of the

potential risk of stressors on narrow endemic species. It is also useful to compare only those effects rated as medium or high, because these likely result in the most detrimental impacts to narrow endemic species. Note that this assessment assumes all effects are equal (thus, the additive scores), when in reality, certain effects may be more detrimental to a narrow endemic species population than others.

Table 4. Actual or potential effects of stressors.

Edaphic or Habitat Associations	Stressors (Invasive Plant Species)[1,2]							
	AGAV	BRDIS	CYCA	DIGR	EHLO	FOVU	GLCO	SIMA
Clay/Gabbro Soils		A,B,C,D	A,B,C,D			A,B,C,D	A,B,C,D	A,B,C,D
Riparian/floodplain		*						
Vernal Pools	A,B,C,D	*		A,B,C,D			A,B,C,D	
Coastal Sage Scrub		A,B,C,D						
Chaparral					B,C,D			

[1] Species Abbreviations: AGAV = *Agrostis avenacea*; BRDIS = *Brachypodium distachyon*; CYCA = *Cynara cardunculus*; DIGR = *Dittrichia graveolens*; EHLO = *Ehrharta longiflora*; FOVU = *Foeniculum vulgare*; GLCO = *Glebionis coronaria* (formerly *Chrysanthemum coronarium*); SIMA = *Silybum marianum*.

[2] Determination of stressor effects is based on individual species PAFs; assignment of a letter code indicates that an effect (threat) has been documented, but does not indicate the magnitude of the effect (see Table 5 for effect magnitude). Letter codes indicate the following:

A = Invasive species alters or has the potential to alter resource allocation (e.g., adds nutrients to soil or alters ecosystems by changing patterns of resource use) (see PAF criteria 1.1.4).

B = Invasive species alters stand structure by creating a new canopy layer or understory component (see PAF criteria 1.2.2).

C = Invasive species alters recruitment of narrow endemic species (see PAF criteria 1.2.1.a).

D = Invasive species forms monotypic stands that exclude narrow endemic species (see PAF criteria 1.2.3.a).

* = Present, but information is insufficient to determine how stressor affects habitat.

The relative assessment of risk suggests a similar ranking for top tier stressors regardless of magnitude of effect, but provides additional specificity for lower tier stressors when only medium and high effects are considered (Table 5). Based on this assessment, the top tier stressors, or stressors with the potential to exert the most detrimental effects on narrow endemic species or their habitats, are (in order of ranking):

- *Brachypodium distachyon*
- *Cynara cardunculus*
- *Agrostis avenacea*
- *Foeniculum vulgare*
- *Dittrichia graveolens*
- *Silybum marianum*

Table 5. Relative assessment of potential risk of stressors.

Effect[1]	Stressors (Invasive Plant Species)[2,3]							
	AGAV	BRDIS	CYCA	DIGR	EHLO	FOVU	GLCO	SIMA
A	1	2	1	1	0	1	1	2
B	2	2	3	2	2	2	1	2
C	3	3	3	3	2	2	3	1
D	2	3	3	2	1	3	2	3
Total	8	10	10	8	5	8	7	8

[1] Effect:

A = Invasive species alters or has the potential to alter resource allocation, e.g., adds nutrients to soil or alters ecosystems by changing patterns of resource use (see PAF criteria 1.1.4).

B = Invasive species alters stand structure by creating a new canopy layer or understory component (see PAF criteria 1.2.2).

C = Invasive species alters recruitment of narrow endemic species (see PAF criteria 1.2.1.a).

D = Invasive species forms monotypic stands that exclude narrow endemic species (see PAF criteria 1.2.3.a).

[2] Species Abbreviations: AGAV = *Agrostis avenacea*; BRDIS = *Brachypodium distachyon*; CYCA = *Cynara cardunculus*; DIGR = *Dittrichia graveolens*; EHLO = *Ehrharta longiflora*; FOVU = *Foeniculum vulgare*; GLCO = *Glebionis coronaria* (formerly *Chrysanthemum coronarium*); SIMA = *Silybum marianum*.

[3] Numeric scores follow PAF threat ratings: 0 = negligible; 1 = low; 2 = medium; 3 = high.

Of these six stressors, direct effects on narrow endemic species in the region appear best-documented for the first four species. The narrow endemic species most at-risk from these top tier stressors are those occurring on clay/gabbro soils and in vernal pools (see Table 3). Near-term implementation actions should focus on controlling top tier stressors where they co-occur with *and threaten the persistence of* narrow endemic species. Evidence of detrimental effects may include declines in the abundance of narrow endemic species and decreases in the area occupied by the narrow endemic species (Allen et al. 2006). Within this group of stressors, funding decisions should focus on conserved lands and consider multiple factors, including but not limited to:

- Significance of narrow endemic species population(s), e.g., major population, or population that is small but genetically significant due to geographic location.
- Presence of multiple narrow endemic species and/or sensitive habitats.
- Context within surrounding landscape, e.g., large habitat block versus small, isolated parcel.
- Feasibility of long-term success due to proven management/restoration techniques and/or ability to address underlying causes of invasion (e.g., disturbance, edge effects, altered conditions).

We recommend caution in prioritizing management projects in the following situations:

- Low-priority or degraded habitats where the cause of disturbance cannot be remedied.
- Habitat where the potential for reestablishment of stressor(s) is high due to lack of control on adjacent properties.
- Stressors for which control measures have been tested but have not demonstrated effectiveness.

In all cases, management actions should incorporate investigations that allow better understanding of the effects of stressors on narrow endemic species and refinement of effective control methods. For example, such investigations should include detailed mapping of stressor(s) to demonstrate their extent, context within conserved lands, and co-occurrence with narrow endemic species. These spatial data can be used to develop treatment strategies and document baseline conditions as well as inform priorities for managing individual stressors.

The remaining stressors considered in this section have a lower priority for funding at this time, although treatment of these species may be included as part of larger restoration efforts at the regional- or reserve-levels. Funding prioritizations may change as additional information on impacts to narrow endemic or covered species is collected. Recommendations are provided below for all eight stressors.

Agrostis avenacea (Pacific bent grass)

SD PAF score: 5.6

Narrow endemic risk assessment score: **8**

Habitat/species impacted: Vernal pools; *Navarretia fossalis, Pogogyne abramsii, Pogogyne nudiuscula*.

Current condition: Pacific bent grass occurs at multiple sites in San Diego County, but is restricted to vernal pools and wet areas. This species has been recorded in vernal pools on Miramar, Otay Mesa, and Camp Pendleton. It occurs in both disturbed/degraded pools and higher quality pools.

Management information: Pacific bent grass produces a dense thatch that inhibits seedling growth and reproduction and may contribute to increased fire intensity. It is unknown whether or not this species forms a viable seed bank. Seeds have a tumbleweed dispersal method, i.e., dried panicles are snapped off and carried a considerable distance by wind. Traditional methods of control (e.g., fire, mechanical or manual removal, herbicides) may be problematic in some situations because of their potential to adversely affect sensitive vernal pool habitat and/or species. Although this species is being managed in some locations, it is still spreading where it occurs in San Diego County (Cal-IPC 2012).

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

- Eliminate the species from invaded habitat.
- Develop/refine methods of removal that minimize impacts to vernal pool habitat and associated species.

- Minimize the potential for reinvasion by removing artificial dams onsite or in proximity to the invaded site, where feasible.
- Reduce/eliminate other potential sources of reinvasion. In some cases, this may require a cooperative effort by multiple land owners.
- Conduct studies to determine seed longevity and use this information to manage the soil seed bank.

Brachypodium distachyon (purple false brome)

SD PAF score: 6.7

Narrow endemic risk assessment score: **10**

Habitat/species impacted: Clay/gabbro soils (also, vernal pools, floodplain, coastal sage scrub); *Acanthomintha ilicifolia, Brodiaea filifolia, Deinandra conjugens, Dudleya variegata, Nolina interrata* (also, *Ambrosia dumosa*; possibly, *Navarretia fossalis, Pogogyne abramsii, Pogogyne nudiuscula*).

Current condition: Purple false brome occurs across San Diego in multiple habitats, but is found primarily in grassland and scrub, with some reports around vernal pools. It has the ability to form dense, nearly monotypic stands that displace all or most other species and may alter ecosystem processes such as fire and soil nutrient/carbon cycling. Infestations appear to be densest and most problematic on clay (and to a lesser degree, gabbro) soils, based on current information, but additional studies are required to verify this observation. Purple false brome appears to have increased in density and distribution at some sites following fire. It reportedly impacts sensitive species and habitats in Carlsbad, Los Peñasquitos Canyon, Sabre Springs, Lusardi grasslands, Mission Trails Regional Park, Crestridge Ecological Reserve, South Crest properties, McGinty Mountain, Rancho Jamul Ecological Reserve, and the San Diego Wildlife Refuge (McConnell 2011, Vinje 2011, Burrascano 2011, Miller 2011, Gordon-Reedy 2011, and Martin 2011).

Management information: Purple false brome is an annual grass with an extremely short life cycle and high seed production. In some cases, more than one cohort may be produced per growing season. Seed bank longevity is unknown and has been reported to be of short duration; however, observations in San Diego County indicate that seed may be viable for 2 years or more. Seed is primarily gravity-dispersed, although human-, vehicle-, and animal-mediated dispersal may play an important role in the spread of this species throughout the region. Because of seed dispersal patterns, topography should be considered when formulating management strategies. For example, upslope habitat should be treated before downslope habitat to minimize reinvasion.

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

- Eliminate the species from invaded habitat or reduce species' cover so that it becomes a subdominant component of the vegetation (subject to research findings, below).
- Minimize the potential for reinvasion by treating upslope habitat prior to downslope habitat.
- Incorporate experimental design into treatments to test alternative methods and applications (e.g., combining herbicide and mechanical treatments, use of grass-specific

herbicides to limit impacts to broad-leaved forbs, fire, timing and duration of treatments).

- Document effective control methods for replication at other sites.
- Restore native habitat components subsequent to treatment to minimize invasion pathways.
- Research the species' biology through experimentation, focusing on factors that may contribute to management strategies (e.g., seed longevity, seed bank dynamics).
- Research the species' population dynamics to determine whether low levels of invasion can co-exist with narrow endemic species.

Cynara cardunculus (artichoke thistle)

SD PAF score: 6.3

Narrow endemic risk assessment score: 10

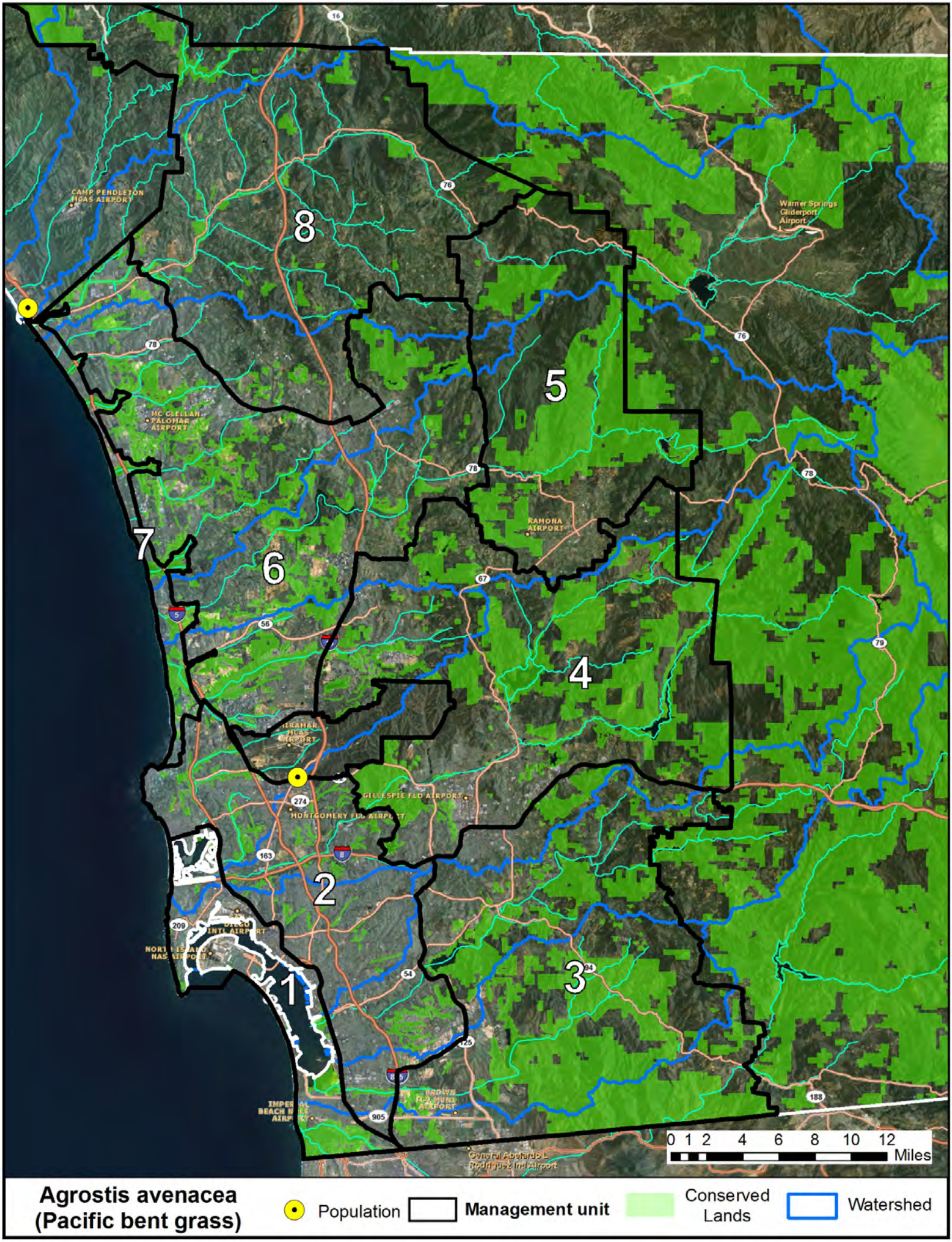
Habitat/species impacted: Clay/gabbro soils; *Acanthomintha ilicifolia, Brodiaea filifolia, Dudleya variegata, Deinandra conjugens*.

Current condition: Artichoke thistle is a B-rated noxious weed (CDFA), widely distributed in coastal and interior grassland and coastal sage scrub habitats, particularly in areas subjected to historic and/or current grazing regimes. It occurs in all eight NCCP management units. This species can occur as scattered plants or dense stands, can impact community structure and composition, and is particularly problematic on clay soils where it co-occurs with sensitive species. Dense stands of artichoke thistle have been reported from Camp Pendleton, Carlsbad, Black Mountain, and Los Peñasquitos Canyon (Burrascano 2011, Vinje 2011, McConnell 2011).

Management information: Artichoke thistle is an herbaceous perennial species that reaches reproductive maturity in 2 years or less and produces up to 600 seeds (achenes) per inflorescence and 1-50 inflorescences per plant. Seeds are dispersed short distances by wind, water, or gravity, and may also attach to cattle and other animals. This species can re-sprout after herbicide treatment and has a persistent seed bank (at least 5 years); therefore, multiple years of treatment are generally required for control. The cut-stump method of treatment has proven effective where this species occurs in proximity to sensitive species (Kelly 2000). Control of artichoke thistle occurs during the summer and so can overlap with the avian nesting season (e.g., California gnatcatcher, cactus wren).

Recommendations: Regional Priority = Very High; NCCP Action = Coordinate; fund trial

- Eliminate the species from invaded habitat, considering the broader landscape when formulating treatment/restoration strategies.
- Reduce/eliminate other potential sources of reinvasion. In some cases, this will require a landscape-level approach and a cooperative effort by multiple land owners.
- Document effective control and restoration methods for replication at other sites.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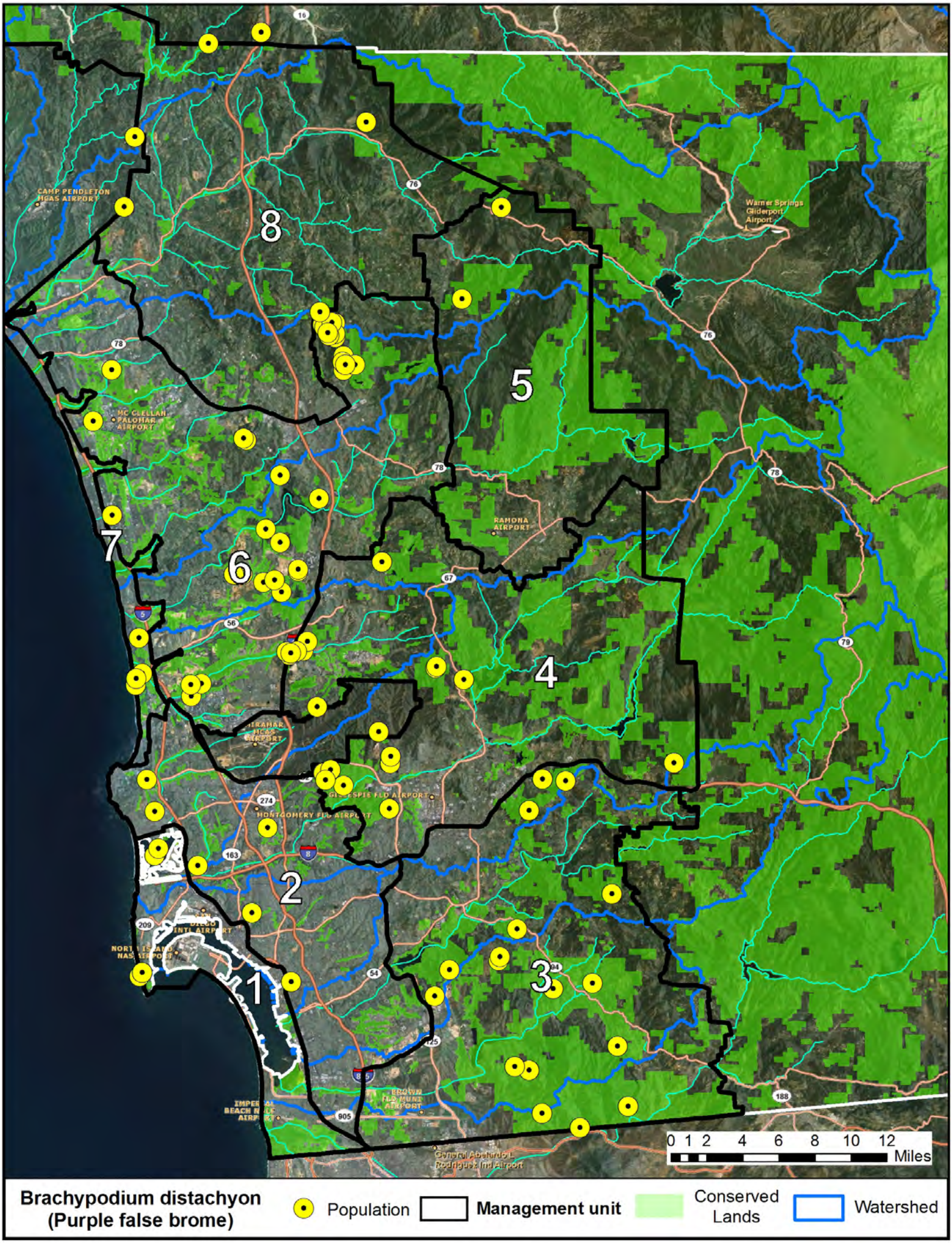
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Conserved Lands
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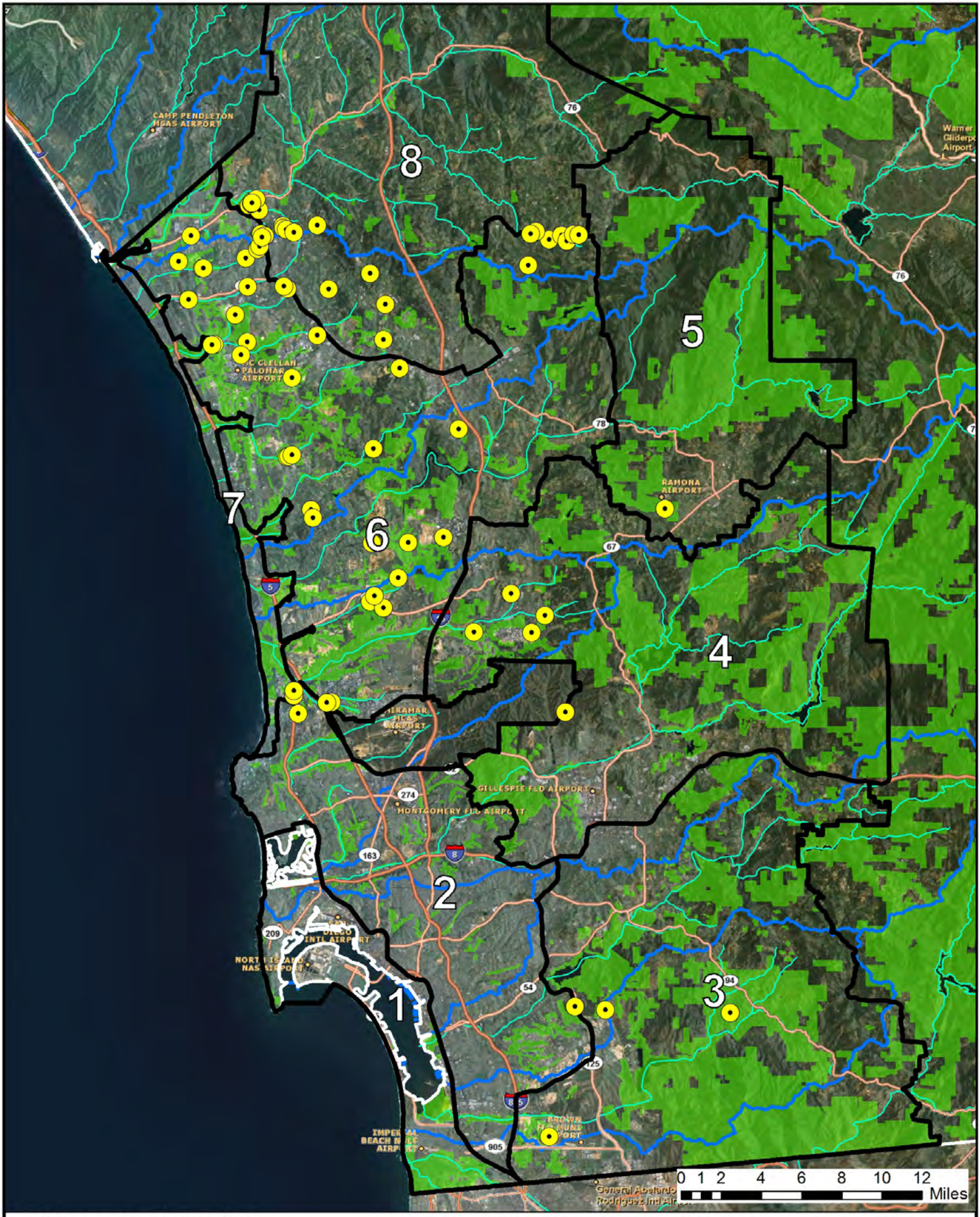
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Cynara cardunculus
(Artichoke thistle)
Population
Management unit
Conserved Lands
Watershed

Dittrichia graveolens (stinkwort)

SD PAF score: 5.6

Narrow endemic risk assessment score: 8

Habitat/species impacted: Vernal pools; *Navarretia fossalis, Pogogyne abramsii, P. nudiuscula*.

Current condition: Stinkwort is a relatively recent introduction (<10 years); however, it has spread quickly and occurs in both wetland (primarily fresh, but also edges of saltmarsh) and upland habitats. The species is most commonly observed in disturbed areas, but reportedly invades areas naturally disturbed by flooding, as well. Once present in a watershed, it has the potential to move downstream. Stinkwort reportedly impacts sensitive species and habitat in Torrey Pines State Park, Carroll Canyon (including the Carroll Canyon Vernal Pool Preserve), and Crestridge Ecological Reserve (Burrascano 2011, Miller 2011, Gordon-Reedy 2011).

Management information: This annual species produces a copious amount of seed and forms a persistent seed bank. Although seed bank longevity is not known definitively, seeds are viable for at least 3 years. Seed is dispersed by wind, water, and many other dispersal agents, and can spread rapidly along transportation corridors. A contaminated gravel operation is thought to have been the source for some infestations in the region. Although this species can be treated effectively with herbicide, timing of treatment is critical, and multiple year treatments are likely necessary. In addition, stinkwort can re-sprout when cut or grazed.

Recommendations: Regional Priority = High; NCCP Action = Additional data

- Document spatial distribution, especially relative to narrow endemic species.
- Document impacts to narrow endemic species from this stressor (e.g., decline in narrow endemic species populations, reduction of available habitat).
- Assess whether undisturbed habitat is susceptible to invasion.
- Research the species' biology through experimentation or communications with other researchers, focusing on factors that may contribute to management strategies (e.g., seed longevity, seed bank dynamics).
- Incorporate control efforts into larger restoration efforts.

Ehrharta longiflora (long-flowered veldt grass)

SD PAF score: 4.5

Narrow endemic risk assessment score: 5

Habitat/species impacted: Chaparral; *Ceanothus cyaneus*

Current condition: This species is poorly known in terms of biology, distribution, and impacts on sensitive resources. It has been reported from three locations in the county−one coastal and two inland sites. On the coast, this species occurs in scrub and the understory of Torrey Pine woodland. In inland locations, it has been reported from scrub and oak woodland habitats and from riparian corridors. Where this species forms dense stands, it may suppress other species and/or add a structural component to the vegetation. Dense stands have been reported from Torrey Pines State Park and Crestridge Ecological Reserve (Armi 2003, Gordon-Reedy 2011).

Management information: Long-flowered veldt grass is an annual species that reproduces only by seed. Seed spreads primarily by wind and occasionally by water; in awns also may attach to passing animals. Although seed bank longevity is unknown, it is reportedly >1 year; thus, multiple year treatments should be anticipated for control of this species. Herbicide treatments in late winter to early spring, prior to seed set, have been effective with the related species, *E. calycina*, and are expected to be effective for *E. longiflora*, as well (Pickart 2000, Vinje 2012).

Recommendations: Regional Priority = Medium; NCCP Action = Additional data

- Document spatial distribution, especially relative to narrow endemic species.
- Document impacts to narrow endemic species (e.g., decline in narrow endemic species populations, reduction of available habitat, and alteration of soil conditions).
- Document preferred habitat conditions.
- Research the species' biology through experimentation or communications with other researchers, focusing on factors that may contribute to management strategies (e.g., seed longevity, seed bank dynamics).

Foeniculum vulgare (fennel)

SD PAF score: 6.5

Narrow endemic risk assessment score: 8

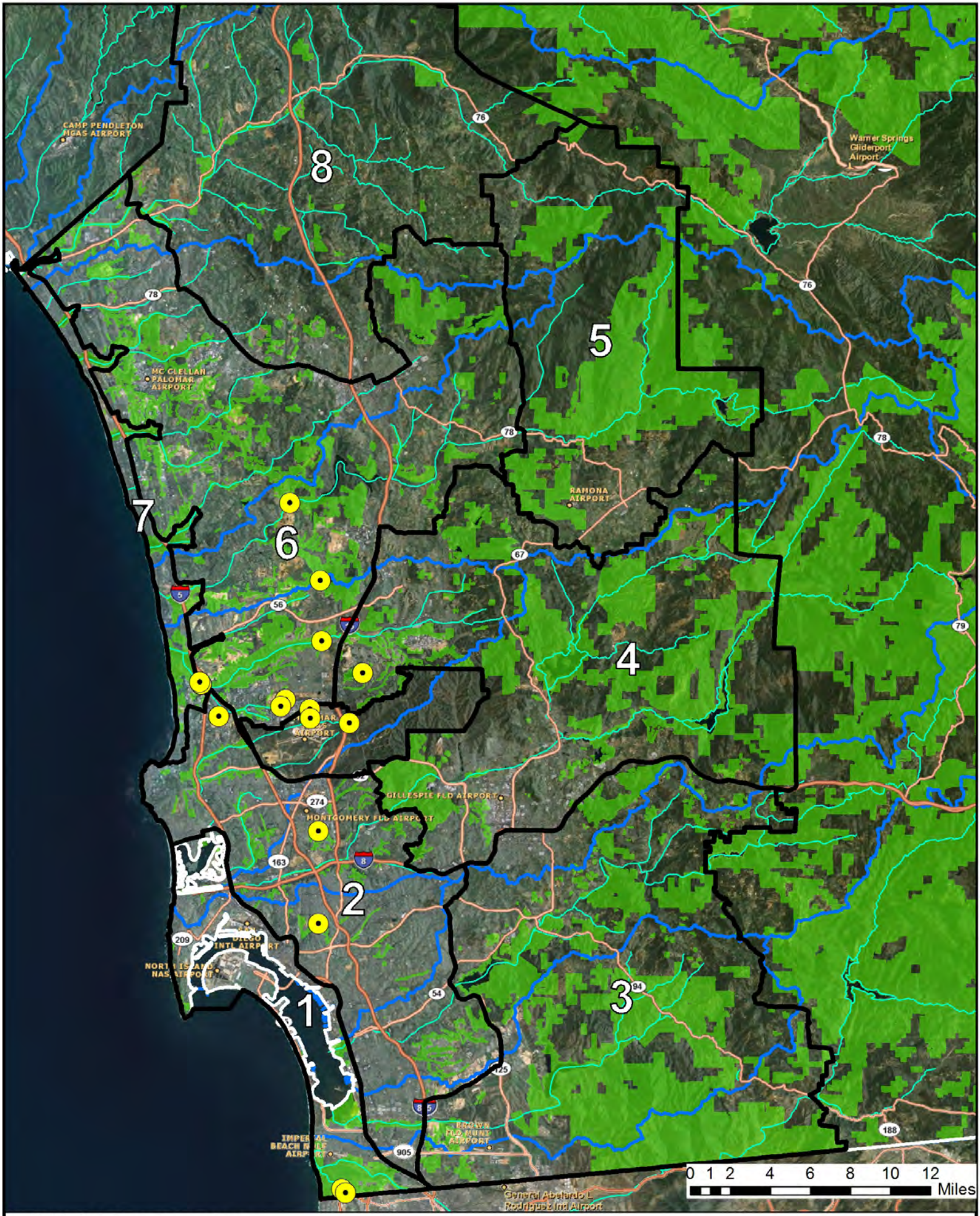
Habitat/species impacted: Clay/gabbro soils; *Brodiaea filifolia*; may also alter ecosystem processes such as fire and sediment transport.

Current condition: Fennel is found across the region in many ecotypes, including grasslands, coastal sage scrub, and to a limited degree, freshwater wetland habitats. It is more common in disturbed areas, but also occurs in undisturbed and naturally disturbed areas. This species becomes problematic where it forms dense stands, which have been reported from Carlsbad, Black Mountain, Los Peñasquitos Canyon, and Mission Trails Regional Park (Vinje 2011, Burrascano 2011).

Management information: Fennel is a perennial herb that reproduces both from seed and from root crowns; it sprouts from the crown following fire or cutting. Seed production is prolific, and the species forms a persistent seed bank. Seeds are water- and possibly, animal-dispersed. Control of well-established stands will likely entail multiple years of treatment and should address underlying causes of disturbance and incorporate post-treatment restoration. Herbicide treatments in early spring appear to be effective for this species (Klinger 2000).

Recommendations: Regional Priority = Very High; NCCP Action = Fund management

- Conduct habitat assessments to determine desired restoration condition(s).
- Eliminate the species from invaded habitat.
- Reduce/eliminate other potential sources of reinvasion. In some cases, this may require a cooperative effort by multiple land owners.
- Document effective control and restoration methods for replication at other sites.
- When formulating treatment/restoration strategies, incorporate multiple years of treatment and post-treatment restoration.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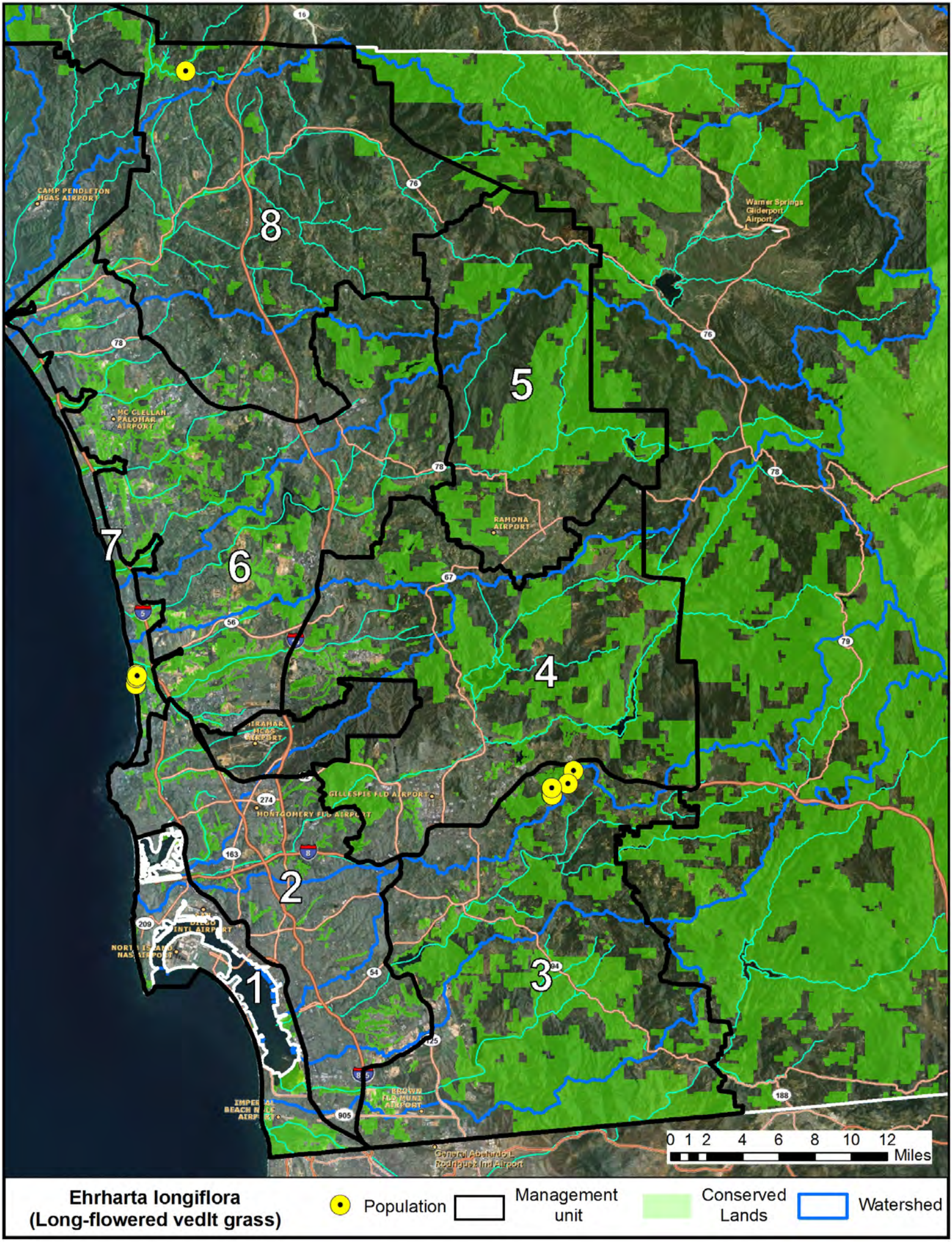
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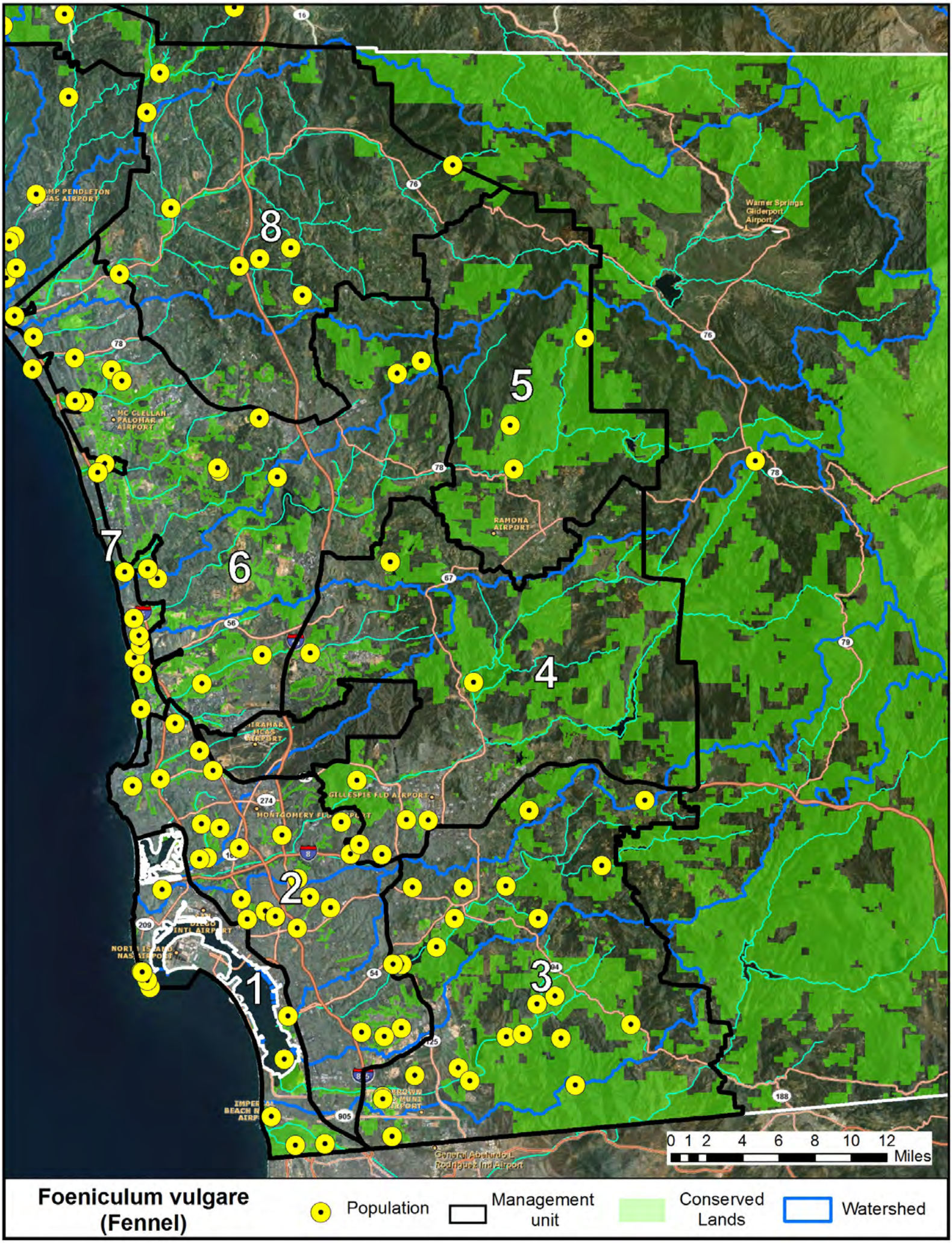
Watershed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Foeniculum vulgare
(Fennel)
Population
Management unit
Conserved Lands
Watershed

Glebionis coronaria (crown daisy) (formerly *Chrysanthemum coronarium)*

SD PAF score: 5.3

Narrow endemic risk assessment score: 7

Habitat/species impacted: Clay/gabbro soils, vernal pools; *Dudleya variegata, Navarretia fossalis, Pogogyne abramsii, P. nudiuscula*.

Current condition: This species occurs across San Diego County, primarily in grassland and scrub habitats and, to a lesser degree, in riparian, dune, and vernal pool areas. Crown daisy thrives in anthropogenically disturbed areas, but can invade more pristine habitat that has experienced small-scale, natural, and artificial disturbances. Crown daisy reportedly impacts sensitive species and habitats at San Onofre State Beach, Lopez Canyon, South Crest properties, Hospitality Point, No Man's Land, Fiesta Island, Mission Bay, and Tijuana Estuary (Pryor 2012, Burrascano 2011, Gordon-Reedy 2011).

Management information: Crown daisy is an annual species that produces many seeds. Seeds appear to be primarily gravity-dispersed and apparently do not form a long-lived seed bank. Although multiple years of treatment may be necessary to prevent re-infestation, control appears feasible in many situations. Herbicide treatment can be effective if used in spring, prior to seed set. If plants are already flowering or fruiting, they can be cut with a line trimmer or machete at the base of the plant (Vinje 2012), although follow-up treatments will likely be required.

Recommendations: Regional Priority = Medium; NCCP Action = Additional data

- Document spatial distribution, especially relative to narrow endemic species.
- Document impacts to narrow endemic species from this stressor (e.g., decline in narrow endemic species populations, reduction of available habitat).
- Based on current information, treat this species at the reserve-level and/or as part of larger restoration efforts for cost-efficiency.

Silybum marianum (milk thistle)

SD PAF score: 5.0

Narrow endemic risk assessment score: 8

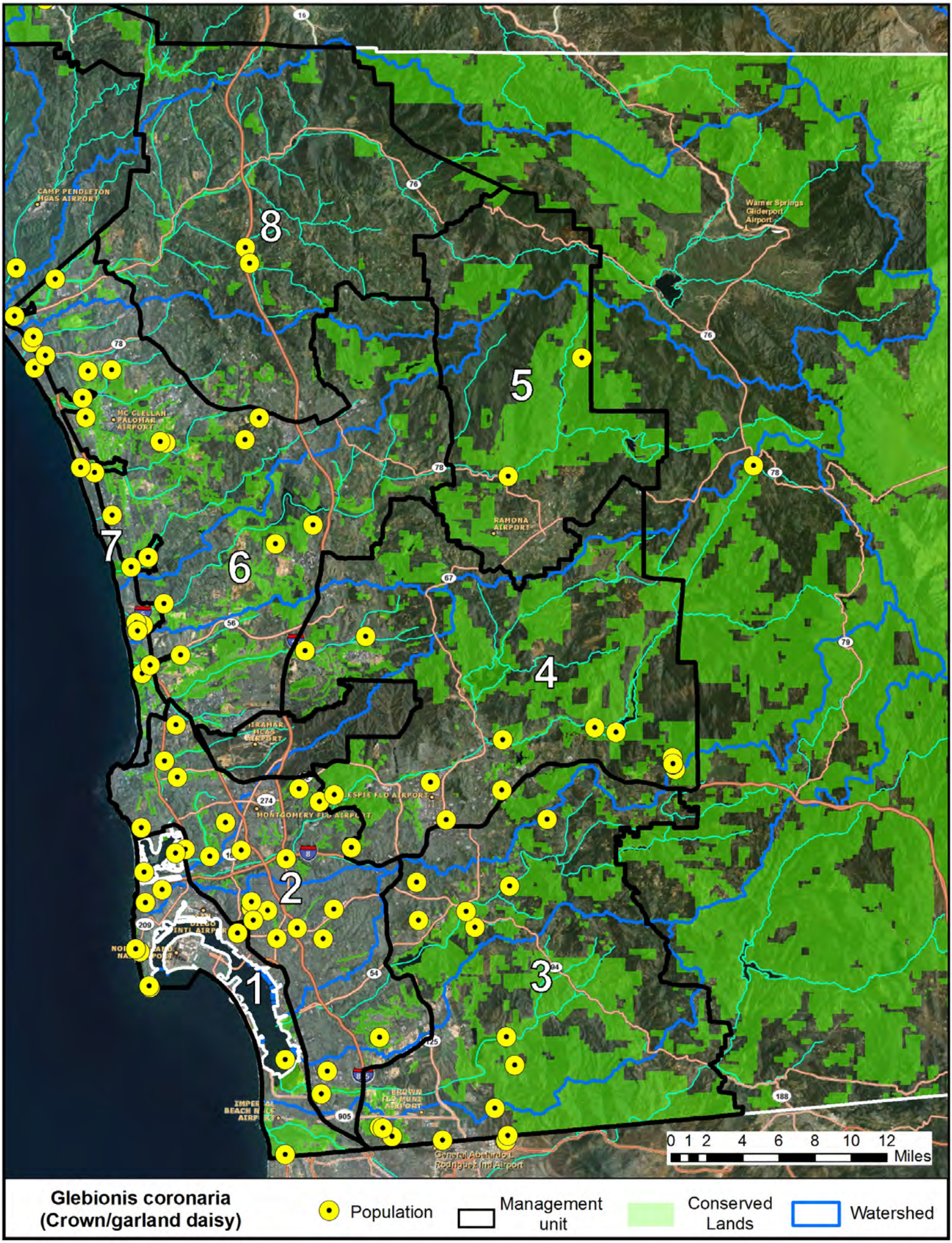
Habitat/species impacted: clay/gabbro soils; *Brodiaea filifolia*.

Current condition: Milk thistle is found across the region in both uplands and drier portions of riparian areas, and typically occurs in areas that have been disturbed by human activity or by fire or flood. Where it forms mono-specific stands in sensitive habitat, it may displace or outcompete sensitive species. Milk thistle reportedly impacts sensitive species and/or habitat on Camp Pendleton and in Carlsbad (McConnell 2011).

Management information: Milk thistle is an annual or short-lived perennial herb with copious seed production; seeds are primarily gravity-dispersed and can remain viable for at least 9 years. Herbicide application prior to seed formation is an effective treatment; however, due to the formation of a persistent seed bank, multiple years of treatment may be required for control. Because this species is disturbance-related, management efforts should address the underlying causes of disturbance.

Recommendations: Regional Priority = High; NCCP Action = Additional data

- Document spatial distribution, especially relative to narrow endemic species;
- Document impacts to narrow endemic species from this stressor (e.g., decline in narrow endemic species populations, reduction of available habitat).
- Incorporate treatment into larger restoration efforts.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Warner Springs Gliderport Airport
MC CLELLAN-PALOMAR AIRPORT
RAMONA AIRPORT
MONTGOMERY FLD AIRPORT
BROWN FLD MUNI AIRPORT
General Abelardo L. Rodriguez Intl Airport
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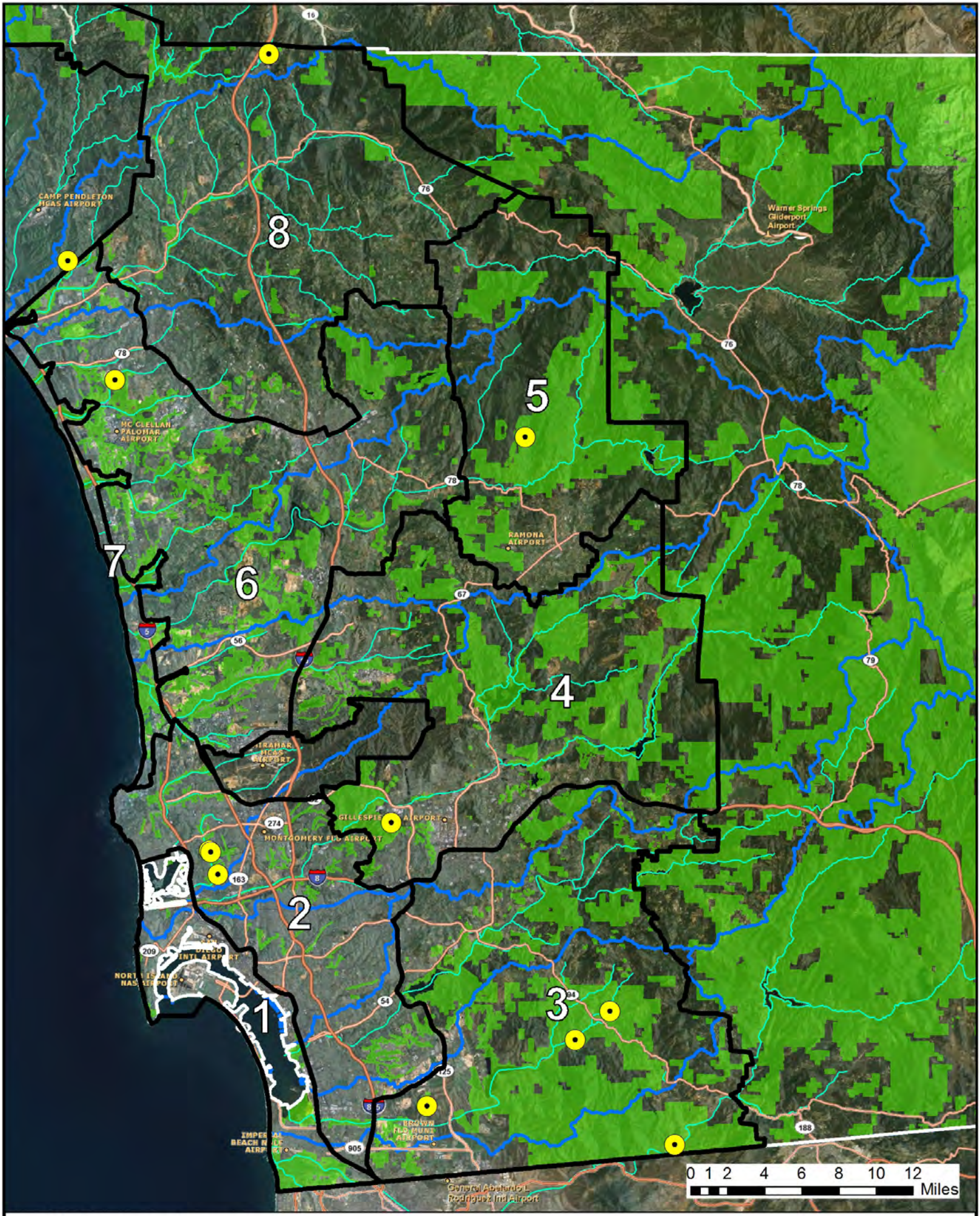
Miles
Glebionis coronaria
(Crown/garland daisy)
Population
Management unit
Conserved Lands
Watershed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Miles
Silybum marianum (Milk thistle)
Population
Management unit
Conserved Lands
Watershed

Recommendations for Next Steps by SDMMP and Land Managers

This first strategic plan for the San Diego region is a living document that should be used as a reference for land managers and, along with the PAFs, should be updated and amended as new data, new treatments, and new priorities emerge. This plan will be an appendix to the Management Strategic Plan for Conserved Lands in Western San Diego County, being prepared by the SDMMP. The SDMMP will serve as the entity to coordinate the invasive plant program in the San Diego region, maintaining and updating all databases associated with this strategic plan for invasive species, with input from land managers and management units.

1. Review and update Invasive Plant Strategic plan with new data.

- Incorporate AECOM invasive species mapping results.
- Incorporate AECOM new vegetation mapping.
- Develop standardized data collection methods to guide land managers in assessing impacts of invasive species on covered species.
- Conduct spatially explicit analyses of co-occurrence factors, e.g., stressors, covered species, soils, vegetation associations.
- Establish a system and timeline for updating information and adding species to the plan.

2. Integrate with SDMMP Management Strategic Plan and other databases.

- Identify responsibilities for reserve-level, landscape-level, and regional (SDMMP) control and prioritization for all management levels of invasive species.
- Establish a regionally coordinated invasive plant database.
    - Include options for reporting new occurrences and tracking management actions.
    - Attribute the database with PAF information.
    - Maintain an approved list of contractors and organizations with permits and a proven record of experience in invasive species control.
    - Consider coordination with other (existing) databases, e.g., Calflora, CalWeedMapper, California Consortium of Herbaria, to minimize duplication and ensure that both regional and statewide systems have current and complete data.
    - Establish landscape level units where management plans are needed (see #5 below).
- Prioritize regional funding for invasive species control on a 5-year cycle, prioritizing within each management level for initial treatment and for re-treatment of species and areas.

- Identify other sources of funding for leveraging EMP funds on a regional basis.
- Provide workshops and develop tools for setting priorities among populations of an invasive species, e.g., using WHIPPET (Weed Heuristics: Invasive Population Prioritization for Eradication Tool).

3. Develop a regional program for early detection of Level 1 and Level 2 species.

- Maintain a database for Level 1 surveillance targets and Level 2 eradication targets (see Appendix A).
- Develop education and outreach materials with photos and tips for recognizing surveillance species for land managers, nonprofit groups, lands trusts, environmental consultants, transportation and utility workers, CNPS members, etc.
- Hold special management and monitoring group meetings in conjunction with the San Diego Weed Management Area group to involve a broader audience in the early detection program.
- Provide training workshops for these groups that include Best Management Practices for preventing the spread of invasive plants during monitoring, management, utility and road work, and fire suppression http://www.cal-ipc.org/ip/prevention/index.php.).

4. Manage spread of invasive plants along infrastructure corridors and from landowners not participating in the NCCP programs.

- Identify existing invasive species problems along corridors, especially those crossing or adjacent to reserves.
- Identify existing invasive control programs by Caltrans, SDG&E, military bases, U.S. Forest Service, California State Parks, etc. for coordination.
- Identify developed areas that may be sources of invasive species.
- Identify invasive plants that should be added to Covenants, Conditions, and Restrictions to facilitate management in areas adjacent to reserve.

5. Develop landscape-scale weed management plans for watersheds and management units within the region.

- Map, quantify, and prioritize areas needing initial treatment and re-treatment of priority species.
- Develop a GIS database to record and track treatments, dates, specific control methods, monitoring, permits, and funding source, for integration with regional databases.
- The lead for each watershed and management unit will coordinate with land managers within the watershed or management unit for plan implementation.

- The San Pasqual Valley integrated weed management plan prepared for the City of San Diego Department of Public Utilities (DUDEK 2012) is an example of the type of planning needed for watersheds and management units.

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Appendix A
Additional Surveillance and Eradication Species

Prepared by Cal-IPC

Cal-IPC's online tool, CalWeedMapper, provides maps and summary statistics on invasive plants. CalWeedMapper identifies 15 invasive plant species as surveillance targets for the NCCP area, including 10 species with a High or Moderate rating on the Cal-IPC statewide Inventory. Of these, 6 species were identified as high priority for adding to Level 1 species and 1 species was identified as high priority for adding to Level 2 species for the San Diego region. The San Diego Weed Management Area was used as a proxy for the western San Diego County region in this assessment.

Surveillance Species	Cal-IPC Inventory	Habitat
Arctotheca prostrata (= infertile *Arctotheca calendula*, sterile capeweed)	Moderate	Coastal prairie
Glyceria declinata (waxy mannagrass)	Moderate	Vernal pools, moist grasslands
Onopordum acanthium (Scotch thistle)	High	Wet meadows, sage brush, riparian areas
Saccharum ravennae (ravennagrass)	Moderate - Alert	Riparian scrub, marsh
Tanacetum vulgare (common tansy)	Moderate	Riparian areas, forest
Volutaria canariensis (Canary Island knapweed)	Not rated (CDFA 'A' rated)	Desert Region (only known location in state from Borrego Springs)
Eradication Species	**Cal-IPC Inventory**	**Habitat**
Sesbania punicea (*rattlebox*)	High - Alert	Riparian areas, Tecolote Canyon