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A Framework for Prioritizing Conservation of Listed and At-risk Species Across Taxa and Installations - A Demonstration Using the Plant Biodiversity and DoD Hotspot of California

Final Technical Report

Matthew G. Hohmann and Wade A. Wall, ERDC

April 2019

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Construction Engineering
Research Laboratory

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San Clemente Island paintbrush (*Castalleja grisea*). Anna Braswell. Sacramento, CA: Pacific Southwest Region, U.S. Fish and Wildlife Service, 2011. Public domain image. https://en.wikipedia.org/wiki/Castilleja_grisea#/media/File:Castilleja_grisea.jpg

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A Framework for Prioritizing Conservation of Listed and At-Risk Species Across Taxa and Installations

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Final Report

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Under Project 16-829, "A Framework for Prioritizing Conservation of At-Risk Species Across Taxa and Installations: A Demonstration Using the Plant Biodiversity and DoD Hotspot of California"

Abstract

The Department of Defense (DoD) performs proactive conservation of at-risk species as a strategy for minimizing restrictions on land use and management. The majority of federally listed and at-risk species (60%) on DoD lands are plants, and more than 35% of all at-risk plants occur on or near to 36 military installations and facilities in California. This regional concentration of at-risk species and DoD installations provides an ideal opportunity for a case study to demonstrate a management-prioritization framework based on the risk of species being federally listed and the potential impacts of listing them on the missions of affected installations. We applied established methods of threat characterization and decision analysis to generate (1) a framework for strategic prioritization of species management that is broadly applicable to other taxa and regions; (2) priority scores for 144 federally listed and at-risk plants on or near installations; (3) conservation strategies for high priority species; and (4) threat-impacts data.

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Preface

This study was conducted for the U.S. Department of Defense (DoD) Legacy Resource Management Program under Project Number 16-829, "A Framework for Prioritizing Conservation of At-Risk Species Across Taxa and Installations: A Demonstration Using the DoD and Plant Biodiversity Hotspot of California." The technical monitor was Alison A. Dalsimer, Program Manager, Legacy Resource Management Program Office.

The work was performed by the Ecological Processes Branch of the Installations Division (CEERD-CNN), U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL). At the time of publication, Dr. Chris Rewerts was Chief, CEERD-CNN; Michelle J. Hanson was Chief, CEERD-CN; and Alan Anderson, CEERD-CZT, was the Technical Director for Sustainable Military Lands. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti and the Director was Dr. Lance D. Hansen.

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The Commander of ERDC is COL Ivan P. Beckman and the Director is Dr. David W. Pittman.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
feet	0.3048	meters
miles (U.S. statute)	1,609.347	meters
yards	0.9144	meters

1 Introduction

1.1 Background

The Department of Defense (DoD) has been performing proactive conservation of at-risk species (also referred to as species at risk [SAR]) as an effective strategy for range and readiness sustainment. DoD defines *at-risk species* as

- any proposed or candidate species for listing under the U.S. Endangered Species Act (ESA), or
- any species categorized by NatureServe* as critically imperiled or imperiled (G1 or G2) throughout their range, or
- any bird species categorized by NatureServ as vulnerable (G3)

and in all cases have at least one population on or within a 2 km buffer of a military installation (NatureServe 2015).

Numerous species and installations (e.g., Brand's phacelia [*Phacelia stellaris*] at Marine Corps Base Camp Pendleton and Naval Base Coronado; burrowing crayfish [*Fallicambarus gordoni*] at Camp Shelby) have benefited from proactive conservation actions and plans (e.g., candidate conservation agreements [CCA]) to the extent that listing under the ESA has not been warranted.

DoD has generated comprehensive lists of at-risk species three times previously (NatureServe 2004, 2011, 2015). Species' conservation rankings are dynamic due to changes in taxonomy and federal status, as well as numbers and locations of populations. Although the number of at-risk species identified on DoD lands has largely been stable to-date (i.e., 523, 519 and 531 in 2004, 2011, and 2015, respectively), it exceeds available conservation funding, forcing Services and installations to make critical decisions about which species to manage. Services and installations require, but generally lack, two critical insights to inform decision making and prioritize conservation management: (1) the likelihood that at-risk species will

* NatureServe, Inc., Arlington, VA. http://www.natureserve.org/about-us, accessed 29 November 2018.

be listed under the ESA and (2) the potential impact of federal listing on installation missions.

Potential listing of any at-risk species under the ESA is determined by its inherent vulnerability, threats to its persistence, and petition actions. Inherent vulnerability is a function of the number, distribution, and demographic viability of populations. Threats to persistence may be attributable to a diversity of factors that can be of natural or anthropogenic origin. Species' inherent vulnerability and external threats encompass the five evaluation factors considered by the U.S. Fish and Wildlife Service (USFWS) for listing determinations. In contrast, petition actions are largely unpredictable.

Potential encroachment on the mission of any DoD Service or installation is a function of the magnitude of conservation responsibility for the listed species, and the species' spatiotemporal overlap and compatibility with military land use and management. Conservation responsibility, in the most basic sense, is determined by the percentage of species or individuals occurring on military lands. However, it can also be affected by specific management objectives formalized in conservation agreements or management plans. Species' spatiotemporal overlap and compatibility with installation land use and management is determined by the number, size, and location of populations as well as the species' daily and seasonal activity cycles in relation to installation activities. Compatibility is determined by species response (i.e., resistance and resilience) to installation land use and management. For example, many species benefit from periodic disturbances such as prescribed fire and soil or vegetation disturbance associated with military land management (Warren et al. 2007, Zografou et al. 2017), while others are negatively impacted (Quist et al. 2003).

The majority of federally listed and at-risk species (~60%) on DoD lands are plants (NatureServe 2004, 2011, 2015). California leads the nation in the number of native plant species, with approximately 32% of all vascular plant species in the United States occurring there (Goldman and Baldwin 2012). Moreover, nearly one-third of the 5,047 plant species that occur in California are endemic to the state. Past DoD assessments indicate that approximately 110 at-risk plant species occur on or near installations in California (NatureServe 2004, 2011, 2015), representing roughly 20% of

all CONUS* and OCONUS at-risk species. This exceptionally large number of designated at-risk plant species is not only due to the California Floristic Province plant biodiversity hotspot study (Myers et al. 2000) but also the disproportionately high number of DoD installations in the state. More installations are located in California than any other state; collectively these 36 installations encompass more than 1.3 M owned or operated hectares (ha), or 3.2% of the state's area. Among DoD Services the Marine Corps manages the largest area of land (493 K ha) in the state, with smaller areas managed by Navy (296 K ha), Army (279 K ha), Air Force (185 K ha) and the California National Guard Bureau (85 K ha).

Services and installations are forced to make decisions about the management of numerous SAR that effectively compete for limited conservation budgets. The magnitude of this challenge is expected to escalate given the ESA listing backlog, trend toward petitions containing hundreds of species, and continued loss and degradation of natural habitats due to urbanization, climate change, and invasive species (Negron-Ortiz 2014). Consequently, there is a fundamental need to augment current lists of at-risk species with rankings that prioritize species by their probability of being listed under the ESA and the potential impact of federal listing on the missions of Services and installations. Having insights into these two fundamental criteria can substantially inform decision making and help to prioritize conservation management, thereby ensuring that limited resources are applied effectively, and impacts on training and testing missions are minimized or prevented.

1.2 Objectives

The overarching objective of this effort was to use the DoD at-risk plant species in California to demonstrate the application of a systematic, replicable, broadly applicable framework for prioritizing species conservation based on species' likelihood of being federally listed and the potential impacts on DoD Service and installation missions.

1.3 Approach

The objective of this work was accomplished in four primary tasks:

* CONUS is continental United States; OCONUS is outside of CONUS.

1. Identification of federally listed and at-risk plant species, and retrieval of associated population-location information.
2. Characterization of the probability of at-risk species being listed under the ESA based on vulnerability and threats to their persistence.
3. Characterization of potential encroachment on the missions of Services and installations as a function of the number, density, and percentage of species' populations occurring at the site.
4. Integration of information about the probability of species being listed and mission encroachment implications to prioritize listed and at-risk plant species conservation across DoD Services and installations in California.

1.4 Scope

This effort evaluated 144 federally listed and at-risk plant species across 36 DoD installations and facilities in California using occurrence data, land ownership information, and a diverse suite of spatial variables to characterize eleven primary threats (Salafsky et al. 2008). Given that the majority (60%) of all federally listed and at-risk species are plants, the subset of species and installations considered in this effort represents ~20% of all CONUS and OCONUS at-risk species and DoD-managed lands. Conservation assessments based on the outputs of the analysis emphasize not only DoD installations known to support populations of listed and at-risk plants, but also the myriad public and private land managers that might serve as potential conservation partners.

2 Methods

2.1 Identifying DoD-relevant listed and at-risk plant species

We used rare plant Element Occurrence (EO) data acquired from the California Natural Diversity Database (CNDD) to identify DoD relevant listed and at-risk species in California (California Department of Fish and Wildlife 2018). This database includes multiple fields that informed various aspects of our assessment, including: EO latitude and longitude, federal listing status, state listing status, other status (i.e., BLM and USFS sensitive), Occurrence Rank (i.e., condition or viability), presence (e.g., extant vs. extirpated), and spatial accuracy. We cross referenced the locational data of all listed, G1 and G2 plant species with spatial data for installation boundaries within the Protected Areas Database of the United States (PAD-US) using ArcMap 10.3.2 (ESRI, Redlands, CA, USA). All spatial data were projected to Alber's Equal Area Conic to minimize areal distortion. Once the names of listed and at-risk plant species located on, or near DoD installations in California were determined, we then filtered the database to include all of the extant EOs for each species.

2.2 Characterizing the vulnerability of species and populations

Species vulnerability is a function of the number of extant populations (which we consider to be synonymous with EOs in this study), their condition (viability), and the availability of protections that may arise from federal listing, state listing under the California Endangered Species Act (CESA), and property ownership/management (e.g., federal, state, or NGO conservation lands). Species having few populations of low viability located on properties lacking any protections are generally expected to be more vulnerable to extinction than species with larger numbers of populations with good viability located on protected and managed properties. We assessed the vulnerability of each species and their individual populations using information in the CNDD about the number and Occurrence Rank of species' EOs, and the relationship between species' protections and the property ownership/management of EOs (Table 1).

To characterize the variable protections afforded to individual populations we generated a protection score. Weights were assigned to EOs based on species' federal status, state status, or other status (i.e., BLM/USFS sensitive) (Appendix, Table A-1) and EO presence on federal, BLM/USFS/DOD,

or other protected properties. We then multiplied these weights within a hierarchy to achieve an overall protection score representing 11 different scenarios or cases (Figure 1).

To generate an index of EO vulnerability we added each of these protection scores to the weights that we assigned to the Occurrence Ranks and the GAP status codes of the properties where EOs occur and divided by three. We then subtracted this average from one to generate an EO vulnerability index potentially ranging between 0.0 – 0.727, with higher values indicating greater vulnerability. Approximately 63% of the EOs for DoD relevant species were lacking an Occurrence Rank, therefore we used the mean (0.675) of all available EO ranks when Occurrence Rank was unknown. To generate a range-wide index of species' vulnerabilities we simply averaged the EO vulnerability scores for each species and divided by the maximum across species. The resulting values ranged from 0.28 – 1.0.

Table 1. Description of listing status, population condition, and land management variables, along with the weights that were assigned to estimate existing protections and overall vulnerability for each Element Occurrence and each species.

Vulnerability or protection variable	Values	Assigned Weights	Description
Federal status	Endangered Threatened None	1.00 1.00 0.75	The ESA limits the destruction, damage and removal of Endangered plant species from federal property and private property in violation of any state law or regulation. For Threatened plants, protections are only enforceable on federal property.
State status	Endangered Threatened None	1.00 1.00 0.75	The California Endangered Species Act limits the destruction, damage and removal of state listed plant species from non-federal property, but includes exceptions for project related take. An incidental take permit (ITP) allows an exception to the take prohibition for otherwise lawful activity if a permittee implements certain conditions specified by the California Department of Fish and Wildlife (DCFW), including minimizing and fully mitigating any take, ensuring adequate funding to implement mitigation measures, and ensuring that take will not jeopardize the continued existence of the species.
Other status	BLM Sensitive USFS Sensitive DOD At-risk None	1.00 1.00 1.00 0.75	The BLM and USFS have established objectives to initiate proactive conservation measures that reduce or eliminate threats to sensitive species, thereby reducing the likelihood of, or need for listing under the ESA. DoD at-risk species are similarly designated for proactive conservation.
Occurrence Rank[1]	A-Excellent B-Good C-Fair D-Poor	1.00 0.75 0.50 0.25	CNDD Occurrence Rank is a ranking of the quality of the habitat and the condition of the population at that location. Rank assignments may be tailored to species, but generally include consideration of the number of individuals, the

Vulnerability or protection variable	Values	Assigned Weights	Description
	U-Unknown	0.675	condition of the native plant community, and the cover of introduced plant species.
Gap Status Code[2]	1 2 3 4	1.00 0.75 0.50 0.25	GAP Status Code is a measure of management intent to conserve biodiversity defined by the USGS National Gap Analysis Program as: Status 1: Permanently protected from conversion of natural land cover and maintained in a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management. Status 2: Permanently protected from conversion of natural land cover and maintained in a primarily natural state, but may be subject to uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance. Status 3: Permanently protected from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging, OHV recreation) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area. Status 4: No known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. Conversion to unnatural land cover is allowed throughout or management intent is unknown.

Figure 1. Weights used to estimate protection scores for species' Element Occurrences (EOs) and the number of EOs across species represented in eleven cases. "Y" denotes yes and "N" denotes no.

Species Protection Status and Land Ownership Hierarchy (weights)				Combined Score	Number of EOs	Case
1 Federal status? (Y=1)	1.1 Federal property? (Y=1)			1	526	1
	1.2 Federal property? (N=0.75)	1.2.1 Other protected area (PA)? (Y=1)		0.75	264	2
		1.2.1 Other PA? (N=0.75)		0.56	252	3
2 Federal status? (N=0.75)	2.1 State status? (Y=1)	2.1.1 Federal property? (Y=0.75)		0.56	99	4
		2.1.2 Federal property? (N=1)	2.1.2.1 Other PA? (Y=1)	0.75	13	5
			2.1.2.2 Other PA? (N=0.75)	0.56	15	6
	2.2 State status? (N=0.75)	2.2.1 BLM/USFS/DOD Property? (Y=1)	2.2.1.1 DOD Property? (Y=1)	0.56	610	7
			2.2.1.2 BLM/USFS sensitive? (Y=1)	0.56	764	8
			2.2.1.3 BLM/USFS sensitive? (N=0.75)	0.42	94	9
		2.2.2 BLM/USFS/DOD Property? (N=0.75)	2.2.2.1 Other PA? (Y=1)	0.42	1239	10
			2.2.2.2 Other PA? (N=0.75)	0.32	1069	11

2.2.1 Characterizing threats to species and populations

External threats to species' persistence can instigate further population declines, trigger petitions, and justify federal listing under the ESA. For example, the interrelated threats of climate stress, invasive species, and increased fire frequency across portions of California are likely to impact at-risk plant species and their habitats, exacerbating risk of listing. The USFWS evaluates listing petitions and proposals based on five factors: 1) the present or threatened destruction, modification, or curtailment of a species' habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting a species' continued existence. The first factor is the most commonly cited in determinations that lead to federal listing (Wilcove et al. 1998). USFWS review of these factors includes intensive analyses and public input over a lengthy multi-step process. Consequently, we employed a surrogate approach to assess threats likely to jeopardize species continued existence. Specifically, we used a set of standard classifications of direct threats developed by the International Union for Conservation of Nature and the Conservation Measures Partnership (IUCN-CMP) (Salafsky et al. 2008). This broadly adopted approach, which is also used by NatureServe to characterize threat impacts (Master et al. 2012), evaluates eleven categories of threats (e.g., residential and commercial development, agriculture, transportation and service corridors, etc.), based on scope and severity (Table 2). These eleven first-level (L1) threat categories can be informed by one or more second-level (L2) or third-level (L3) threats within a hierarchy. For example, agriculture as a L1 threat may include crops and grazing as distinct L2 threats.

Table 2. Threats, data type, and data source.

Level and Name	Data Type	Units	Data Source	Data Source Link
1 Development				
1.1 residential development	categorical grid	unitless (ratio of area)	USGS NLCD 2011	https://www.mrlc.gov/nlcd11_data.php
1.2 commercial/industrial development	categorical grid	unitless (ratio of area)	USGS NLCD 2011	https://www.mrlc.gov/nlcd11_data.php
1.3 recreation development	categorical	unitless (ratio of area)	USFS developed recreation areas	https://data.fs.usda.gov/geodata/edw/datasets.php
2 Agriculture				
2.1 crops	categorical grid	unitless (ratio of area)	USGS NLCD 2011	https://www.mrlc.gov/nlcd11_data.php
2.2 grazing/livestock	categorical numeric numeric	unitless (ratio of area) unitless (ratio of area) unitless (ratio of area)	USGS NLCD 2011; BLM National Grazing Allotments; USFS Rangeland Management Units-Grazing Allotments	https://www.mrlc.gov/nlcd11_data.php https://landscape.blm.gov/geoportal/catalog/BLMNational/BLMNational.page https://data.fs.usda.gov/geodata/edw/datasets.php
3 Energy production & mining				
3.1 oil/gas drilling				
3.1.1 oil/gas wells	numeric	# ha^{-1}	CA Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR)	http://www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx

Level and Name	Data Type	Units	Data Source	Data Source Link
3.1.2 oil/gas fields	categorical polygon	unitless (ratio of area)	CA Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR)	http://www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx
3.2 mining & quarrying	numeric	# ha^{-1}	U.S. Geological Survey Mineral Resources Data System 2011	https://mrdata.usgs.gov/mrds/
3.3 renewable energy				
3.3.1 wind, solar, geothermal, small hydro	categorical	unitless (ratio of area)	CA Energy Commission REAT 2018	available from gis@energy.ca.gov upon request
3.3.2 bioenergy	ordinal grid	unitless (average of values)	CA Fire Resource and Assessment Program (FRAP)	http://frap.fire.ca.gov/index
4 Roads, railroads & utility lines				
4.1 roads & railroads				
4.1.1 roads	numeric line	m ha^{-1}	U.S. Census Bureau 2017 TIGER/Line Shapefile	https://www.census.gov/geo/maps-data/data/tiger-line.html
4.1.2 railroads	numeric line	m ha^{-1}	CA Department of Transportation	http://www.dot.ca.gov/hq/tsip/gis/datalibrary/
4.2 utility/service lines				

Level and Name	Data Type	Units	Data Source	Data Source Link
4.2.1 transmission lines	numeric line	m ha^{-1}	California Energy Commission	http://cecgis-caenergy.opendata.arcgis.com/
4.2.2 oil/gas pipelines	numeric line	m ha^{-1}	California Energy Commission	https://cecgis-caenergy.opendata.arcgis.com/
5 Biological resource use				
5.1 logging/fuels management	ordinal grid	unitless (average valuse)	CA FRAP	http://frap.fire.ca.gov/index
6 Human intrusions & disturbance				
6.1 recreational activities				
6.1.1 ORV use	ordinal grid	unitless (average)	BLM REA MBR 2010 PAD inclusion/exclusion for off-highway vehicle use	http://www.landscape.blm.gov/MBR_2010_layerpackages/CBRMBR_IN_pad_excl.lpk
6.1.2 hiking trails	numeric line	m ha^{-1}	USFS trails; Pacific Crest Trail	https://data.fs.usda.gov/geodata/edw/datasets.php
6.2 military activities	categorical grid	unitless (ratio of area)	PADUS	https://gapanalysis.usgs.gov/padus/data/download/ ; https://www.landfire.gov/slope.php
7 Ecosystem modification				
7.1 fire regime change	ordinal grid	unitless (average of values)	CA FRAP Fire Regime Condition Class (FRCC); three fire regime departure categories	http://frap.fire.ca.gov/index

Level and Name	Data Type	Units	Data Source	Data Source Link
8 Invasive species				
8.1 invasive plants	numeric	# species ha^{-1}	CalWeedMapper	https://calweedmapper.cal-ipc.org/spatial-data/
8.2 invasive animals				
8.2.1 feral pigs	numeric grid	unitless (average probability of occurrence)	McClure et al. (2015)	available from the authors on request
8.2.2 feral horses and burros	categorical polygon	unitless (ratio of area)	BLM National Wild Horse and Burro Herd Area and Herd Management Area	https://gis.blm.gov/EGISDownload/LayerPackages/BLM_National_Wild_Horse_and_Burro.zip
9 Pollution				
9.1 air-borne pollutants				
9.1.1 nitrogen critical load	numeric grid	kg N ha^{-1} yr^{-1}	USEPA	ftp://ftp.epa.gov/castnet/tdep/grids/n_tw/
9.1.2 ozone critical load (AOT40)	numeric grid	ppm yr^{-1}	CA Air Resources Board	https://www.arb.ca.gov/aqd/aqdcd/aqdcddld.htm
9.2 erosion	ordinal grid	unitless (average)	CA FRAP; three erosion classes	http://frap.fire.ca.gov/index
10 Geologic events				
10.1 volcanos	categorical polygon	unitless (ratio of area)	CA Geologic Survey	https://maps.conservation.ca.gov/cgs/#datalist

Level and Name	Data Type	Units	Data Source	Data Source Link
10.2 tsunamis	categorical polygon	unitless (ratio of area)	CA Geologic Survey	https://maps.conservation.ca.gov/cgs/#datalist
10.3 landslides	ordinal grid	unitless (average)	CA Geologic Survey	https://maps.conservation.ca.gov/cgs/#datalist
11 Climate change				
11.1 habitat shifting & alteration (sea level rise)	categorical polygon	unitless (ratio of area)	Pacific Institute	http://www.pacinst.org/reports/sea_level_rise/data/index.htm
11.2 temperature and precipitation extremes (climate stress)	numeric grid	unitless (average of values)	The Nature Conservancy	http://tnc.maps.arcgis.com/home/item.html?id=b667a89a2d594e288243f065be9e0cbd
11.3 flooding (flood hazard)	categorical polygon	unitless (ratio of area)	FEMA National Flood Hazard Layer (NFHL)	https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd

2.2.1.1 Threat Severity

We used available spatial datasets (Table 2) to evaluate the severity of eleven primary threats within the vicinity of each focal species' EOs using ArcMap. Location data for EOs are made available within the CNDD as either polysons or point features derived from observations having variable spatial accuracy. CNDD assigns an ordinal accuracy code to each EO that ranges from 10-90 in increments of 10, with lower values indicating greater spatial accuracy (Table 3). The median accuracy code across all EOs of listed and at-risk plant species relevant to DoD was 40, which corresponds to a circular feature with a 150 meter radius. Consequently, we chose to evaluate threat severity within a 150 meter radius buffer on EO point locations. Several EOs occur so close to the California state boundary that the 150 m buffer spanned into a neighboring state. We eliminated these EOs from our analyses because spatial data used to assess several threats were not consistently available outside of California.

Table 3. Accuracy descriptions and codes for Element Occurrence data within the California Natural Diversity Database (CNDDB).

CNDDB Accuracy Description	CNDD Accuracy Code
Small specific bounded area with an 80 meter radius	10
Specific bounded area	20
Non-specific bounded area	30
Circular feature with a 150 meter radius (1/10 mile)	40
Circular feature with a 300 meter radius (1/5 mile)	50
Circular feature with a 600 meter radius (2/5 mile)	60
Circular feature with a 1000 meter radius (3/5 mile)	70
Circular feature with a 1300 meter radius (4/5 mile)	80
Circular feature with a 1600 meter radius (1 mile)	90

Spatial threat data were in the form of vector (polygon, point, line) or grid layers, and varied in data type (e.g., categorical, ordinal, numeric) (Table 2). For polygon and grid data we either calculated the average value of cells within the buffers (e.g., fire regime change, feral pig probability of occurrence, ozone critical load, climate stress, etc.), or the proportion of the

buffer affected by the threat (e.g., residential development, crops, tsunamis, sea level rise, etc.), depending on data type. The former often represented graded threats and the latter "all or nothing" (i.e., discrete) threats. For example, graded threats such as erosion risk potentially vary in their degree of intensity or severity of impact within a 150 meter buffered EO location, while other threats, like agricultural land conversion are either present or not within a given area. For point data (e.g., gas wells), we calculated the number of features per hectare within each 150 meter buffered EO location. For line data, we applied either a 10 m buffer (roads, railroads, transmission lines, and pipelines) or a 1 m buffer (trails) to the features and calculated the proportion of the EO buffer affected by the threat. Two variables (volcanoes and wild horse and burro herd areas) had no overlap with buffered EOs, and were eliminated from further analyses.

After extracting L1, L2, and L3 threat severity data for each EO, we standardized the eight threat variables that did not inherently range between 0-1 by dividing by the maximum value. This transformation placed all the threat severity data on a common 0-1 scale and eliminated any units (e.g., O_3 ppm yr^{-1}). It also allowed us to sum the threat severity data at each hierarchical level without giving any threat undue emphasis resulting from differences in the scales of values or numbers of lower level variables.

For each species, we then averaged the severity values of each L1 threat across EOs and placed them into four severity categories (i.e., slight, moderate, serious, extreme) (Table 4), matching the values to the anticipated percent reduction of the EO (Salafsky et al. 2003, Master et al. 2012). These rankings have been proposed based on the premise that they provide sufficient spread, but do not create false precision (Salafsky et al. 2003).

Table 4. Severity and scope categories used to characterize the magnitude of impact of eleven primary threats to species' Element Occurrences and range-wide populations.*

Threat Component	Category	Description
Severity	Extreme	Likely to reduce the occurrence by 71-100%
	Serious	Likely to reduce the occurrence by 31-70%
	Moderate	Likely to reduce the occurrence by 11-30%
	Slight	Likely to reduce the occurrence by 1-10%
Scope	Pervasive	Affects all or most (71-100%) of the total population
	Large	Affects much (31-70%) of the total population
	Restricted	Affects some (11-30%) of the total population
	Small	Affects a small (1-10%) proportion of the total population

*After Master et al. (2012).

2.2.1.2 Threat Scope

For species, threat scope is measured as the proportion of Element Occurrences affected by each L1 threat. We assessed the proportion of each species' EOs impacted by each L1 threat and assigned scope categories (Table 4).

2.2.1.3 Threat Impact

For each species, we assessed the impact of each L1 threat by combining threat severity and scope using the matrix depicted in Figure 2 (Master et al. 2012).

Figure 2. NatureServe guidance for assigning impact categories to level 1 threats based on scope and severity.

		Scope			
		Pervasive	Large	Restricted	Small
Severity	Extreme	Very High	High	Medium	Low
	Serious	High	High	Medium	Low
	Moderate	Medium	Medium	Low	Low
	Slight	Low	Low	Low	Low

*After Master et al. (2012).

Per NatureServe protocols (Master et al. 2012), we then assessed the overall (i.e., combined) impact of threats to species by evaluating the impact categories of the eleven L1 threats. An overall threat impact category was assigned to each species based on the numbers of L1 threats within each impact category as shown in Table 5.

Table 5. NatureServe guidance for assigning overall threat impact categories to species.

Impact Categories of Level 1 Threats	Overall Threat Impact
≥1 Very High, *or* ≥2 High, *or* 1 High + ≥2 Medium	Very High
1 High, *or* ≥3 Medium, *or* 2 Medium + 2 Low, *or* 1 Medium + ≥3 Low	High
1 Medium, *or* ≥4 Low	Medium
1-3 Low	Low

*After Master et al. (2012).

However this process did not offer adequate detail about interspecific variation in overall threat impact, as all species were assigned to the "Very High" category except *Malacothrix squalida*, which was categorized as having "High" overall threat impact. Therefore, for each L1 threat we assigned ordinal values (1-4) to the severity and scope categories, and multiplied these values as depicted in Figure 3. We then averaged these eleven L1 threat impact values for each species to generate an overall impact value (range = 3.0 – 11.6). Finally, we standardized these values across species by dividing by the maximum to arrive at an overall threat impact

index that ranged from 0.26–1 across the 144 species. Although there is roughly a fourfold difference in these overall threat impact index values, all of them should effectively be interpreted as "Very High".

Figure 3. Matrix showing the level one threat impact values (in parentheses) generated by multiplying ordinal scope and severity values.

		Scope (%)			
		Pervasive (4)	Large (3)	Restricted (2)	Small (1)
Severity (%)	Extreme (4)	Very High (16)	High (12)	Medium (8)	Low (4)
	Serious (3)	High (12)	High (9)	Medium (6)	Low (3)
	Moderate (2)	Medium (8)	Medium (6)	Low (4)	Low (2)
	Slight (1)	Low (4)	Low (3)	Low (2)	Low (1)

2.3 Characterizing potential encroachment on the missions of Services and installations

The potential impact to the military missions of installations and Services varies among species as a consequence of the number and density of EOs on installations, as well as the magnitude of conservation responsibility borne should the species be listed (i.e., percent of range-wide EOs occurring on DoD lands). Information needed to assess these three determinants of potential mission encroachment was generated during prior steps. In order to utilize these subcriteria in a Multi-Criteria Decision Analysis of conservation priority (see next section), we rescaled them to a have common range of 0–1. For EO density and number of EOs this was accomplished by dividing by the maximum values across species. The percent of range-wide EOs occurring on DoD lands was not rescaled since it naturally ranged from 0-1.

2.4 Integrating information on risk of listing and mission encroachment to prioritize plant species conservation

Multi-criteria decision analysis (MCDA) is a well-established and increasingly utilized group of decision-making methods (Greene et al. 2010; Hajkowicz 2008; Malczewski 2006) ideal for integrating the many considerations important for prioritizing at-risk plants. MCDA is defined

as an evaluation based on multiple criteria, wherein the criteria are quantifiable indicators of the degree to which the decision problem may be influenced (Malczewski 1999). MCDA provides a hierarchical, scaling framework to integrate multiple objectives with multiple datasets to help decision makers solve complex decision problems (Malczewski 2006). MCDA has a history of use in environmental planning and natural resource management (e.g., Guikema and Milke 1999; Mendoza and Martins 2006), including applications to biodiversity conservation (Regan et al. 2007), ecosystem management (Prato 1999), and invasive plant management (Roura-Pascual et al. 2009; Hohmann et al. 2013).

We used weighted linear combination (aka simple additive weighting), a type of MCDA to develop our prioritization framework for at-risk plants (Malczewski 2006). In this method a weighting is applied to objectives and criteria in order to characterize relative importance. Within each level of the hierarchy, weights sum to one. We used the variables developed in previous steps as criteria to assess the decision problem of 1) reducing the risk of federal listing, and 2) reducing the risk of potential impact to Service and installation missions (Table 6). For the species already federally listed under the ESA, the former instead characterizes possible elevation from Threatened to Endangered and/or challenges associated with species down-listing or recovery. We chose to use equal weights for all criteria except for EO density, which was assigned lower importance because the high species densities found on several small installations do not likely justify a comparably high level of importance.

For each species a total priority score was obtained by multiplying the importance weight assigned to each criteria by the standardized value for the species on that criteria and summing the products over all criteria. After the priority scores were calculated for all species they could be ranked and aggregated across species and installations to identify management priorities.

Table 6. Objectives, criteria, and weights used to prioritize listed and at-risk plants associated with DoD installations in California.

Objectives (weight)	Criteria (weight)
Reduce the risk of federal listing (0.5)	Vulnerability (0.33)
	Overall Threat Impact (0.33)
	Range-wide number of extant populations (0.33)
Reduce the risk of potential impact to Service and installation missions (0.5)	Number of populations on DoD lands (0.375)
	Proportion of species' populations on DoD lands (0.375)
	Density of species' populations on DoD lands (0.25)

3 Results

3.1 Summary of the number of species and EOs managed by Services and installations

We identified 116 listed and at-risk plant species and 1072 EOs occurring on 36 DoD installations and facilities in California (Appendix, Table A-2). An additional 28 at-risk species are known to occur within 2 km of installations and potentially also have populations on installations. Roughly 28% of all species and 21% of all EOs are represented by federally listed species.

Among DoD Services the Navy has the largest number of listed and at-risk plant species (53; Table 7), with successively fewer species managed by the Marine Corps, Air Force, Army Reserve, Army Guard, and Army. Variation in the number of EOs among Service installations mirrors the pattern observed for the number of species (Table 7). In contrast, the highest density of species is found on Army Guard installations (Table 7), with successively lower densities on Army Reserve, Air Force, Navy, Marine Corps, and Army installations. Variation in the density of EOs among Services largely follows a pattern similar to that observed for species density.

Table 7. Number* and density of species and EOs across DoD Services.

Service	Number of Installations	Total area (km^2)	Number of Federally Listed Species	Number of At-risk Species	Total Species	Species Density (100 km^2)	Number of Federally Listed EOs	Number of At-risk Species EOs	Total EOs	EO Density (100 km^2)
Air Force	5	1763.23	7	18	25	1.42	48	171	219	12.42
Army	3	3058.37	3	2	5	0.16	13	2	15	0.49
Army Guard	2	195.44	2	13	15	7.67	3	28	31	15.86
Army Reserve	1	655.99	1	18	19	2.89	15	73	88	13.41
Marine Corps	5	4902.89	9	17	26	0.53	118	133	251	5.12
Navy	20	5314.07	15	38	53	1.00	235	233	468	9.01

*Note the total number of species does not sum to 116 because of redundancies across Services.

The total number of species-installation combinations is 162, as most species (~73%) occur on only a single installation. The largest number of installations on which any species occurs is five, and is only represented by one species (*Chloropyron maritimum ssp. maritimum*). Consequently, there is little redundancy in the representation of species on installations within Services. The few exceptions include Marine Corps Base (MCB) Camp Pendleton and MCAS Miramar, which have four species in common, and eight species occur on two or more Navy installations.

Across DoD installations, Fort Hunter Liggett and Vandenberg AFB manage the largest number of listed and at-risk plants (19 each; Table 8). Santa Cruz Island, San Clemente, MCB Camp Pendleton, and MCAS Miramar all also manage more than 10 species, while the remaining installations manage nine or fewer species. In contrast, the highest species densities are found on the smallest installations.

Variation in the number of federally listed and at-risk plant EOs across installations largely mirrors the pattern observed for the number of species, but a notable exception is that San Clemente manages the largest number of EOs (289). Similar to what was observed for numbers of species, the highest densities of EOs are found on a number of relatively small installations (Table 8).

Table 8. Numbers and densities of listed and at-risk species and Element Occurrences on DoD installations and facilities in California.

Service*/Installation	Area (km^2)	Listed and At-Risk Species	Species Density (km^2)	Element Occurrences	EO Density (km^2)
Air Force Active	*1763.23*	*25*	*0.01*	*219*	*0.12*
Beale Air Force Base	93.67	1	0.01	3	0.03
Edwards Air Force Base	1247.6	3	0	80	0.06
Pillar Point AFS	0.18	1	5.56	1	5.56
Travis Air Force Base	20.53	2	0.1	3	0.15
Vandenberg Air Force Base	401.25	19	0.05	132	0.33

Service*/Installation	Area (km²)	Listed and At-Risk Species	Species Density (km²)	Element Occurrences	EO Density (km²)
Army Active	*3058.37*	*5*	*0*	*15*	*0*
NTC and Fort Irwin	3056.72	2	0	11	0
Ord Military Community	0.03	1	33.33	1	33.33
Presidio Of Monterey	1.62	2	1.23	3	1.85
Army Guard	*195.44*	*15*	*0.08*	*31*	*0.16*
ITC Camp San Luis Obisbo	23	6	0.26	18	0.78
MTC-H Camp Roberts	172.44	9	0.05	13	0.08
Army Reserve	*655.99*	*19*	*0.03*	*88*	*0.13*
Fort Hunter Liggett	655.99	19	0.03	88	0.13
Marine Corps Active	*4902.89*	*26*	*0.01*	*251*	*0.05*
Choc Mt Air Gunnery Range	1863.26	1	0	10	0.01
MCAS Miramar	91.38	12	0.13	108	1.18
MCB Camp Pendleton	514.29	15	0.03	131	0.25
MCLB Barstow	14.98	1	0.07	1	0.07
Twentynine Palms Main Base	2418.98	1	0	1	0
Navy Active	*5314.07*	*53*	*0.01*	*468*	*0.09*
Former NAVPHIBASE Coronado	2.72	1	0.37	1	0.37
NAF El Centro	239.84	1	0	2	0.01
Naval Medical Center San Diego	0.31	3	9.68	3	9.68
NAVBASE Ventura City Point Mugu	17.59	1	0.06	3	0.17
NAVPHIBASE Seal Side	1.33	2	1.5	2	1.5
NAVSUPPDET Monterey	0.77	3	3.9	3	3.9
NAWS China Lake	4491.08	2	0	2	0
NB Coronado	11.11	2	0.18	4	0.36
NB Coronado Cleveland NF Survival Training	24.67	3	0.12	8	0.32
NB Coronado Imperial Beach	4.87	1	0.21	1	0.21

Service*/Installation	Area (km²)	Listed and At-Risk Species	Species Density (km²)	Element Occurrences	EO Density (km²)
NB Coronado Silver Strand	2.22	2	0.9	2	0.9
NB Point Loma	4.73	7	1.48	16	3.38
NB San Diego Chollas Heights Hsg	0.3	2	6.67	2	6.67
NB San Diego Murphy Canyon	2.75	3	1.09	3	1.09
NB San Diego Pomerado Terrace	0.21	1	4.76	1	4.76
NWS Seal Beach	19.59	1	0.05	1	0.05
Port Hueneme	6.54	1	0.15	1	0.15
San Clemente	175.53	14	0.08	289	1.65
San Nicolas Island	59.58	3	0.05	13	0.22
Santa Cruz Island	248.33	14	0.06	111	0.45

*Note: Service totals (in bold italicized font) may be lower than installation totals due to shared species.

3.2 Summary of the number of species and EOs managed by other agencies

More broadly the 144 listed and at-risk plant species occur on an additional 3,873 EOs across California. Approximately half of all EOs occur on federally owned or managed properties, with nearly half of these EOs residing on DoD lands (Table 9). The USFS, BLM, and state and local governments also manage more than 5% of all species' EOs. Smaller numbers of EOs occur on other protected lands, but 1,336 or roughly 27% of all EOs occur on private property or areas of unknown management where active conservation efforts are unlikely to be implemented.

Across all land owner/management types, the number of known EOs for any species ranges from 1-147, with an average of 34.3 ± 30.4 (SD) (Appendix, Table A-3). The percent of individual species' EOs managed by DoD is highly variable, ranging from 0 to 100%, with an average of 37.06 ± 32.62%. DoD currently manages all of the known extant EOs for 17 species.

Seven agencies representing federal, state, and local governments, as well as NGOs each manage more than 25% of all DoD listed and at-risk species, suggesting an existing foundation for diverse, multi-agency, conservation partnering opportunities. However, approximately 74% of species also have EOs that occur on private property or lands of unknown or unprotected status, suggesting further potential decline in their conservation status.

Table 9. Occurrence of species and EOs across land owner/management types.

Land Owner/Management Type	Number of species	Percent of Species	Number of EOs	Percent of EOs
Federal	141	97.92	2352	47.56
Bureau of Indian Affairs (BIA)	*7*	*4.86*	*14*	*0.28*
Bureau of Land Management (BLM)	*68*	*47.22*	*473*	*9.57*
Department of Defense (DOD)	*116*	*80.56*	*1072*	*21.68*
Fish and Wildlife Service (FWS)	*35*	*24.31*	*117*	*2.37*
National Oceanic and Atmospheric Administration (NOAA)	*14*	*9.72*	*37*	*0.75*
National Park Service (NPS)	*22*	*15.28*	*144*	*2.91*
Natural Resources Conservation Service (NRCS)	*2*	*1.39*	*3*	*0.06*
U.S. Army Corps of Engineers (USACE)	*1*	*0.69*	*2*	*0.04*
U.S. Bureau of Reclamation (USBR)	*1*	*0.69*	*1*	*0.02*
U.S. Forest Service (USFS)	*40*	*27.78*	*489*	*9.89*
District	24	16.67	76	1.54
Regional (REG)	16	11.11	46	0.93
Regional Water District (RWD)	15	10.42	30	0.61
State	84	58.33	387	7.83
State Department of Natural Resources (DNR)	*1*	*0.69*	*1*	*0.02*
State Fish and Wildlife (SFW)	*45*	*31.25*	*165*	*3.34*
State Park and Recreation (SPR)	*47*	*32.64*	*152*	*3.07*
Other State (OTHS)	*40*	*27.78*	*69*	*1.40*
Local	77	53.47	567	11.47

Land Owner/Management Type	Number of species	Percent of Species	Number of EOs	Percent of EOs
City	*59*	*40.97*	*373*	*7.54*
County	*53*	*36.81*	*194*	*3.92*
Joint	12	8.33	30	0.61
Non-governmental Organization (NGO)	49	34.03	195	3.94
Private	85	59.03	681	13.77
Unknown	99	68.75	657	13.29

3.3 Species' vulnerability

Mean protection scores estimated for individual species, which were based on protection status (e.g., federally or state listed) and property ownership of EO locations, ranged from 0.32 to 1.0 and had a mean of 0.57 across species. Fourteen species had a mean protection score of 1.0, indicating that all EOs occur on federal property and the species are either federally Endangered or Threatened (Appendix, Table A-4).

Species' mean Gap Status Code, which characterizes the management intent of the land owners where EOs occur, ranged from 0.25 to 0.75 and had a mean of 0.44 across all species. Given that no species had a mean Gap Status Code of 1.00 suggests there are numerous opportunities to expand the commitment of land owners to permanently protect EOs (Appendix, Table A-4). Notably, ten species had mean Gap Status Codes of 0.25, indicating none of their EOs occur on lands with any permanent protections to prevent conversion of natural habitat types to anthropogenic use.

Species' mean Occurrence Ranks, which characterize the average condition of species' EOs (Appendix, Table A-4), ranged from 0.50 to 0.88 and had a mean of 0.70 across all species. Relatively few species had high or low mean Occurrence Ranks, instead most species' ranks were close to the cross-species mean. This likely resulted from our choice to use the average Occurrence Rank across all EOs, when EO condition was unknown.

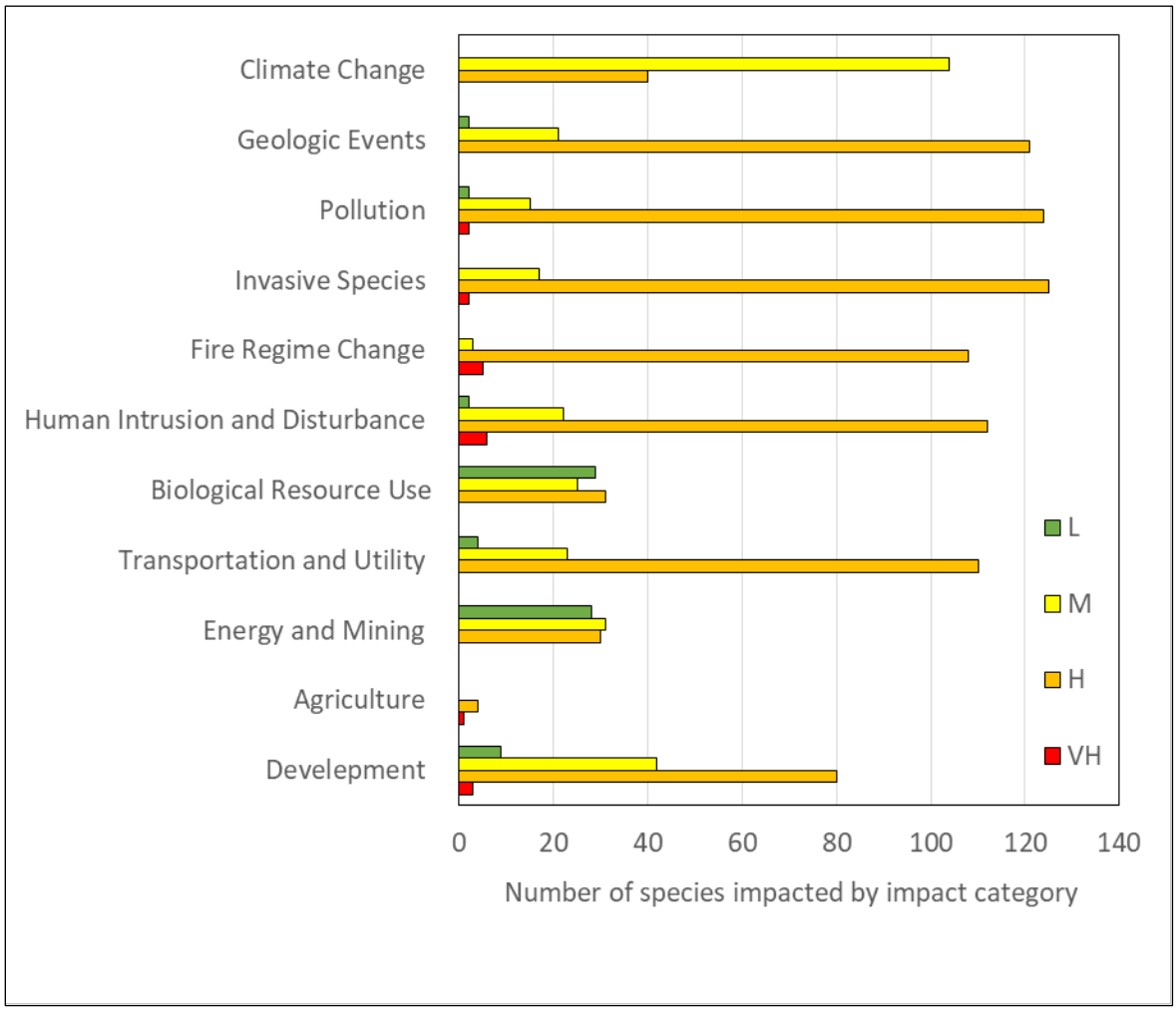
Species' mean vulnerability indices, which characterize the vulnerability of species' EOs as represented by one minus the mean of each EO protection score, GAP Status Code, and Occurrence Rank, ranged from 0.18 to 0.64 and had an average of 0.44 across all species (Appendix, Table A-4).

3.4 Threat impacts

3.4.1 Level one threats

Impacts of L1 threats were found to be widespread across species; all but one threat (Agriculture) were estimated to impact the majority of species with some magnitude (Figure 4; Appendix, Table A-5). The most common impact category estimated for threats across species was "High", except for Climate Change and Energy and Mining, which most commonly had a "Medium" impact on species.

Figure 4. Number of species impacted within each impact category (L = low, M = medium, H = high, VH = very high) for each level one threat.



Across species, mean ordinal impact values of threats ranged from 6.3 – 12.8 (Table 10). Among threat types, Biological Resource Use and Energy and Mining were estimated to have the lowest impact where they affect species. Although Agriculture impacts relatively few species, where it does

affect species' populations it was estimated to have a greater impact than other threats.

Table 10. Number and proportion of species impacted by each level one threat type and the mean ordinal impact value.

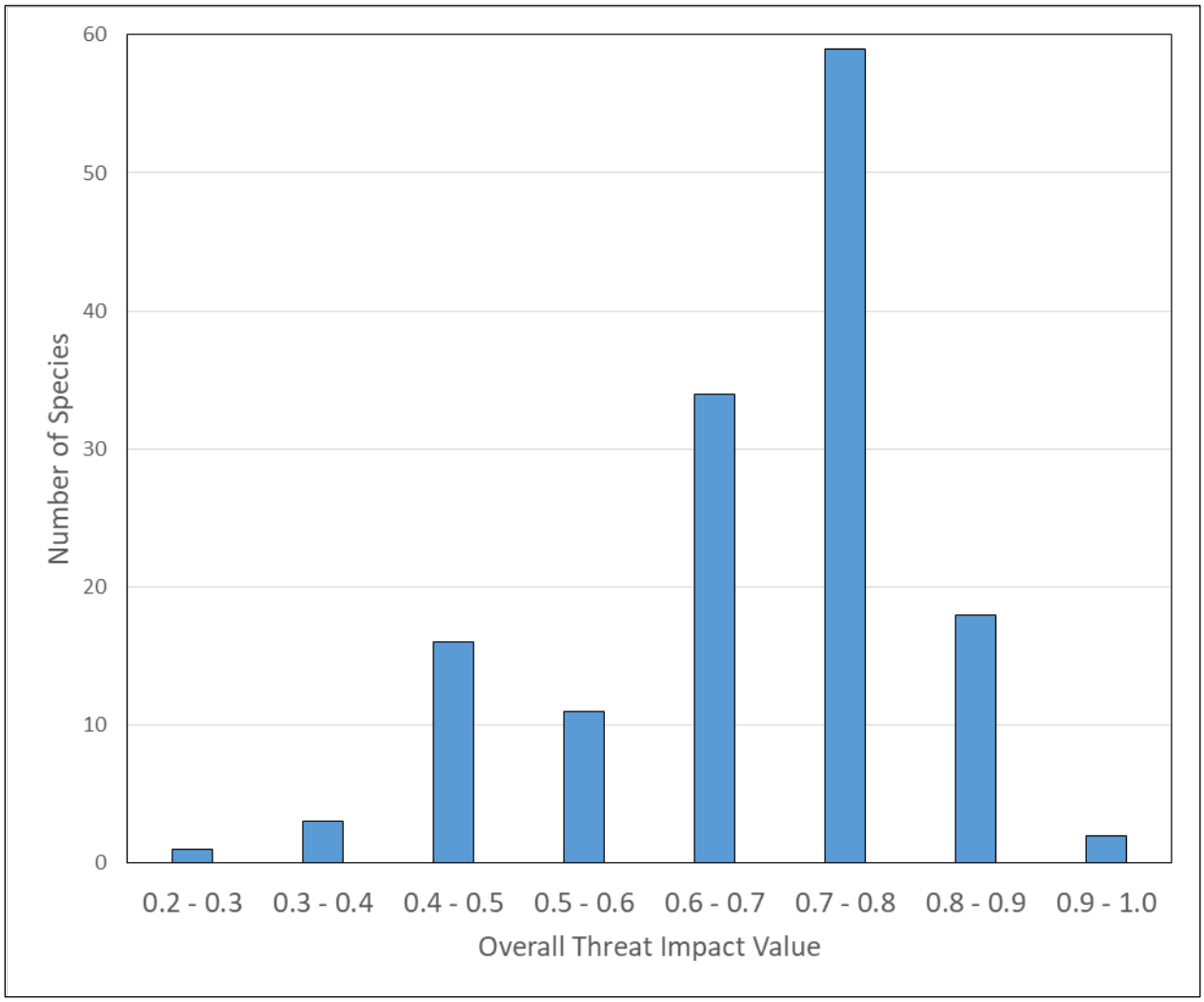
Threat	Number of species impacted (proportion impacted)	Mean Impact Value
Development	134 (0.93)	8.8
Agriculture	5 (0.03)	12.8
Energy and Mining	89 (0.62)	6.3
Transportation and Utility	137 (0.95)	9.3
Biological Resource Use	85 (0.59)	6.3
Human Intrusion and Disturbance	142 (0.99)	9.5
Fire Regime Change	116 (0.81)	11.4
Invasive Species	144 (1)	11.6
Pollution	143 (0.99)	11.2
Geologic Events	144 (1)	10.9
Climate Change	144 (1)	9.1

3.4.2 Overall threat impact

Overall threat impact categories estimated using NatureServe guidance provided little ability to distinguish differences among species, as all but one species were estimated to have a "Very High" overall threat impact. In contrast, overall threat impact values based on the product of threat severity and scope helped to differentiate species (Appendix, Table A-5). Standardized mean overall threat impact values ranged from 0.26 – 1.0, but most species had values between 0.6 - 0.9 (Figure 5). The five highest overall threat impact values were shared by twelve species (ordered high to low): *Calycadenia micrantha* (1.0), *Entosthodon kochii* (0.91), *Arctostaphylos montereyensis* (0.84), C*amissoniopsis hardhamiae* (0.84), *Collinsia antonina* (0.84), *Fritillaria ojaiensis* (0.84), *Malacothamnus abbottii* (0.84), *Malacothamnus davidsonii* (0.84), *Clarkia jolonensis* (0.82), *Arctostaphylos pajaroensis* (0.81), *Ericameria fasciculata* (0.81), *Symphyotrichum defoliatum* (0.81) (Appendix, Table A-5). Seven species shared the five lowest overall threat impact values (ordered low to high):

Malacothrix indecora (0.26), *Malacothrix squalida* (0.31), *Lavatera assurgentiflora* ssp. *assurgentiflora* (0.39), *Ribes thacherianum* (0.39), *Lithophragma maximum* (0.41), *Ribes viburnifolium* (0.41), *Hazardia cana* (0.45) (Appendix, Table A-5). Given that none of the twelve species with the highest threat impact values are either State or federally listed, while three of the seven species with the lowest values are federally listed, suggests that protections can help reduce threats to species' continued existence.

Figure 5. Histogram of standardized mean overall threat impact values across all species.



3.5 Priority scores

Across DoD the highest priority score was estimated for C*ymopterus deserticola* (Figure 6), which occurs on Edwards Air Force Base (Appendix, Table A-6). Sixteen additional species having priority scores within the top ten percent of scores across DoD were represented on another five of the 36 installations (Table 11). Four of the six installations had only a single species from among the top ten percent of priority scores, but Fort Hunter Liggett and San Clemente each had multiple species with relatively high scores. Among Services, Navy had the largest number of species (10) with high priority scores (Table 11), but a smaller percent of species (19%) compared to the Army Reserves (21%). None of the species on Army and Army Guard installations had priority scores within the top ten percent of scores across DoD.

Figure 6. Desert cymopterus (*Cymopterus deserticola*), a Mojave Desert endemic known to occur on Edwards AFB, was estimated to have the highest priority score of any species.

Examining the representation of species with the top ten percent of priority scores within Services, we found that species were distributed across 8 of 36 installations (Table 11). As is expected, Services with a larger number of species had a greater number of species with high priority scores than Services with fewer species. Of more interest to Services and installations is the representation of species with high priority scores among installations and the management implications of the criteria that resulted in high priority scores (see next Section).

Table 11. Number of listed and at-risk species known to occur on installations, and the number of species having priority scores in the top ten percent across DoD and Services. The sum of installation values is shown within Service rows.

Service*/Installation	Number of species	Number of species with priority scores in the top 10% across DoD	Number of species with priority scores in the top 10% across Service
Air Force Active	*25*	*2*	*3*
Beale Air Force Base	1	0	0
Edwards Air Force Base	3	1	1
Pillar Point AFS	1	0	0
Travis Air Force Base	2	0	0
Vandenberg Air Force Base	19	1	2
Army Active	*5*	*0*	*1*
NTC and Fort Irwin	2	0	0
Ord Military Community	1	0	1
Presidio Of Monterey	2	0	0
Army Guard	*15*	*0*	*2*
ITC Camp San Luis Obisbo	6	0	0
MTC-H Camp Roberts	9	0	2
Army Reserve	*19*	*4*	*2*
Fort Hunter Liggett	19	4	2
Marine Corps Active	*26*	*1*	*3*
Chocolate Mt Air Gunnery Range	1	0	0
MCAS Miramar	12	0	2
MCB Camp Pendleton	15	1	1
MCLB Barstow	1	0	0
Twentynine Palms Main Base	1	0	0
Navy Active	*53*	*10*	*7*
Former NAVPHIBASE Coronado	1	0	0
NAF El Centro	1	0	0
Naval Medical Center San Diego	3	0	0
NAVBASE Ventura City Point Mugu	1	0	0
NAVPHIBASE Seal Side	2	0	0
NAVSUPPDET Monterey	3	0	0
NAWS China Lake	2	0	0
NB Coronado	2	0	0
NB Coronado Cleveland NF Survival Training	3	0	0

Service*/Installation	Number of species	Number of species with priority scores in the top 10% across DoD	Number of species with priority scores in the top 10% across Service
NB Coronado Imperial Beach	1	0	0
NB Coronado Silver Strand	2	0	0
NB Point Loma	7	0	0
NB San Diego Chollas Heights Hsg	2	0	0
NB San Diego Murphy Canyon	3	0	0
NB San Diego Pomerado Terrace	1	0	0
NWS Seal Beach	1	0	0
Port Hueneme	1	0	0
San Clemente	14	9	7
San Nicolas Island	3	0	0
Santa Cruz Island	14	1	0

*Note: Service totals (in bold italicized font) may be lower than installation totals due to shared species.

3.6 Management recommendations

Values estimated for the criteria and objectives within our MCDA can identify general management recommendations for species and guide additional exploration of the variables on which they were estimated (Table 12). For example, *Cymopterus deserticola* had the highest impact risk of any species owing to the large number of EOs on Edwards AFB (59) and the relatively large percentage of total number of species' EOs (72%) that they represent (Table 12).

Considering individual criteria used to quantify listing risk for the species with the top 10% of priority scores across DoD, the five highest values for the criterion "number of species EOs" were estimated for *Collinsia antonina*, *Erythranthe hardhamiae*, *Pogogyne clareana*, *Eryngium pendletonense*, and *Ribes thacherianum* (Table 12). Actions that can increase the number of EOs for these species are limited to population (re)introduction and additional survey efforts to locate previously unknown populations. For the criterion "species vulnerability", the five highest values were estimated for *Cymopterus deserticola, Collinsia antonina, Erythranthe hardhamiae, Brodiaea kinkiensis,* and *Triteleia clementina*. There are multiple ways to reduce species vulnerability, such as increasing species mean protection status, GAP Status, or Occurrence Rank. Protection status can be increased by listing species under the California ESA

and/or increasing the protections for EOs currently lacking any protections (e.g., establishing conservation easements). Gap Status can be improved by developing and implementing formal management plans for EOs that reside on properties with low Gap Status Codes. Occurrence Rank can be improved by implementing various management actions (e.g., controlling invasive species, augmenting populations, restoring natural fire regimes, etc.) at EOs that are currently in poor condition. For the criterion "overall threat impact", the five highest values were estimated for *Deinandra increscens* ssp. *villosa*, *Chlorogalum purpureum* var. *purpureum*, *Collinsia antonina*, *Erythranthe hardhamiae*, *Pogogyne clareana*. Overall threat impact can be improved by identifying the L1 threats that are impacting species EOs and reducing either their scope or severity.

Considering individual criteria used to quantify risk of installation impacts for species with the top 10% of priority scores across DoD, the highest values for "number of EOs on-site" were estimated for *Cymopterus desertícola*, *Deinandra increscens* ssp. *villosa*, *Acmispon dendroideus* var. *traskiae, Bergerocactus emoryi*, and *Castilleja grisea* (Table 12). Management actions to decrease the number of EOs on installations are not advisable, but it may be possible to use mitigation banking for some species depending on their listing status and the availability of proven population (re)introduction protocols. For the criterion "percent of species' EOs on-site", eleven of the species wholly occur within installation boundaries. To reduce the value of this criterion it will be necessary to (re)introduce populations into suitable habitats on other protected lands, or locate heretofore unknown populations on non-DoD properties (e.g., by combining habitat suitability mapping with additional field surveys). For the criterion "EO density", the five highest values were estimated for *Acmispon dendroideus* var. *traskiae*, *Bergerocactus emoryi*, *Castilleja grisea*, *Hazardia cana*, *Phacelia floribunda*, and *Triteleia clementina*. Although, these values were relatively low, management actions identified above for the criterion "number of EOs on-site" would also inherently reduce "EO density."

A complete list of values estimated for the six criteria and two objectives that were used in the MCDA to estimate priority scores for all species is provided in Appendix, Table A-6.

Table 12. Standardized criteria and objective values used in the MCDA to estimate priority scores for the top ten percent of scores across DoD (*) and within Services (**). Note, criteria values do not include the applied weightings, while objective and overall priority scores reflect weights applied at lower levels of the decision hierarchy.

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
AF Active										
Edwards Air Force Base										
Cymopterus deserticola *,**	0.442	0.854	0.602	0.633	1	0.720	0.002	0.646	0.640	1
Vandenberg Air Force Base										
Ancistrocarphus keilii **	0.986	0.857	0.742	0.862	0.017	0.500	0	0.194	0.528	0.825
Deinandra increscens ssp. villosa *,**	0.667	0.636	0.695	0.666	0.525	0.633	0.003	0.435	0.551	0.861
Army Active										
Ord Military Community										
Chorizanthe pungens var. pungens **	0.660	0.615	0.750	0.675	0.017	0.020	1	0.264	0.470	0.734
Army Guard										
MTC-H Camp Roberts										
Entosthodon kochii **	0.973	0.839	0.906	0.906	0.017	0.250	0	0.100	0.503	0.786
Plagiobothrys uncinatus **	0.905	0.781	0.766	0.817	0.034	0.143	0	0.066	0.442	0.691
Army Reserve										
Fort Hunter Liggett										
Chlorogalum purpureum var. purpureum *,**	0.884	0.542	0.773	0.733	0.254	0.882	0.001	0.426	0.580	0.906
Collinsia antonina *	0.946	0.766	0.836	0.849	0.085	0.625	0	0.266	0.558	0.872

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Erythranthe hardhamiae *	0.959	0.826	0.773	0.853	0.051	0.500	0	0.207	0.530	0.828
Pogogyne clareana *,**	0.959	0.689	0.797	0.815	0.102	1	0	0.413	0.614	0.959
Marine Corps Active										
MCAS Miramar										
Monardella viminea *	0.803	0.606	0.773	0.727	0.254	0.517	0.005	0.29	0.509	0.795
Pogogyne abramsii *	0.85	0.649	0.664	0.721	0.186	0.500	0.004	0.258	0.490	0.766
MCB Camp Pendleton										
Eryngium pendletonense *,**	0.973	0.754	0.688	0.805	0.068	1	0	0.401	0.603	0.942
Navy Active										
San Clemente										
Acmispon dendroideus var. traskiae *,**	0.728	0.537	0.477	0.581	0.678	1	0.007	0.631	0.606	0.947
Bergerocactus emoryi *,**	0.524	0.73	0.602	0.619	0.847	0.714	0.009	0.588	0.604	0.944
Brodiaea kinkiensis *,**	0.884	0.764	0.523	0.724	0.288	1	0.003	0.484	0.604	0.944
Castilleja grisea *,**	0.741	0.49	0.461	0.564	0.644	1	0.007	0.618	0.591	0.923
Delphinium variegatum ssp. kinkiense *	0.871	0.549	0.461	0.627	0.322	1	0.004	0.497	0.562	0.878
Hazardia cana *,**	0.796	0.759	0.445	0.667	0.508	1	0.006	0.567	0.617	0.964
Malacothamnus clementinus *	0.891	0.526	0.469	0.629	0.271	1	0.003	0.477	0.553	0.864
Phacelia floribunda *,**	0.810	0.700	0.484	0.665	0.475	1	0.005	0.554	0.610	0.953
Triteleia clementina *,**	0.823	0.784	0.477	0.695	0.441	1	0.005	0.542	0.619	0.967
Santa Cruz Island										

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Ribes thacherianum *	0.918	0.532	0.391	0.614	0.203	1	0.002	0.452	0.533	0.833

4 Recommendations

4.1 General applicability

The magnitude of the conservation challenge posed by federally listed and at-risk plants for DoD is sure to escalate given the listing backlog (Negron-Ortiz 2014), trend toward mega listing petitions, and continued loss and degradation of natural habitats due to urbanization, climate change, and invasive species. Consequently, there is a critical need to strategically plan for this pending formidable conservation challenge. Fortunately, authorities under the Sikes Act allow DoD to not only advance natural resource conservation on military lands, but also use cooperative conservation for the maintenance or improvement of natural resources beyond installation boundaries. We not only recommend that the outputs of our assessment of conservation priorities for California listed and at-risk plants be used during future decision making, but also that the approach be applied to other taxonomic groups and other regions of the United States where mission encroachment due to numerous listed and at-risk species is a particular concern. For example, Hawaii is an obvious location where additional prioritization of species conservation would likely benefit DoD, Services and installations. By utilizing a formal decision-making approach to prioritize conservation efforts, Service and installation managers can ensure limited resources are applied effectively and impacts to training and testing missions are minimized or prevented.

The species prioritization generated in this assessment can be utilized during conservation decision making at installation, Service, and DoD organizational levels. For example, installations are able to implement proactive management and partnership-based activities through their Integrated Natural Resources Management Plans. Where multiple species force installation land managers to make choices about which conservation objectives to pursue, we recommend that our prioritization be used to inform decisions.

Services (i.e., headquarters and major commands) not only approve installation funding requests that make species conservation actions possible, they also can facilitate inter-installation, inter-Service, and multi-agency initiatives that can more broadly benefit listed and at-risk species conservation. Some species have populations distributed across multiple land

management agencies, complicating implementation of conservation partnerships needed to improve their conservation status. For example, *Bergerocactus emoryi,* which is found on NB Point Loma and San Clemente and was identified as having a priority score among the top 10% across the DoD, has populations on multiple other federal and state agency properties, local government properties (city and county), and private lands (Appendix, Table A-3). Many small installations also may not have sufficient staff or expertise to pursue species conservation efforts through their own initiative and consequently be reliant on assistance from higher levels within their Service. Therefore, we recommend that DoD Services utilize our prioritization where it can assist conservation decision making (e.g., potential encroachment analyses), whether it is under the Army Compatible Use Buffers (ACUB) Program, Navy Encroachment Management Program, or comparable Air Force planning processes. Note that our assessment only evaluated the relative impact of potential encroachment to installations, not the relative importance of different installation's missions to the Service mission. Where this information is available Services can incorporate it as an additional criterion.

The Office of the Secretary of Defense (OSD) provides policy, guidance, and funding support for Service efforts to protect missions and installations from encroachment via the Readiness and Environmental Protection Integration (REPI) program. The REPI program promotes collaborative, habitat-based projects at landscape or regional scales that benefit on-installation flexibility by conserving resources outside installation boundaries. Among other criteria, the REPI program evaluates and prioritizes projects for funding based on the encroachment threat to the military mission and the potential to prevent, or mitigate impacts. Although we are not aware of the specific evaluation processes employed by the REPI program, we recommend that if there is interest in incorporating ESA listing risk as a future encroachment threat, the program might want to adopt the approach we demonstrated here for California at-risk plants.

4.2 Military mission benefits

Installation training ranges are essential for preparing DoD forces for combat and complex missions across the globe. For more than a decade DoD has annually summarized the requirements necessary to ensure the long-term sustainability of its training ranges within the Sustainable Ranges Report (SRR). The 2015 SRR, like earlier reports, outlined seven goals supporting the DoD's training range sustainment plan. Two of the

seven goals, namely "mitigate encroachment pressures on training activities" and "sustain excellence in environmental stewardship" are supported by the proposed effort. Threatened and endangered species are consistently reported as the primary encroachment threat to range accessibility and capability across DoD, while at-risk species are identified as a key evolving challenge to sustainability. In the 2015 Sustainable Range Report, Army identified listed species encroachment as a threat to three of five mission areas: movement and maneuver, fire support and sustainment. Similarly, the most significant encroachment issue at Marine Corps range complexes involves species listed under the ESA and maneuver and live-fire training, which impacts individual, unit, and MEB level training mission areas. Edwards Air Force Base was the sole Air Force base in California evaluated in the 2015 SRR. It reported encroachment on its air drop mission, but elsewhere across Air Force landspace specific training mission areas that were reported to be impacted by listed species include: air drop, strategic attack, counter air, counter land, counter space and special operations. Listed and at-risk species pose severe to moderate encroachment issues for Navy landspace training missions such as anti-air, anti-surface, amphibious, strike, expeditionary, and naval special warfare at China Lake, Point Mugo Sea Range (including San Nicolas Island), and SOCAL Range Complex (including San Clemente Island), among others.

Analyses and assessments of encroachment at the installation, regional and Service levels are common actions proposed by DoD Services in the 2015 SRR to mitigate encroachment pressure on training activities. Federal listing of only a subset of the 106 at-risk plant species that are spread across 640 different populations on 36 installations and facilities in California would likely cause significant encroachment constraints on present and future training land use (e.g., range expansion or creation). Encroachment analyses generated during our framework development and demonstration will allow these installations and their respective Services, to make strategic conservation and management decisions that could potentially eliminate concerns justifying federal listing of these species. Listed plants only receive limited protections on non-federal properties, making ffederal land stewards primarily responsible for their conservation. Strategic conservation of listed and at-risk plants is not only fundamentally important in its own right, but also has the potential to directly and indirectly determine the diversity of many other taxonomic groups (e.g., insect pollinators).

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Acronyms and Abbreviations

Term	Definition
ACUB	Army Compatible Use Buffer
AFB	Air Force Base
BLM	Bureau of Land Management
Cal-IPC	California Invasive Plant Council
CEERD	U.S. Army Corps of Engineers, Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
CESA	California Endangered Species Act
CCA	Candidate Conservation Agreement
CNDDB	California Natural Diversity Database
CNTY	County
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
EO	Element Occurrence
ERDC	U.S. Army Engineer Research and Development Center
ERDC-CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
EPA	Environmental Protection Agency
ESA	U.S. Endangered Species Act
ESRI	Environmental Systems Research Institute, Inc.
FEMA	Federal Emergency Management Agency
FRAP	Fire Resource and Assessment Program
GAP	USGS Gap Analysis Program
GCM	Global Circulation Model
HCP	Habitat Conservation Plan
hrs	Hours
HUC	Hydrologic Unit Codes
INRMP	Integrated Natural Resources Management Plan
JFTC	Joint Forces Training Center

JNT	Joint
L1	Level one
L2	Level two
LANDFIRE	Landscape Fire and Resource Management Planning Tools
MCB	Marine Corps Base
NGO	Nongovernmental Organization
NLCD	National Land Cover Data
OCONUS	Outside the continental US
ORVs	Off road vehicles
OSD	Office of the Secretary of Defense
OTHFED	Other federal agency
OTHS	Other state agency
PAD	Protected Areas Database
ppb	Parts per billion
ppm	Parts per million
PVT	Private
REG	Regional
REPI	Readiness and Environmental Protection Integration
RWD	Regional Water District
SAR	Species At-Risk
SHA	Safe Harbor Agreement
SOCAL	Southerh California
SRR	Sustainable Ranges Report
TNC	The Nature Conservancy
UNK	Unknown
URL	Universal Resource Locator
US	United States
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Appendix: Supplemental Tables

Table A1. Scientific name, common name, federal and state listing status, NatureServe global rank, and other federal agency special status of DoD at-risk plant species in California.

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Abies bracteata	bristlecone fir	None	None	G2G3	USFS
Acmispon dendroideus var. traskiae	San Clemente Island lotus	Threatened	Endangered	G4T3	None
Acmispon prostratus	Nuttall's acmispon	None	None	G1G2	None
Agave shawii var. shawii	Shaw's agave	None	None	G2G3T2	None
Agrostis hooveri	Hoover's bent grass	None	None	G2	BLM/USFS
Allium hickmanii	Hickman's onion	None	None	G2	BLM
Ancistrocarphus keilii	Santa Ynez groundstar	None	None	G1	BLM
Arctostaphylos glandulosa ssp. crassifolia	Del Mar manzanita	Endangered	None	G5T2	None
Arctostaphylos montereyensis	Toro manzanita	None	None	G2?	BLM
Arctostaphylos pajaroensis	Pajaro manzanita	None	None	G1	BLM
Arctostaphylos pumila	sandmat manzanita	None	None	G1	BLM
Arctostaphylos purissima	La Purisima manzanita	None	None	G2	None
Arctostaphylos rainbowensis	Rainbow manzanita	None	None	G2	BLM/USFS
Arctostaphylos rudis	sand mesa manzanita	None	None	G2	BLM
Aristocapsa insignis	Indian Valley spineflower	None	None	G1	BLM
Astragalus jaegerianus	Lane Mountain milk-vetch	Endangered	None	G2	None
Astragalus pycnostachyus var. pycnostachyus	coastal marsh milk-vetch	None	None	G2T2	BLM
Astragalus tener var. ferrisiae	Ferris' milk-vetch	None	None	G2T1	BLM

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Astragalus tener var. tener	alkali milk-vetch	None	None	G2T2	None
Astragalus tener var. titi	coastal dunes milk-vetch	Endangered	Endangered	G2T1	None
Atriplex depressa	brittlescale	None	None	G2	None
Baccharis vanessae	Encinitas baccharis	Threatened	Endangered	G1	None
Berberis pinnata ssp. insularis	island barberry	Endangered	Endangered	G5T1	None
Bergerocactus emoryi	golden-spined cereus	None	None	G2G3	None
Bloomeria clevelandii	San Diego goldenstar	None	None	G2	BLM
Boechera hoffmannii	Hoffmann's rockcress	Endangered	None	G1G2	None
Brodiaea filifolia	thread-leaved brodiaea	Threatened	Endangered	G2	None
Brodiaea kinkiensis	San Clemente Island brodiaea	None	None	G2	None
Brodiaea orcuttii	Orcutt's brodiaea	None	None	G2	BLM/USFS
Calochortus obispoensis	San Luis mariposa-lily	None	None	G2	BLM/USFS
Calochortus simulans	La Panza mariposa-lily	None	None	G2	BLM/USFS
Calycadenia micrantha	small-flowered calycadenia	None	None	G2	BLM/USFS
Camissoniopsis hardhamiae	Hardham's evening-primrose	None	None	G2	BLM/USFS
Castilleja grisea	San Clemente Island paintbrush	Threatened	Endangered	G3	None
Ceanothus cyaneus	Lakeside ceanothus	None	None	G2	BLM/USFS
Ceanothus otayensis	Otay Mountain ceanothus	None	None	G1G2	BLM
Ceanothus verrucosus	wart-stemmed ceanothus	None	None	G2	None
Chenopodium littoreum	coastal goosefoot	None	None	G2	None
Chlorogalum purpureum var. purpureum	Santa Lucia purple amole	Threatened	None	G2T2	None

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Chloropyron maritimum ssp. maritimum	salt marsh bird's-beak	Endangered	Endangered	G4?T1	None
Chorizanthe orcuttiana	Orcutt's spineflower	Endangered	Endangered	G1	None
Chorizanthe pungens var. pungens	Monterey spineflower	Threatened	None	G2T2	None
Chorizanthe rectispina	straight-awned spineflower	None	None	G2	BLM/USFS
Cirsium fontinale var. obispoense	San Luis Obispo fountain thistle	Endangered	Endangered	G2T2	None
Cirsium rhothophilum	surf thistle	None	Threatened	G1	BLM
Cirsium scariosum var. loncholepis	La Graciosa thistle	Endangered	Threatened	G5T1	None
Clarkia jolonensis	Jolon clarkia	None	None	G2	USFS
Clinopodium chandleri	San Miguel savory	None	None	G2	BLM/USFS
Collinsia antonina	San Antonio collinsia	None	None	G2	BLM
Crocanthemum greenei	island rush-rose	Threatened	None	G3	None
Cryptantha traskiae	Trask's cryptantha	None	None	G2	None
Cymopterus deserticola	desert cymopterus	None	None	G2	BLM
Deinandra increscens ssp. villosa	Gaviota tarplant	Endangered	Endangered	G4G5T2	None
Deinandra mohavensis	Mojave tarplant	None	Endangered	G2	BLM/USFS
Delphinium recurvatum	recurved larkspur	None	None	G2?	BLM
Delphinium variegatum ssp. kinkiense	San Clemente Island larkspur	Endangered	Endangered	G4T2	None
Dicranostegia orcuttiana	Orcutt's bird's-beak	None	None	G2G3	None
Diplacus brandegeei	Santa Cruz Island monkeyflower	None	None	G1Q	None
Diplacus mohavensis	Mojave monkeyflower	None	None	G2	BLM

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Diplacus vandenbergensis	Vandenberg monkeyflower	Endangered	None	G1	None
Dissanthelium californicum	California dissanthelium	None	None	G2	None
Dithyrea maritima	beach spectaclepod	None	Threatened	G1	BLM
Dudleya multicaulis	many-stemmed dudleya	None	None	G2	BLM/USFS
Dudleya nesiotica	Santa Cruz Island dudleya	Threatened	Rare	G1	None
Dudleya variegata	variegated dudleya	None	None	G2	BLM
Dudleya viscida	sticky dudleya	None	None	G2	USFS
Entosthodon kochii	Koch's cord moss	None	None	G1	None
Eriastrum luteum	yellow-flowered eriastrum	None	None	G2	BLM/USFS
Eriastrum rosamondense	Rosamond eriastrum	None	None	G1?	None
Ericameria fasciculata	Eastwood's goldenbush	None	None	G2	BLM
Erigeron blochmaniae	Blochman's leafy daisy	None	None	G2	BLM
Eriodictyon capitatum	Lompoc yerba santa	Endangered	Rare	G2	None
Eriophyllum mohavense	Barstow woolly sunflower	None	None	G2	BLM
Eryngium aristulatum var. parishii	San Diego button-celery	Endangered	Endangered	G5T1	None
Eryngium pendletonense	Pendleton button-celery	None	None	G1	None
Erysimum ammophilum	sand-loving wallflower	None	None	G2	BLM
Erythranthe hardhamiae	Santa Lucia monkeyflower	None	None	G1	None
Extriplex joaquinana	San Joaquin spearscale	None	None	G2	BLM
Fritillaria ojaiensis	Ojai fritillary	None	None	G2?	BLM/USFS
Fritillaria viridea	San Benito fritillary	None	None	G2	BLM/USFS
Galium buxifolium	box bedstraw	Endangered	Rare	G2G3	None

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Galium clementis	Santa Lucia bedstraw	None	None	G2	USFS
Geothallus tuberosus	Campbell's liverwort	None	None	G1	None
Gilia tenuiflora ssp. arenaria	Monterey gilia	Endangered	Threatened	G3G4T2	None
Grindelia hallii	San Diego gumplant	None	None	G2	BLM
Hazardia cana	San Clemente Island hazardia	None	None	G2	None
Hypogymnia schizidiata	island tube lichen	None	None	G1	None
Isocoma arguta	Carquinez goldenbush	None	None	G1	None
Lasthenia conjugens	Contra Costa goldfields	Endangered	None	G1	None
Lavatera assurgentiflora ssp. assurgentiflora	island mallow	None	None	G1T1	None
Lavatera assurgentiflora ssp. glabra	southern island mallow	None	None	G1T1	None
Layia carnosa	beach layia	Endangered	Endangered	G2	None
Layia heterotricha	pale-yellow layia	None	None	G2	BLM/USFS
Layia jonesii	Jones' layia	None	None	G2	BLM/USFS
Legenere limosa	legenere	None	None	G2	BLM
Leptosiphon rosaceus	rose leptosiphon	None	None	G1	None
Leptosyne maritima	sea dahlia	None	None	G2	None
Linanthus maculatus ssp. maculatus	Little San Bernardino Mtns. linanthus	None	None	G2T2	BLM
Lithophragma maximum	San Clemente Island woodland star	Endangered	Endangered	G1	None
Malacothamnus abbottii	Abbott's bush-mallow	None	None	G1	None
Malacothamnus clementinus	San Clemente Island bush-mallow	Endangered	Endangered	G2G3	None
Malacothamnus davidsonii	Davidson's bush-mallow	None	None	G2	None

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Malacothamnus fasciculatus var. nesioticus	Santa Cruz Island bush-mallow	Endangered	Endangered	G4T1	None
Malacothrix indecora	Santa Cruz Island malacothrix	Endangered	None	G2	None
Malacothrix similis	Mexican malacothrix	None	None	G2G3	None
Malacothrix squalida	island malacothrix	Endangered	None	G1	None
Microseris paludosa	marsh microseris	None	None	G2	None
Monardella palmeri	Palmer's monardella	None	None	G2	USFS
Monardella undulata ssp. undulata	San Luis Obispo monardella	None	None	G2	BLM
Monardella viminea	willowy monardella	Endangered	Endangered	G1	None
Nasturtium gambelii	Gambel's water cress	Endangered	Threatened	G1	None
Navarretia fossalis	spreading navarretia	Threatened	None	G2	None
Navarretia prostrata	prostrate vernal pool navarretia	None	None	G2	None
Orcuttia californica	California Orcutt grass	Endangered	Endangered	G1	None
Penstemon albomarginatus	white-margined beardtongue	None	None	G2	BLM
Phacelia floribunda	many-flowered phacelia	None	None	G2	None
Phacelia stellaris	Brand's star phacelia	None	None	G1	None
Pholisma sonorae	sand food	None	None	G2	BLM
Pinus radiata	Monterey pine	None	None	G1	None
Piperia yadonii	Yadon's rein orchid	Endangered	None	G1	None
Plagiobothrys uncinatus	hooked popcornflower	None	None	G2	BLM/USFS
Pogogyne abramsii	San Diego mesa mint	Endangered	Endangered	G1	None
Pogogyne clareana	Santa Lucia mint	None	Endangered	G2	None

Scientific Name	Common Name	Federal Listing Status	California Listing Status	Global Rank	Other Non-DoD Status
Ribes thacherianum	Santa Cruz Island gooseberry	None	None	G2	None
Ribes viburnifolium	Santa Catalina Island currant	None	None	G2?	None
Rosa pinetorum	pine rose	None	None	G2	None
Salvia greatae	Orocopia sage	None	None	G2G3	BLM
Salvia munzii	Munz's sage	None	None	G2	None
Sanicula maritima	adobe sanicle	None	Rare	G2	USFS
Scrophularia atrata	black-flowered figwort	None	None	G2?	None
Sibara filifolia	Santa Cruz Island winged-rockcress	Endangered	None	G2	None
Sphaerocarpos drewei	bottle liverwort	None	None	G1	None
Stebbinsoseris decipiens	Santa Cruz microseris	None	None	G2	None
Streptanthus albidus ssp. peramoenus	most beautiful jewelflower	None	None	G2T2	USFS
Symphyotrichum defoliatum	San Bernardino aster	None	None	G2	BLM/USFS
Symphyotrichum greatae	Greata's aster	None	None	G2	BLM
Thysanocarpus conchuliferus	Santa Cruz Island fringepod	Endangered	None	G2?	None
Trifolium buckwestiorum	Santa Cruz clover	None	None	G2	BLM
Trifolium dedeckerae	Dedecker's clover	None	None	G2	BLM/USFS
Trifolium hydrophilum	saline clover	None	None	G2	None
Trifolium polyodon	Pacific Grove clover	None	Rare	G1	BLM
Triphysaria floribunda	San Francisco owl's-clover	None	None	G2?	None
Triteleia clementina	San Clemente Island triteleia	None	None	G2	None
Tropidocarpum capparideum	caper-fruited tropidocarpum	None	None	G1	USFS

Table A2. Number of Element Occurrences of DoD listed and at-risk plant species known to occur on Services and installations in California.

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
AIR FORCE ACTIVE		**219**
Beale Air Force Base		**3**
Legenere limosa	SAR	3
Edwards Air Force Base		**80**
Cymopterus deserticola	SAR	59
Eriastrum rosamondense	SAR	2
Eriophyllum mohavense	SAR	19
Pillar Point AFS		**1**
Astragalus pycnostachyus var. pycnostachyus	SAR	1
Travis Air Force Base		**3**
Astragalus tener var. tener	SAR	1
Lasthenia conjugens	Endangered	2
Vandenberg Air Force Base		**132**
Agrostis hooveri	SAR	4
Ancistrocarphus keilii	SAR	1
Arctostaphylos purissima	SAR	13
Arctostaphylos rudis	SAR	11
Chenopodium littoreum	SAR	3
Chorizanthe rectispina	SAR	2
Cirsium rhothophilum	SAR	9
Cirsium scariosum var. loncholepis	Endangered	1
Deinandra increscens ssp. villosa	Endangered	31
Diplacus vandenbergensis	Endangered	6
Dithyrea maritima	SAR	5
Erigeron blochmaniae	SAR	3
Eriodictyon capitatum	Endangered	3
Layia carnosa	Endangered	3
Layia heterotricha	SAR	1
Monardella undulata ssp. undulata	SAR	12

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
Nasturtium gambelii	Endangered	2
Scrophularia atrata	SAR	21
Symphyotrichum defoliatum	SAR	1
ARMY ACTIVE		**15**
NTC and Fort Irwin		**11**
Astragalus jaegerianus	Endangered	10
Cymopterus deserticola	SAR	1
Ord Military Community		**1**
Chorizanthe pungens var. pungens	Threatened	1
Presidio Of Monterey		**3**
Arctostaphylos pumila	SAR	1
Piperia yadonii	Endangered	2
ARMY GUARD		**31**
ITC Camp San Luis Obisbo		**18**
Calochortus obispoensis	SAR	7
Calochortus simulans	SAR	2
Cirsium fontinale var. obispoense	Endangered	2
Layia jonesii	SAR	2
Monardella palmeri	SAR	3
Streptanthus albidus ssp. peramoenus	SAR	2
MTC-H Camp Roberts		**13**
Camissoniopsis hardhamiae	SAR	1
Chlorogalum purpureum var. purpureum	Threatened	1
Chorizanthe rectispina	SAR	2
Entosthodon kochii	SAR	1
Eriastrum luteum	SAR	1
Malacothamnus davidsonii	SAR	1
Navarretia prostrata	SAR	3
Plagiobothrys uncinatus	SAR	2
Stebbinsoseris decipiens	SAR	1

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
ARMY RESERVE		**88**
Fort Hunter Liggett		**88**
Abies bracteata	SAR	2
Aristocapsa insignis	SAR	1
Calycadenia micrantha	SAR	3
Camissoniopsis hardhamiae	SAR	2
Chlorogalum purpureum var. purpureum	Threatened	15
Clarkia jolonensis	SAR	2
Collinsia antonina	SAR	5
Eriastrum luteum	SAR	10
Erythranthe hardhamiae	SAR	3
Fritillaria ojaiensis	SAR	3
Fritillaria viridea	SAR	4
Layia heterotricha	SAR	2
Malacothamnus davidsonii	SAR	9
Monardella palmeri	SAR	3
Navarretia prostrata	SAR	4
Plagiobothrys uncinatus	SAR	3
Pogogyne clareana	SAR	6
Streptanthus albidus ssp. peramoenus	SAR	7
Tropidocarpum capparideum	SAR	4
MARINE CORPS ACTIVE		**251**
Choc Mt Air Gnry Rng		**10**
Salvia greatae	SAR	10
MCAS Miramar		**108**
Arctostaphylos glandulosa ssp. crassifolia	Endangered	11
Bloomeria clevelandii	SAR	26
Brodiaea orcuttii	SAR	18
Ceanothus otayensis	SAR	1
Ceanothus verrucosus	SAR	3
Dudleya variegata	SAR	3

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
Eryngium aristulatum var. parishii	Endangered	12
Monardella viminea	Endangered	15
Navarretia fossalis	Threatened	4
Navarretia prostrata	SAR	1
Orcuttia californica	Endangered	3
Pogogyne abramsii	Endangered	11
MCB Camp Pendleton		**131**
Acmispon prostratus	SAR	4
Arctostaphylos rainbowensis	SAR	10
Astragalus tener var. titi	Endangered	1
Baccharis vanessae	Threatened	1
Brodiaea filifolia	Threatened	46
Brodiaea orcuttii	SAR	2
Dudleya multicaulis	SAR	30
Dudleya viscida	SAR	6
Eryngium aristulatum var. parishii	Endangered	9
Eryngium pendletonense	SAR	4
Erysimum ammophilum	SAR	7
Leptosyne maritima	SAR	3
Navarretia fossalis	Threatened	5
Navarretia prostrata	SAR	2
Phacelia stellaris	SAR	1
MCLB Barstow		*1*
Diplacus mohavensis	SAR	1
Twentynine Palms Main Base		1
Penstemon albomarginatus	SAR	1
NAVY ACTIVE		468
Former NAVPHIBASE Coronado		*1*
Phacelia stellaris	SAR	1
NAF El Centro		*2*
Pholisma sonorae	SAR	2

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
Naval Medical Center San Diego		*3*
Geothallus tuberosus	SAR	1
Pogogyne abramsii	Endangered	1
Sphaerocarpos drewei	SAR	1
NAVBASE Ventura City Point Mugu		**3**
Chloropyron maritimum ssp. maritimum	Endangered	3
NAVPHIBASE Seal Side		**2**
Astragalus tener var. titi	Endangered	1
Chloropyron maritimum ssp. maritimum	Endangered	1
NAVSUPPDET Monterey		**3**
Chorizanthe pungens var. pungens	Threatened	1
Erysimum ammophilum	SAR	1
Gilia tenuiflora ssp. arenaria	Endangered	1
NAWS China Lake		**2**
Cymopterus deserticola	SAR	1
Trifolium dedeckerae	SAR	1
NB Coronado		**4**
Acmispon prostratus	SAR	3
Phacelia stellaris	SAR	1
NB Coronado Cleveland NF Survival Training		**8**
Brodiaea orcuttii	SAR	2
Deinandra mohavensis	SAR	5
Symphyotrichum defoliatum	SAR	1
NB Coronado Imperial Beach		1
Chloropyron maritimum ssp. maritimum	Endangered	1
NB Coronado Silver Strand		**2**
Dudleya variegata	SAR	1
Leptosyne maritima	SAR	1
NB Point Loma		**16**
Acmispon prostratus	SAR	1
Agave shawii var. shawii	SAR	3

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
Bergerocactus emoryi	SAR	2
Ceanothus verrucosus	SAR	1
Chorizanthe orcuttiana	Endangered	4
Erysimum ammophilum	SAR	3
Leptosyne maritima	SAR	2
NB San Diego Chollas Heights Hsg		**2**
Bloomeria clevelandii	SAR	1
Eryngium aristulatum var. parishii	Endangered	1
NB San Diego Murphy Canyon		**3**
Bloomeria clevelandii	SAR	1
Brodiaea orcuttii	SAR	1
Pogogyne abramsii	Endangered	1
NB San Diego Pomerado Terrace		**1**
Monardella viminea	Endangered	1
NWS Seal Beach		**1**
Chloropyron maritimum ssp. maritimum	Endangered	1
Port Hueneme		**1**
Chloropyron maritimum ssp. maritimum	Endangered	1
San Clemente		**289**
Acmispon dendroideus var. traskiae	Threatened	40
Bergerocactus emoryi	SAR	50
Brodiaea kinkiensis	SAR	17
Castilleja grisea	Threatened	38
Cryptantha traskiae	SAR	9
Delphinium variegatum ssp. kinkiense	Endangered	19
Dissanthelium californicum	SAR	1
Hazardia cana	SAR	30
Lavatera assurgentiflora ssp. glabra	SAR	7
Lithophragma maximum	Endangered	6
Malacothamnus clementinus	Endangered	16
Phacelia floribunda	SAR	28

Service/Installation	Federal Listing Status or Species At-Risk (SAR)	Number of EOs
Sibara filifolia	Endangered	2
Triteleia clementina	SAR	26
San Nicolas Island		**13**
Cryptantha traskiae	SAR	8
Dithyrea maritima	SAR	4
Lavatera assurgentiflora ssp. assurgentiflora	SAR	1
Santa Cruz Island		**111**
Berberis pinnata ssp. insularis	Endangered	6
Boechera hoffmannii	Endangered	4
Crocanthemum greenei	Threatened	43
Diplacus brandegeei	SAR	1
Dudleya nesiotica	Threatened	2
Galium buxifolium	Endangered	13
Hypogymnia schizidiata	SAR	1
Malacothamnus fasciculatus var. nesioticus	Endangered	8
Malacothrix indecora	Endangered	2
Malacothrix similis	SAR	1
Malacothrix squalida	Endangered	1
Ribes thacherianum	SAR	12
Sibara filifolia	Endangered	2
Thysanocarpus conchuliferus	Endangered	15
Grand Total		1072

Table A3. Number and percentage of species' EOs that occur on different land owner/management types.

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Abies bracteata		2 (2.5)			69 (86.25)					2 (2.5)						1 (1.25)	6 (7.5)	80
Acmispon dendroideus var. traskiae		40 (100)																40
Acmispon prostratus	5 (14.71)	8 (23.53)	6 (17.65)						2 (5.88)	1 (2.94)		10 (29.41)		1 (2.94)			1 (2.94)	34
Agave shawii var. shawii	1 (16.67)	3 (50)	1 (16.67)	1 (16.67)														6
Agrostis hooveri	1 (3.33)	4 (13.33)			1 (3.33)				1 (3.33)	2 (6.67)	1 (3.33)				2 (6.67)	10 (33.33)	8 (26.67)	30
Allium hickmanii	2 (6.25)					5 (15.63)				4 (12.5)		3 (9.38)			1 (3.13)	17 (53.13)		32
Ancistrocarphus keilii		1 (50)															1 (50)	2
Arctostaphylos glandulosa ssp. crassifolia		11 (19.64)							2 (3.57)	2 (3.57)		20 (35.71)	5 (8.93)	2 (3.57)		5 (8.93)	9 (16.07)	56
Arctostaphylos montereyensis	4 (23.53)										2 (11.76)	1 (5.88)	3 (17.65)		1 (5.88)	1 (5.88)	5 (29.41)	17
Arctostaphylos pajaroensis	2 (7.41)									1 (3.7)	1 (3.7)	1 (3.7)	2 (7.41)		5 (18.52)	6 (22.22)	9 (33.33)	27
Arctostaphylos pumila	2 (11.76)	1 (5.88)				2 (11.76)				3 (17.65)		2 (11.76)				2 (11.76)	5 (29.41)	17

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Arctostaphylos purissima		13 (31.71)			1 (2.44)				1 (2.44)			1 (2.44)				16 (39.02)	9 (21.95)	41
Arctostaphylos rainbowensis	8 (8.99)	10 (11.24)			10 (11.24)	2 (2.25)			6 (6.74)				5 (5.62)		6 (6.74)	30 (33.71)	12 (13.48)	89
Arctostaphylos rudis		11 (30.56)							1 (2.78)							15 (41.67)	9 (25)	36
Aristocapsa insignis		1 (20)			1 (20)											1 (20)	2 (40)	5
Astragalus jaegerianus	12 (54.55)	10 (45.45)																22
Astragalus pycnostachyus var. pycnostachyus	6 (24)	1 (4)		11 (44)		1 (4)				2 (8)					1 (4)		3 (12)	25
Astragalus tener var. ferrisiae			4 (22.22)			1 (5.56)			5 (27.78)								8 (44.44)	18
Astragalus tener var. tener		1 (1.82)	9 (16.36)						8 (14.55)		2 (3.64)	3 (5.45)	5 (9.09)		7 (12.73)	9 (16.36)	11 (20)	55
Astragalus tener var. titi		2 (33.33)				1 (16.67)											3 (50)	6
Atriplex depressa			14 (23.33)				3 (5)	3 (5)	4 (6.67)		1 (1.67)	2 (3.33)		2 (3.33)	5 (8.33)	14 (23.33)	12 (20)	60
Baccharis vanessae	1 (3.85)	1 (3.85)			1 (3.85)			3 (11.54)	1 (3.85)			8 (30.77)	3 (11.54)	1 (3.85)		6 (23.08)	1 (3.85)	26
Berberis pinnata ssp. insularis		6 (85.71)		1 (14.29)														7

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Bergerocactus emoryi		52 (74.29)	1 (1.43)	1 (1.43)		3 (4.29)				3 (4.29)		4 (5.71)	1 (1.43)			1 (1.43)	4 (5.71)	70
Bloomeria clevelandii	3 (2.7)	28 (25.23)	6 (5.41)					1 (0.9)	5 (4.5)		1 (0.9)	33 (29.73)	5 (4.5)	4 (3.6)		9 (8.11)	16 (14.41)	111
Boechera hoffmannii		4 (57.14)		3 (42.86)														7
Brodiaea filifolia		46 (35.94)			6 (4.69)				8 (6.25)			11 (8.59)	8 (6.25)	3 (2.34)	4 (3.13)	35 (27.34)	7 (5.47)	128
Brodiaea kinkiensis		17 (100)																17
Brodiaea orcuttii	7 (5.47)	23 (17.97)			14 (10.94)	2 (1.56)	2 (1.56)	2 (1.56)	2 (1.56)	8 (6.25)	1 (0.78)	25 (19.53)	8 (6.25)	4 (3.13)		22 (17.19)	8 (6.25)	128
Calochortus obispoensis		7 (17.95)			3 (7.69)						5 (12.82)	9 (23.08)			3 (7.69)	11 (28.21)	1 (2.56)	39
Calochortus simulans	9 (10.47)	2 (2.33)			30 (34.88)				19 (22.09)		1 (1.16)	1 (1.16)	1 (1.16)			13 (15.12)	10 (11.63)	86
Calycadenia micrantha		3 (13.64)			17 (77.27)												2 (9.09)	22
Camissoniopsis hardhamiae	1 (4.55)	3 (13.64)			1 (4.55)								1 (4.55)			9 (40.91)	7 (31.82)	22
Castilleja grisea		38 (100)																38
Ceanothus cyaneus	5 (11.9)				7 (16.67)	2 (4.76)	1 (2.38)		6 (14.29)			3 (7.14)	4 (9.52)		2 (4.76)	2 (4.76)	10 (23.81)	42
Ceanothus otayensis	17 (65.38)	1 (3.85)	3 (11.54)								1 (3.85)	1 (3.85)					3 (11.54)	26

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Ceanothus verrucosus		4 (5.71)			1 (1.43)			2 (2.86)			1 (1.43)	26 (37.14)	3 (4.29)	4 (5.71)	1 (1.43)	16 (22.86)	12 (17.14)	70
Chenopodium littoreum		3 (25)	1 (8.33)						1 (8.33)	3 (25)					1 (8.33)		3 (25)	12
Chlorogalum purpureum var. purpureum		16 (94.12)															1 (5.88)	17
Chloropyron maritimum ssp. maritimum	2 (7.14)	7 (25)	5 (17.86)		1 (3.57)				5 (17.86)		1 (3.57)	1 (3.57)			2 (7.14)		4 (14.29)	28
Chorizanthe orcuttiana		4 (30.77)								3 (23.08)		3 (23.08)					3 (23.08)	13
Chorizanthe pungens var. pungens	4 (8)	2 (4)	1 (2)			5 (10)	2 (4)		2 (4)	1 (2)	2 (4)		2 (4)		6 (12)	10 (20)	13 (26)	50
Chorizanthe rectispina	4 (10.53)	4 (10.53)			1 (2.63)				1 (2.63)				1 (2.63)			19 (50)	8 (21.05)	38
Cirsium fontinale var. obispoense		2 (9.52)			1 (4.76)						1 (4.76)	6 (28.57)			2 (9.52)	8 (38.1)	1 (4.76)	21
Cirsium rhothophilum	3 (15)	9 (45)	1 (5)						2 (10)	1 (5)			1 (5)		1 (5)	1 (5)	1 (5)	20
Cirsium scariosum var. loncholepis		1 (5.88)	2 (11.76)							4 (23.53)		1 (5.88)			2 (11.76)	5 (29.41)	2 (11.76)	17
Clarkia jolonensis	1 (4.35)	2 (8.7)			5 (21.74)	2 (8.7)					1 (4.35)	1 (4.35)	2 (8.7)		1 (4.35)		8 (34.78)	23

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Clinopodium chandleri	5 (16.67)		4 (13.33)		8 (26.67)								4 (13.33)		2 (6.67)	2 (6.67)	5 (16.67)	30
Collinsia antonina	1 (12.5)	5 (62.5)														2 (25)		8
Crocanthemum greenei		43 (66.15)		7 (10.77)		1 (1.54)									14 (21.54)			65
Cryptantha traskiae		17 (100)																17
Cymopterus deserticola	14 (17.07)	61 (74.39)														4 (4.88)	3 (3.66)	82
Deinandra increscens ssp. villosa	1 (2.04)	31 (63.27)								1 (2.04)			4 (8.16)			11 (22.45)	1 (2.04)	49
Deinandra mohavensis	12 (15.79)	5 (6.58)			42 (55.26)	5 (6.58)	1 (1.32)					1 (1.32)				5 (6.58)	5 (6.58)	76
Delphinium recurvatum	18 (20.93)		4 (4.65)		1 (1.16)				9 (10.47)		3 (3.49)		2 (2.33)	4 (4.65)	1 (1.16)	12 (13.95)	32 (37.21)	86
Delphinium variegatum ssp. kinkiense		19 (100)																19
Dicranostegia orcuttiana			1 (7.69)						1 (7.69)		1 (7.69)	8 (61.54)	2 (15.38)					13
Diplacus brandegeei		1 (100)																1
Diplacus mohavensis	51 (85)	1 (1.67)									1 (1.67)		1 (1.67)			4 (6.67)	2 (3.33)	60

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Diplacus vandenbergensis		6 (46.15)							3 (23.08)	3 (23.08)							1 (7.69)	13
Dissanthelium californicum		1 (14.29)													6 (85.71)			7
Dithyrea maritima	5 (20)	9 (36)	1 (4)	1 (4)						4 (16)					2 (8)	1 (4)	2 (8)	25
Dudleya multicaulis	2 (1.36)	30 (20.41)			8 (5.44)		1 (0.68)	1 (0.68)	2 (1.36)	4 (2.72)	3 (2.04)	14 (9.52)	24 (16.33)		23 (15.65)	23 (15.65)	12 (8.16)	147
Dudleya nesiotica		2 (100)																2
Dudleya variegata	5 (4.59)	4 (3.67)	6 (5.5)					1 (0.92)	7 (6.42)		2 (1.83)	39 (35.78)	6 (5.5)		3 (2.75)	20 (18.35)	16 (14.68)	109
Dudleya viscida	1 (3.23)	6 (19.35)			14 (45.16)					1 (3.23)		2 (6.45)		2 (6.45)		2 (6.45)	3 (9.68)	31
Entosthodon kochii	1 (25)	1 (25)									1 (25)				1 (25)			4
Eriastrum luteum	3 (9.09)	11 (33.33)									1 (3.03)					5 (15.15)	13 (39.39)	33
Eriastrum rosamondense		2 (25)															6 (75)	8
Ericameria fasciculata	2 (8.7)										1 (4.35)	2 (8.7)	4 (17.39)		2 (8.7)	6 (26.09)	6 (26.09)	23
Erigeron blochmaniae	2 (9.52)	3 (14.29)	4 (19.05)						1 (4.76)	3 (14.29)		1 (4.76)	3 (14.29)			1 (4.76)	3 (14.29)	21
Eriodictyon capitatum		3 (50)														3 (50)		6

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Eriophyllum mohavense	36 (53.73)	19 (28.36)														7 (10.45)	5 (7.46)	67
Eryngium aristulatum var. parishii		22 (30.99)	1 (1.41)		1 (1.41)				4 (5.63)			17 (23.94)				18 (25.35)	8 (11.27)	71
Eryngium pendletonense		4 (100)																4
Erysimum ammophilum	6 (10.34)	11 (18.97)	1 (1.72)	8 (13.79)		2 (3.45)			2 (3.45)	10 (17.24)	2 (3.45)	5 (8.62)			1 (1.72)	6 (10.34)	4 (6.9)	58
Erythranthe hardhamiae		3 (50)			1 (16.67)											1 (16.67)	1 (16.67)	6
Extriplex joaquinana	4 (3.48)		7 (6.09)		1 (0.87)		12 (10.43)	6 (5.22)	3 (2.61)	7 (6.09)		6 (5.22)	3 (2.61)	1 (0.87)	4 (3.48)	30 (26.09)	31 (26.96)	115
Fritillaria ojaiensis	1 (2.04)	3 (6.12)			34 (69.39)					1 (2.04)		3 (6.12)	1 (2.04)			3 (6.12)	3 (6.12)	49
Fritillaria viridea	13 (54.17)	4 (16.67)			4 (16.67)												3 (12.5)	24
Galium buxifolium		13 (76.47)		4 (23.53)														17
Galium clementis					14 (93.33)						1 (6.67)							15
Geothallus tuberosus		1 (25)	1 (25)						1 (25)								1 (25)	4
Gilia tenuiflora ssp. arenaria	7 (25.93)	1 (3.7)					1 (3.7)			5 (18.52)	2 (7.41)	2 (7.41)	1 (3.7)		2 (7.41)	3 (11.11)	3 (11.11)	27

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Grindelia hallii	2 (3.33)				15 (25)	1 (1.67)	2 (3.33)	2 (3.33)		15 (25)			6 (10)		1 (1.67)	8 (13.33)	8 (13.33)	60
Hazardia cana		30 (100)																30
Hypogymnia schizidiata		1 (33.33)		2 (66.67)														3
Isocoma arguta											1 (7.14)		1 (7.14)		3 (21.43)	1 (7.14)	8 (57.14)	14
Lasthenia conjugens	3 (11.54)	2 (7.69)	2 (7.69)								2 (7.69)		1 (3.85)		2 (7.69)	10 (38.46)	4 (15.38)	26
Lavatera assurgentiflora ssp. assurgentiflora		1 (16.67)		5 (83.33)														6
Lavatera assurgentiflora ssp. glabra		7 (58.33)				2 (16.67)									1 (8.33)	2 (16.67)		12
Layia carnosa	2 (10)	3 (15)		7 (35)					2 (10)	1 (5)		2 (10)			1 (5)	2 (10)		20
Layia heterotricha	44 (36.07)	3 (2.46)			31 (25.41)	1 (0.82)			4 (3.28)	2 (1.64)	1 (0.82)		1 (0.82)		1 (0.82)	8 (6.56)	26 (21.31)	122
Layia jonesii		2 (8)							1 (4)	1 (4)	2 (8)	3 (12)			2 (8)	7 (28)	7 (28)	25
Legenere limosa	3 (4)	3 (4)	2 (2.67)			2 (2.67)	3 (4)		4 (5.33)	1 (1.33)		1 (1.33)	7 (9.33)		9 (12)	36 (48)	4 (5.33)	75
Leptosiphon rosaceus	2 (6.45)			24 (77.42)		3 (9.68)				1 (3.23)			1 (3.23)					31

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Leptosyne maritima	10 (20.83)	6 (12.5)	2 (4.17)	1 (2.08)				1 (2.08)	7 (14.58)	2 (4.17)		8 (16.67)	2 (4.17)			3 (6.25)	6 (12.5)	48
Linanthus maculatus ssp. maculatus	25 (53.19)			10 (21.28)	1 (2.13)						1 (2.13)					2 (4.26)	8 (17.02)	47
Lithophragma maximum		6 (100)																6
Malacothamnus abbottii																10 (76.92)	3 (23.08)	13
Malacothamnus clementinus		16 (100)																16
Malacothamnus davidsonii		10 (14.71)			30 (44.12)	2 (2.94)						6 (8.82)	3 (4.41)	2 (2.94)		1 (1.47)	14 (20.59)	68
Malacothamnus fasciculatus var. nesioticus		8 (100)																8
Malacothrix indecora		2 (28.57)		5 (71.43)														7
Malacothrix similis	1 (33.33)	1 (33.33)		1 (33.33)														3
Malacothrix squalida		1 (25)		3 (75)														4
Microseris paludosa	5 (13.51)			8 (21.62)	1 (2.7)			1 (2.7)	1 (2.7)	1 (2.7)	1 (2.7)	3 (8.11)			5 (13.51)	1 (2.7)	10 (27.03)	37
Monardella palmeri	1 (4.17)	6 (25)			9 (37.5)							1 (4.17)				4 (16.67)	3 (12.5)	24

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Monardella undulata ssp. undulata	1 (4.17)	12 (50)	2 (8.33)							4 (16.67)					1 (4.17)	4 (16.67)		24
Monardella viminea		16 (55.17)	1 (3.45)									8 (27.59)				3 (10.34)	1 (3.45)	29
Nasturtium gambelii		2 (33.33)								2 (33.33)						2 (33.33)		6
Navarretia fossalis		9 (12.33)	1 (1.37)						5 (6.85)		1 (1.37)	14 (19.18)	3 (4.11)			25 (34.25)	15 (20.55)	73
Navarretia prostrata	19 (33.33)	10 (17.54)	5 (8.77)						6 (10.53)	3 (5.26)		2 (3.51)	1 (1.75)			1 (1.75)	10 (17.54)	57
Orcuttia californica		3 (9.09)							4 (12.12)		1 (3.03)	5 (15.15)	1 (3.03)			12 (36.36)	7 (21.21)	33
Penstemon albomarginatus	19 (82.61)	1 (4.35)															3 (13.04)	23
Phacelia floribunda		28 (100)																28
Phacelia stellaris	2 (13.33)	3 (20)	1 (6.67)				1 (6.67)			1 (6.67)		1 (6.67)	1 (6.67)				5 (33.33)	15
Pholisma sonorae	8 (57.14)	2 (14.29)															4 (28.57)	14
Pinus radiata										2 (40)					1 (20)	2 (40)		5
Piperia yadonii	1 (4)	2 (8)					1 (4)			2 (8)		5 (20)	1 (4)		5 (20)	6 (24)	2 (8)	25
Plagiobothrys uncinatus		5 (35.71)		1 (7.14)	2 (14.29)						1 (7.14)				1 (7.14)	1 (7.14)	3 (21.43)	14

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Pogogyne abramsii		13 (59.09)	1 (4.55)									5 (22.73)				2 (9.09)	1 (4.55)	22
Pogogyne clareana		6 (100)																6
Ribes thacherianum		12 (100)																12
Ribes viburnifolium						6 (18.75)							1 (3.13)		23 (71.88)		2 (6.25)	32
Rosa pinetorum	1 (7.14)				2 (14.29)				1 (7.14)	1 (7.14)	1 (7.14)	2 (14.29)	1 (7.14)		2 (14.29)		3 (21.43)	14
Salvia greatae	14 (56)	10 (40)														1 (4)		25
Salvia munzii	9 (21.43)		8 (19.05)					2 (4.76)	3 (7.14)		1 (2.38)	9 (21.43)	2 (4.76)			4 (9.52)	4 (9.52)	42
Sanicula maritima						2 (14.29)				4 (28.57)		2 (14.29)				5 (35.71)	1 (7.14)	14
Scrophularia atrata	2 (3.28)	21 (34.43)							3 (4.92)	3 (4.92)	4 (6.56)	1 (1.64)	2 (3.28)		1 (1.64)	12 (19.67)	12 (19.67)	61
Sibara filifolia		4 (57.14)													2 (28.57)		1 (14.29)	7
Sphaerocarpos drewei		1 (33.33)	1 (33.33)				1 (33.33)											3
Stebbinsoseris decipiens		1 (5.26)		3 (15.79)				1 (5.26)	2 (10.53)	2 (10.53)	2 (10.53)	1 (5.26)				4 (21.05)	3 (15.79)	19

Species	Federal						REG	RWD	State			Local		JNT	NGO	PVT	UNK	Total
	BLM	DOD	FWS	NPS	USFS	OTHFED			SFW	SPR	OTHS	City	CNTY					
Streptanthus albidus ssp. peramoenus	2 (1.94)	9 (8.74)			8 (7.77)		11 (10.68)	3 (2.91)		4 (3.88)		8 (7.77)	31 (30.1)			14 (13.59)	13 (12.62)	103
Symphyotrichum defoliatum	1 (1.12)	2 (2.25)			31 (34.83)	1 (1.12)	2 (2.25)	1 (1.12)	3 (3.37)	15 (16.85)			4 (4.49)			4 (4.49)	25 (28.09)	89
Symphyotrichum greatae					50 (89.29)								1 (1.79)				5 (8.93)	56
Thysanocarpus conchuliferus		15 (100)																15
Trifolium buckwestiorum	5 (10)									3 (6)	11 (22)	1 (2)	2 (4)		16 (32)	5 (10)	7 (14)	50
Trifolium dedeckerae	1 (7.14)	1 (7.14)			12 (85.71)													14
Trifolium hydrophilum			7 (16.28)				2 (4.65)		4 (9.3)			8 (18.6)			3 (6.98)	6 (13.95)	13 (30.23)	43
Trifolium polyodon						2 (16.67)				3 (25)			1 (8.33)		1 (8.33)	5 (41.67)		12
Triphysaria floribunda				37 (77.08)								1 (2.08)	5 (10.42)				5 (10.42)	48
Triteleia clementina		26 (100)																26
Tropidocarpum capparideum		4 (30.77)														5 (38.46)	4 (30.77)	13

Table A4. Mean protection score, GAP status, Rank Occurrence, and Vulnerability index for DoD relevant listed and at-risk species in California. Higher vulnerability indices indicate greater vulnerability.

Scientific Name	Mean Protection Score	Mean GAP Status	Mean Occurrence Rank	Mean Vulnerability
Abies bracteata	0.54	0.48	0.68	0.43
Acmispon dendroideus var. traskiae	1	0.30	0.68	0.34
Acmispon prostratus	0.45	0.55	0.54	0.49
Agave shawii var. shawii	0.49	0.54	0.67	0.43
Agrostis hooveri	0.39	0.31	0.68	0.54
Allium hickmanii	0.38	0.41	0.72	0.5
Ancistrocarphus keilii	0.44	0.25	0.68	0.55
Arctostaphylos glandulosa ssp. crassifolia	0.75	0.39	0.66	0.40
Arctostaphylos montereyensis	0.42	0.46	0.69	0.48
Arctostaphylos pajaroensis	0.37	0.40	0.69	0.51
Arctostaphylos pumila	0.40	0.38	0.64	0.52
Arctostaphylos purissima	0.40	0.27	0.72	0.54
Arctostaphylos rainbowensis	0.42	0.37	0.68	0.51
Arctostaphylos rudis	0.40	0.26	0.66	0.56
Aristocapsa insignis	0.42	0.3	0.68	0.54
Astragalus jaegerianus	1	0.42	0.67	0.30
Astragalus pycnostachyus var. pycnostachyus	0.45	0.61	0.67	0.42
Astragalus tener var. ferrisiae	0.38	0.53	0.67	0.48
Astragalus tener var. tener	0.39	0.45	0.7	0.49
Astragalus tener var. titi	0.78	0.29	0.69	0.41
Atriplex depressa	0.38	0.43	0.70	0.50
Baccharis vanessae	0.73	0.46	0.63	0.39
Berberis pinnata ssp. insularis	1	0.75	0.68	0.19
Bergerocactus emoryi	0.52	0.41	0.68	0.46
Bloomeria clevelandii	0.44	0.41	0.69	0.49
Boechera hoffmannii	1	0.75	0.67	0.19
Brodiaea filifolia	0.79	0.34	0.63	0.41
Brodiaea kinkiensis	0.56	0.25	0.73	0.49

Scientific Name	Mean Protection Score	Mean GAP Status	Mean Occurrence Rank	Mean Vulnerability
Brodiaea orcuttii	0.44	0.43	0.65	0.49
Calochortus obispoensis	0.43	0.33	0.72	0.51
Calochortus simulans	0.46	0.47	0.64	0.48
Calycadenia micrantha	0.54	0.44	0.7	0.44
Camissoniopsis hardhamiae	0.38	0.28	0.76	0.53
Castilleja grisea	1	0.3	0.76	0.31
Ceanothus cyaneus	0.43	0.44	0.69	0.48
Ceanothus otayensis	0.51	0.49	0.67	0.45
Ceanothus verrucosus	0.39	0.4	0.66	0.52
Chenopodium littoreum	0.43	0.4	0.68	0.5
Chlorogalum purpureum var. purpureum	0.97	0.25	0.74	0.34
Chloropyron maritimum ssp. maritimum	0.86	0.59	0.65	0.3
Chorizanthe orcuttiana	0.8	0.42	0.7	0.36
Chorizanthe pungens var. pungens	0.72	0.42	0.68	0.39
Chorizanthe rectispina	0.38	0.3	0.71	0.54
Cirsium fontinale var. obispoense	0.7	0.33	0.8	0.39
Cirsium rhothophilum	0.61	0.71	0.69	0.33
Cirsium scariosum var. loncholepis	0.72	0.35	0.64	0.43
Clarkia jolonensis	0.43	0.4	0.68	0.5
Clinopodium chandleri	0.46	0.48	0.7	0.45
Collinsia antonina	0.5	0.28	0.76	0.49
Crocanthemum greenei	0.95	0.75	0.67	0.21
Cryptantha traskiae	0.56	0.56	0.72	0.39
Cymopterus deserticola	0.54	0.29	0.54	0.54
Deinandra increscens ssp. villosa	0.87	0.27	0.65	0.4
Deinandra mohavensis	0.57	0.44	0.68	0.44
Delphinium recurvatum	0.4	0.4	0.72	0.49
Delphinium variegatum ssp. kinkiense	1	0.28	0.68	0.35
Dicranostegia orcuttiana	0.42	0.54	0.68	0.45
Diplacus brandegeei	0.56	0.75	0.68	0.34

Scientific Name	Mean Protection Score	Mean GAP Status	Mean Occurrence Rank	Mean Vulnerability
Diplacus mohavensis	0.53	0.48	0.65	0.45
Diplacus vandenbergensis	0.85	0.38	0.67	0.36
Dissanthelium californicum	0.44	0.75	0.68	0.38
Dithyrea maritima	0.61	0.5	0.7	0.4
Dudleya multicaulis	0.43	0.45	0.69	0.48
Dudleya nesiotica	1	0.75	0.71	0.18
Dudleya variegata	0.4	0.45	0.67	0.49
Dudleya viscida	0.5	0.44	0.75	0.44
Entosthodon kochii	0.46	0.31	0.63	0.53
Eriastrum luteum	0.42	0.27	0.72	0.53
Eriastrum rosamondense	0.38	0.25	0.68	0.57
Ericameria fasciculata	0.38	0.4	0.68	0.51
Erigeron blochmaniae	0.43	0.49	0.67	0.47
Eriodictyon capitatum	0.78	0.25	0.78	0.4
Eriophyllum mohavense	0.52	0.38	0.71	0.46
Eryngium aristulatum var. parishii	0.76	0.35	0.6	0.43
Eryngium pendletonense	0.56	0.25	0.75	0.48
Erysimum ammophilum	0.44	0.5	0.68	0.46
Erythranthe hardhamiae	0.46	0.29	0.68	0.53
Extriplex joaquinana	0.37	0.33	0.64	0.55
Fritillaria ojaiensis	0.52	0.45	0.69	0.45
Fritillaria viridea	0.53	0.43	0.72	0.44
Galium buxifolium	1	0.75	0.65	0.2
Galium clementis	0.55	0.52	0.72	0.41
Geothallus tuberosus	0.43	0.5	0.68	0.47
Gilia tenuiflora ssp. arenaria	0.78	0.48	0.68	0.35
Grindelia hallii	0.43	0.55	0.64	0.46
Hazardia cana	0.56	0.32	0.68	0.48
Hypogymnia schizidiata	0.47	0.75	0.68	0.37
Isocoma arguta	0.36	0.34	0.67	0.55
Lasthenia conjugens	0.72	0.36	0.72	0.4

Scientific Name	Mean Protection Score	Mean GAP Status	Mean Occurrence Rank	Mean Vulnerability
Lavatera assurgentiflora ssp. assurgentiflora	0.44	0.71	0.68	0.39
Lavatera assurgentiflora ssp. glabra	0.49	0.29	0.64	0.53
Layia carnosa	0.88	0.58	0.69	0.29
Layia heterotricha	0.48	0.43	0.71	0.46
Layia jonesii	0.38	0.32	0.67	0.54
Legenere limosa	0.38	0.4	0.71	0.5
Leptosiphon rosaceus	0.42	0.72	0.63	0.41
Leptosyne maritima	0.42	0.52	0.63	0.48
Linanthus maculatus ssp. maculatus	0.47	0.54	0.69	0.43
Lithophragma maximum	1	0.25	0.68	0.36
Malacothamnus abbottii	0.32	0.25	0.52	0.64
Malacothamnus clementinus	1	0.31	0.68	0.33
Malacothamnus davidsonii	0.42	0.41	0.66	0.5
Malacothamnus fasciculatus var. nesioticus	1	0.75	0.63	0.21
Malacothrix indecora	1	0.75	0.72	0.18
Malacothrix similis	0.47	0.67	0.68	0.4
Malacothrix squalida	1	0.75	0.68	0.19
Microseris paludosa	0.39	0.53	0.69	0.46
Monardella palmeri	0.48	0.38	0.7	0.48
Monardella undulata ssp. undulata	0.48	0.36	0.66	0.5
Monardella viminea	0.88	0.33	0.64	0.39
Nasturtium gambelii	0.77	0.33	0.69	0.4
Navarretia fossalis	0.68	0.34	0.65	0.44
Navarretia prostrata	0.43	0.46	0.7	0.47
Orcuttia californica	0.66	0.35	0.59	0.47
Penstemon albomarginatus	0.53	0.47	0.5	0.5
Phacelia floribunda	0.56	0.43	0.68	0.45
Phacelia stellaris	0.41	0.38	0.69	0.5
Pholisma sonorae	0.49	0.41	0.7	0.46
Pinus radiata	0.38	0.45	0.85	0.44

Scientific Name	Mean Protection Score	Mean GAP Status	Mean Occurrence Rank	Mean Vulnerability
Piperia yadonii	0.72	0.44	0.66	0.39
Plagiobothrys uncinatus	0.46	0.39	0.66	0.5
Pogogyne abramsii	0.88	0.32	0.56	0.41
Pogogyne clareana	0.56	0.25	0.88	0.44
Ribes thacherianum	0.56	0.75	0.68	0.34
Ribes viburnifolium	0.41	0.65	0.67	0.42
Rosa pinetorum	0.4	0.54	0.68	0.46
Salvia greatae	0.55	0.42	0.76	0.42
Salvia munzii	0.4	0.51	0.69	0.47
Sanicula maritima	0.38	0.46	0.62	0.51
Scrophularia atrata	0.43	0.32	0.68	0.52
Sibara filifolia	0.87	0.54	0.69	0.3
Sphaerocarpos drewei	0.47	0.5	0.68	0.45
Stebbinsoseris decipiens	0.39	0.51	0.67	0.48
Streptanthus albidus ssp. per-amoenus	0.42	0.42	0.72	0.48
Symphyotrichum defoliatum	0.44	0.48	0.68	0.47
Symphyotrichum greatae	0.54	0.48	0.68	0.43
Thysanocarpus conchuliferus	1	0.75	0.69	0.19
Trifolium buckwestiorum	0.41	0.52	0.67	0.47
Trifolium dedeckerae	0.56	0.48	0.71	0.41
Trifolium hydrophilum	0.38	0.45	0.68	0.5
Trifolium polyodon	0.38	0.46	0.65	0.51
Triphysaria floribunda	0.41	0.67	0.66	0.42
Triteleia clementina	0.56	0.27	0.68	0.5
Tropidocarpum capparideum	0.39	0.25	0.71	0.55

Table A5. Estimated species' level one and overall threat impact categories based on NatureServe guidance, as well as ordinal threat impact values assigned based on the product of threat severity and scope. Mean and standardized overall threat impact values are also shown.

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Abies bracteata	MEDIUM (6)		LOW (3)	MEDIUM (6)	MEDIUM (6)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.55	0.65	VERY HIGH
Acmispon dendroideus var. traskiae	MEDIUM (6)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.55	0.48	VERY HIGH
Acmispon prostratus	HIGH (12)			HIGH (12)		HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	7.91	0.68	VERY HIGH
Agave shawii var. shawii	HIGH (12)			HIGH (9)		HIGH (9)	VERY HIGH (16)	HIGH (12)	MEDIUM (8)	HIGH (12)	HIGH (12)	8.18	0.7	VERY HIGH
Agrostis hooveri	MEDIUM (8)		HIGH (12)	HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.36	0.8	VERY HIGH
Allium hickmanii	HIGH (9)		LOW (2)	HIGH (12)	LOW (2)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.91	0.68	VERY HIGH
Ancistrocarphus keilii			HIGH (9)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.64	0.74	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Arctostaphylos glandulosa ssp. crassifolia	HIGH (12)			HIGH (9)		HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.55	0.65	VERY HIGH
Arctostaphylos montereyensis	HIGH (12)		HIGH (9)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.73	0.84	VERY HIGH
Arctostaphylos pajaroensis	HIGH (12)		HIGH (9)	HIGH (12)	HIGH (9)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.45	0.81	VERY HIGH
Arctostaphylos pumila	HIGH (12)		LOW (3)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	7.73	0.66	VERY HIGH
Arctostaphylos purissima	MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Arctostaphylos rainbowensis	MEDIUM (6)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	8	0.69	VERY HIGH
Arctostaphylos rudis	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH
Aristocapsa insignis	MEDIUM (8)		HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	HIGH (12)	9.09	0.78	VERY HIGH
Astragalus jaegerianus				MEDIUM (6)		HIGH (9)	HIGH (12)	VERY HIGH (16)	HIGH (12)	HIGH (9)	HIGH (12)	6.91	0.59	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Astragalus pycnostachyus var. pycnostachyus	HIGH (9)			HIGH (9)		HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (8)	HIGH (12)	HIGH (12)	7.55	0.65	VERY HIGH
Astragalus tener var. ferrisiae	HIGH (9)	HIGH (12)	HIGH (9)	HIGH (9)	LOW (4)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (6)	HIGH (12)	9.36	0.8	VERY HIGH
Astragalus tener var. tener	HIGH (9)		MEDIUM (6)	HIGH (9)		HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	LOW (4)	HIGH (12)	7.73	0.66	VERY HIGH
Astragalus tener var. titi	VERY HIGH (16)			HIGH (12)		HIGH (9)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	HIGH (9)	HIGH (12)	7.64	0.66	VERY HIGH
Atriplex depressa	HIGH (9)		MEDIUM (6)	HIGH (9)	LOW (2)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (6)	HIGH (12)	8.09	0.7	VERY HIGH
Baccharis vanessae	HIGH (9)		LOW (3)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.09	0.7	VERY HIGH
Berberis pinnata ssp. insularis	LOW (4)			MEDIUM (8)		VERY HIGH (16)		HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	6	0.52	VERY HIGH
Bergerocactus emoryi	HIGH (9)			HIGH (9)		HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (12)	MEDIUM (8)	7	0.6	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Bloomeria clevelandii	HIGH (9)		LOW (3)	HIGH (9)	LOW (2)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8	0.69	VERY HIGH
Boechera hoffmannii	MEDIUM (8)			LOW (4)		HIGH (12)		MEDIUM (8)	MEDIUM (8)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Brodiaea filifolia	HIGH (9)		LOW (3)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.09	0.7	VERY HIGH
Brodiaea kinkiensis	MEDIUM (6)			HIGH (9)		HIGH (12)		MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	6.09	0.52	VERY HIGH
Brodiaea orcuttii	HIGH (9)		LOW (3)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.36	0.72	VERY HIGH
Calochortus obispoensis	MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Calochortus simulans	MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Calycadenia micrantha	MEDIUM (8)	VERY HIGH (16)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	11.64	1	VERY HIGH
Camissoniopsis hardhamiae	HIGH (12)		HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.73	0.84	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Castilleja grisea	LOW (4)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.36	0.46	VERY HIGH
Ceanothus cyaneus	HIGH (9)		MEDIUM (6)	HIGH (9)	LOW (4)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.45	0.73	VERY HIGH
Ceanothus otayensis	MEDIUM (6)		LOW (3)	HIGH (12)	LOW (3)	MEDIUM (8)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8	0.69	VERY HIGH
Ceanothus verrucosus	HIGH (12)		LOW (3)	HIGH (12)	LOW (3)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.36	0.72	VERY HIGH
Chenopodium littoreum	HIGH (9)			MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	7.36	0.63	VERY HIGH
Chlorogalum purpureum var. purpureum	MEDIUM (8)		HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	9	0.77	VERY HIGH
Chloropyron maritimum ssp. maritimum	HIGH (12)		MEDIUM (6)	HIGH (9)	LOW (2)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.64	0.74	VERY HIGH
Chorizanthe orcuttiana	VERY HIGH (16)			MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (12)	MEDIUM (8)	HIGH (12)	HIGH (12)	7.64	0.66	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Chorizanthe pungens var. pungens	HIGH (12)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.73	0.75	VERY HIGH
Chorizanthe rectispina	HIGH (9)		HIGH (12)	HIGH (9)	MEDIUM (6)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Cirsium fontinale var. obispoense	MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Cirsium rhothophilum	MEDIUM (6)		MEDIUM (6)	HIGH (9)		HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.18	0.7	VERY HIGH
Cirsium scariosum var. loncholepis	MEDIUM (6)		HIGH (9)	HIGH (9)	LOW (3)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	HIGH (12)	8.09	0.7	VERY HIGH
Clarkia jolonensis	HIGH (12)		MEDIUM (6)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	9.55	0.82	VERY HIGH
Clinopodium chandleri	MEDIUM (6)		LOW (3)	HIGH (9)	LOW (4)	HIGH (9)	VERY HIGH (16)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.27	0.71	VERY HIGH
Collinsia antonina	MEDIUM (6)		HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.73	0.84	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Crocanthemum greenei	LOW (2)			MEDIUM (6)		HIGH (12)		HIGH (12)	MEDIUM (8)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Cryptantha traskiae	HIGH (9)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.82	0.5	VERY HIGH
Cymopterus deserticola	MEDIUM (6)			HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (6)	MEDIUM (8)	7	0.6	VERY HIGH
Deinandra increscens ssp. villosa	MEDIUM (8)		LOW (4)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.09	0.7	VERY HIGH
Deinandra mohavensis	MEDIUM (6)		MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH
Delphinium recurvatum	HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (9)	LOW (3)	LOW (3)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	9	0.77	VERY HIGH
Delphinium variegatum ssp. kinkiense	LOW (4)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.36	0.46	VERY HIGH
Dicranostegia orcuttiana	HIGH (12)			HIGH (9)		HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.18	0.7	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Diplacus brandegeei						VERY HIGH (16)		HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Diplacus mohavensis	MEDIUM (6)			HIGH (9)		MEDIUM (6)	HIGH (12)	MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	6.64	0.57	VERY HIGH
Diplacus vandenbergensis	MEDIUM (8)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.36	0.8	VERY HIGH
Dissanthelium californicum	HIGH (9)			HIGH (9)		MEDIUM (6)		HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	5.64	0.48	VERY HIGH
Dithyrea maritima	MEDIUM (6)		LOW (3)	LOW (4)		HIGH (9)	HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (12)	6.64	0.57	VERY HIGH
Dudleya multicaulis	HIGH (9)		LOW (3)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.09	0.7	VERY HIGH
Dudleya nesiotica						VERY HIGH (16)		HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Dudleya variegata	HIGH (9)		LOW (3)	HIGH (9)	LOW (3)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.09	0.7	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Dudleya viscida	HIGH (9)			HIGH (9)	MEDIUM (6)	HIGH (9)	VERY HIGH (16)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.45	0.73	VERY HIGH
Entosthodon kochii	MEDIUM (8)	HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	10.55	0.91	VERY HIGH
Eriastrum luteum	MEDIUM (6)		HIGH (9)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	8.82	0.76	VERY HIGH
Eriastrum rosamondense	HIGH (9)			HIGH (9)		MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (6)	HIGH (12)	7.09	0.61	VERY HIGH
Ericameria fasciculata	HIGH (12)		HIGH (9)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.45	0.81	VERY HIGH
Erigeron blochmaniae	HIGH (9)		MEDIUM (6)	MEDIUM (6)	LOW (2)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.36	0.72	VERY HIGH
Eriodictyon capitatum	MEDIUM (8)		HIGH (9)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	8.73	0.75	VERY HIGH
Eriophyllum mohavense	MEDIUM (6)			HIGH (9)		HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	7.36	0.63	VERY HIGH
Eryngium aristulatum var. parishii	HIGH (12)		LOW (3)	HIGH (12)	LOW (3)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (9)	MEDIUM (8)	8.09	0.7	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Eryngium pendletonense	HIGH (12)			MEDIUM (8)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8	0.69	VERY HIGH
Erysimum ammophilum	HIGH (12)		LOW (3)	HIGH (9)	LOW (2)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8	0.69	VERY HIGH
Erythranthe hardhamiae	MEDIUM (8)		MEDIUM (6)	HIGH (12)	MEDIUM (8)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9	0.77	VERY HIGH
Extriplex joaquinana	HIGH (9)		MEDIUM (6)	HIGH (9)	LOW (3)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.18	0.7	VERY HIGH
Fritillaria ojaiensis	HIGH (9)		MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	VERY HIGH (16)	HIGH (12)	MEDIUM (8)	9.82	0.84	VERY HIGH
Fritillaria viridea	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH
Galium buxifolium	MEDIUM (6)			LOW (4)		VERY HIGH (16)		HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	5.82	0.5	VERY HIGH
Galium clementis	LOW (2)			HIGH (12)	MEDIUM (6)	MEDIUM (6)	HIGH (12)	HIGH (12)	VERY HIGH (16)	HIGH (12)	MEDIUM (8)	7.82	0.67	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Geothallus tuberosus	HIGH (12)			HIGH (12)		MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	7.18	0.62	VERY HIGH
Gilia tenuiflora ssp. arenaria	HIGH (12)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (9)	HIGH (12)	MEDIUM (8)	8.36	0.72	VERY HIGH
Grindelia hallii	HIGH (12)		LOW (4)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.27	0.8	VERY HIGH
Hazardia cana	LOW (2)			LOW (3)		HIGH (12)		MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	5.18	0.45	VERY HIGH
Hypogymnia schizidiata	MEDIUM (6)			HIGH (12)		HIGH (12)		MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	6.36	0.55	VERY HIGH
Isocoma arguta	HIGH (9)		LOW (4)	HIGH (12)		LOW (3)	HIGH (12)	HIGH (12)	HIGH (12)	LOW (4)	HIGH (12)	7.27	0.63	VERY HIGH
Lasthenia conjugens	HIGH (9)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (6)	HIGH (12)	8.45	0.73	VERY HIGH
Lavatera assurgentiflora ssp. assurgentiflora	LOW (4)			MEDIUM (8)		MEDIUM (6)		MEDIUM (8)	LOW (4)	HIGH (12)	MEDIUM (8)	4.55	0.39	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Lavatera assurgentiflora ssp. glabra	HIGH (9)			HIGH (9)		HIGH (9)		HIGH (12)	HIGH (9)	HIGH (12)	MEDIUM (8)	6.18	0.53	VERY HIGH
Layia carnosa	HIGH (9)			HIGH (9)		HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	7.91	0.68	VERY HIGH
Layia heterotricha	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH
Layia jonesii	HIGH (12)		LOW (2)	HIGH (9)	LOW (2)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.91	0.68	VERY HIGH
Legenere limosa	MEDIUM (6)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.45	0.73	VERY HIGH
Leptosiphon rosaceus	HIGH (9)			HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.18	0.7	VERY HIGH
Leptosyne maritima	HIGH (12)			MEDIUM (6)		HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	7.64	0.66	VERY HIGH
Linanthus maculatus ssp. maculatus	HIGH (9)		LOW (2)	HIGH (12)		HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.36	0.72	VERY HIGH
Lithophragma maximum						HIGH (12)		MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	4.73	0.41	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Malacothamnus abbottii	HIGH (12)		HIGH (12)	HIGH (12)	HIGH (12)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	9.82	0.84	VERY HIGH
Malacothamnus clementinus	MEDIUM (6)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	MEDIUM (8)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Malacothamnus davidsonii	HIGH (12)		MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.73	0.84	VERY HIGH
Malacothamnus fasciculatus var. nesioticus	HIGH (9)			HIGH (9)		VERY HIGH (16)		HIGH (12)	MEDIUM (8)	HIGH (12)	MEDIUM (8)	6.73	0.58	VERY HIGH
Malacothrix indecora						HIGH (9)		MEDIUM (8)		MEDIUM (8)	MEDIUM (8)	3	0.26	VERY HIGH
Malacothrix similis	HIGH (12)			MEDIUM (6)		HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	6.45	0.55	VERY HIGH
Malacothrix squalida	LOW (4)					MEDIUM (8)		MEDIUM (8)	LOW (4)	MEDIUM (8)	MEDIUM (8)	3.64	0.31	HIGH
Microseris paludosa	HIGH (9)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.64	0.74	VERY HIGH
Monardella palmeri	MEDIUM (6)		MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.64	0.74	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Monardella undulata ssp. undulata	MEDIUM (6)		MEDIUM (6)	HIGH (12)	LOW (4)	HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	MEDIUM (8)	7.73	0.66	VERY HIGH
Monardella viminea	HIGH (12)		LOW (3)	HIGH (12)	LOW (4)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9	0.77	VERY HIGH
Nasturtium gambelii	HIGH (9)		MEDIUM (6)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	9.27	0.8	VERY HIGH
Navarretia fossalis	HIGH (12)		LOW (3)	HIGH (9)	LOW (2)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.09	0.7	VERY HIGH
Navarretia prostrata	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	9.27	0.8	VERY HIGH
Orcuttia californica	HIGH (12)		LOW (2)	HIGH (9)	LOW (3)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (9)	MEDIUM (8)	7.45	0.64	VERY HIGH
Penstemon albomarginatus	MEDIUM (6)			HIGH (9)		HIGH (9)	HIGH (12)	VERY HIGH (16)	HIGH (12)	HIGH (9)	MEDIUM (8)	7.36	0.63	VERY HIGH
Phacelia floribunda	LOW (4)			HIGH (9)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.64	0.48	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Phacelia stellaris	VERY HIGH (16)		LOW (4)	HIGH (12)		HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.64	0.74	VERY HIGH
Pholisma sonorae	HIGH (9)		LOW (3)	HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.18	0.7	VERY HIGH
Pinus radiata	MEDIUM (6)		MEDIUM (6)	MEDIUM (6)	MEDIUM (6)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.82	0.67	VERY HIGH
Piperia yadonii	HIGH (12)		MEDIUM (6)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	8.82	0.76	VERY HIGH
Plagiobothrys uncinatus	MEDIUM (6)		MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Pogogyne abramsii	HIGH (12)			HIGH (12)		HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	7.73	0.66	VERY HIGH
Pogogyne clareana	MEDIUM (8)		HIGH (9)	HIGH (12)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	9.27	0.8	VERY HIGH
Ribes thacherianum						HIGH (12)		HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	4.55	0.39	VERY HIGH
Ribes viburnifolium	MEDIUM (6)			MEDIUM (6)				HIGH (12)	HIGH (9)	HIGH (12)	MEDIUM (8)	4.82	0.41	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Rosa pinetorum	HIGH (12)		LOW (2)	MEDIUM (8)	MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	8.55	0.73	VERY HIGH
Salvia greatae				HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7	0.6	VERY HIGH
Salvia munzii	HIGH (9)			MEDIUM (6)		HIGH (9)	VERY HIGH (16)	HIGH (12)	HIGH (12)	MEDIUM (8)	MEDIUM (8)	7.27	0.63	VERY HIGH
Sanicula maritima	HIGH (9)			HIGH (9)	LOW (2)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.73	0.66	VERY HIGH
Scrophularia atrata	HIGH (12)		HIGH (9)	HIGH (12)	LOW (4)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.27	0.8	VERY HIGH
Sibara filifolia	MEDIUM (6)			MEDIUM (6)		HIGH (9)		HIGH (12)	MEDIUM (6)	HIGH (12)	MEDIUM (8)	5.36	0.46	VERY HIGH
Sphaerocarpos drewei	HIGH (12)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (9)	MEDIUM (6)	MEDIUM (8)	9.18	0.79	VERY HIGH
Stebbinsoseris decipiens	HIGH (9)		LOW (4)	HIGH (12)	LOW (4)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.55	0.73	VERY HIGH
Streptanthus albidus ssp. peramoenus	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Symphyotrichum defoliatum	HIGH (12)		MEDIUM (6)	HIGH (12)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.45	0.81	VERY HIGH
Symphyotrichum greatae	HIGH (9)		MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	9.18	0.79	VERY HIGH
Thysanocarpus conchuliferus						VERY HIGH (16)		HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	5.45	0.47	VERY HIGH
Trifolium buckwestiorum	HIGH (9)		HIGH (9)	HIGH (9)	HIGH (9)	MEDIUM (6)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.91	0.77	VERY HIGH
Trifolium dedeckerae		HIGH (12)	LOW (4)	MEDIUM (6)	MEDIUM (6)	HIGH (12)	VERY HIGH (16)	MEDIUM (8)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.73	0.75	VERY HIGH
Trifolium hydrophilum	HIGH (9)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	8.45	0.73	VERY HIGH
Trifolium polyodon	HIGH (9)		MEDIUM (6)	HIGH (9)	MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	8.36	0.72	VERY HIGH
Triphysaria floribunda	HIGH (9)			HIGH (9)		HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	HIGH (12)	MEDIUM (8)	7.82	0.67	VERY HIGH

Scientific Name	Level One Threat Impact Categories (ordinal impact values based on the product of threat severity and scope)											Mean Overall Threat Impact Value	Standardized Mean Overall Threat Impact	NatureServe Overall Threat Impact Category
	Development	Agriculture	Energy and Mining	Transportation and Utility	Logging	Human Intrusion and Disturbance	Fire Regime Change	Invasive Species	Pollution	Geologic Events	Climate Change			
Triteleia clementina	MEDIUM (6)			MEDIUM (6)		HIGH (12)		MEDIUM (8)	HIGH (9)	HIGH (12)	MEDIUM (8)	5.55	0.48	VERY HIGH
Tropidocarpum capparideum	HIGH (12)		MEDIUM (6)	HIGH (12)	MEDIUM (6)	HIGH (9)	HIGH (9)	HIGH (12)	HIGH (12)	HIGH (9)	HIGH (12)	9	0.77	VERY HIGH

Table A6. Complete list of standardized criteria and objective values used in the MCDA to estimate species' priority scores. Note, criteria values do not include the applied weightings, while objective (i.e. Listing Risk and Impact Risk) and overall priority scores reflect weights applied at lower levels of the decision hierarchy. * = top 10% across DoD, ** = top 10% across Service

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
AIR FORCE ACTIVE										
Beale Air Force Base										
Legenere limosa	0.490	0.791	0.727	0.669	0.051	0.040	0.001	0.034	0.352	0.550
Edwards Air Force Base										
Cymopterus deserticola *,**	0.442	0.854	0.602	0.633	1	0.720	0.002	0.646	0.640	1
Eriastrum rosamondense	0.946	0.888	0.609	0.814	0.034	0.250	0	0.107	0.461	0.720
Eriophyllum mohavense	0.544	0.728	0.633	0.635	0.322	0.284	0	0.227	0.431	0.673
Pillar Point AFS										
Astragalus pycnostachyus var. pycnostachyus	0.830	0.667	0.648	0.715	0.017	0.040	0.182	0.067	0.391	0.611
Travis Air Force Base										
Astragalus tener var. tener	0.626	0.770	0.664	0.687	0.017	0.018	0.002	0.014	0.351	0.548
Lasthenia conjugens	0.823	0.634	0.727	0.728	0.034	0.077	0.003	0.042	0.385	0.602
Vandenberg Air Force Base										
Agrostis hooveri	0.796	0.850	0.805	0.817	0.068	0.133	0	0.075	0.446	0.697
Ancistrocarphus keilii **	0.986	0.857	0.742	0.862	0.017	0.500	0	0.194	0.528	0.825
Arctostaphylos purissima	0.721	0.845	0.766	0.777	0.220	0.317	0.001	0.202	0.490	0.766
Arctostaphylos rudis	0.755	0.881	0.789	0.808	0.186	0.306	0.001	0.185	0.497	0.777
Chenopodium littoreum	0.918	0.785	0.633	0.779	0.051	0.250	0	0.113	0.446	0.697
Chorizanthe rectispina	0.741	0.843	0.766	0.783	0.034	0.053	0	0.033	0.408	0.638

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Cirsium rhothophilum	0.864	0.517	0.703	0.695	0.153	0.450	0.001	0.226	0.461	0.720
Cirsium scariosum var. loncholepis	0.884	0.677	0.695	0.752	0.017	0.059	0	0.029	0.391	0.611
Deinandra increscens ssp. villosa *,**	0.667	0.636	0.695	0.666	0.525	0.633	0.003	0.435	0.551	0.861
Diplacus vandenbergensis	0.912	0.572	0.805	0.763	0.102	0.462	0	0.212	0.488	0.763
Dithyrea maritima	0.83	0.628	0.57	0.676	0.085	0.200	0	0.107	0.392	0.613
Erigeron blochmaniae	0.857	0.740	0.719	0.772	0.051	0.143	0	0.073	0.423	0.661
Eriodictyon capitatum	0.959	0.624	0.750	0.778	0.051	0.500	0	0.207	0.493	0.770
Layia carnosa	0.864	0.448	0.680	0.664	0.051	0.150	0	0.075	0.370	0.578
Layia heterotricha	0.170	0.721	0.789	0.560	0.017	0.008	0	0.009	0.285	0.445
Monardella undulata ssp. undulata	0.837	0.784	0.664	0.762	0.203	0.500	0.001	0.264	0.513	0.802
Nasturtium gambelii	0.959	0.633	0.797	0.796	0.034	0.333	0	0.138	0.467	0.730
Scrophularia atrata	0.585	0.823	0.797	0.735	0.356	0.344	0.002	0.263	0.499	0.780
Symphyotrichum defoliatum	0.395	0.733	0.813	0.647	0.017	0.011	0	0.011	0.329	0.514
ARMY ACTIVE										
NTC and Fort Irwin										
Astragalus jaegerianus	0.850	0.477	0.594	0.640	0.169	0.455	0	0.234	0.437	0.683
Cymopterus deserticola	0.442	0.854	0.602	0.633	0.017	0.012	0	0.011	0.322	0.503
Ord Military Community										
Chorizanthe pungens var. pungens **	0.660	0.615	0.750	0.675	0.017	0.020	1	0.264	0.470	0.734

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Presidio Of Monterey										
Arctostaphylos pumila	0.884	0.823	0.664	0.790	0.017	0.059	0.020	0.034	0.412	0.644
Piperia yadonii	0.830	0.620	0.758	0.736	0.034	0.080	0.040	0.053	0.395	0.617
ARMY GUARD										
ITC Camp San Luis Obisbo										
Calochortus obispoensis	0.735	0.800	0.766	0.767	0.119	0.179	0.01	0.114	0.441	0.689
Calochortus simulans	0.415	0.748	0.766	0.643	0.034	0.023	0.003	0.022	0.333	0.520
Cirsium fontinale var. obispoense	0.857	0.607	0.766	0.743	0.034	0.095	0.003	0.049	0.396	0.619
Layia jonesii	0.830	0.854	0.680	0.788	0.034	0.080	0.003	0.044	0.416	0.650
Monardella palmeri	0.837	0.753	0.742	0.777	0.051	0.125	0.004	0.067	0.422	0.659
Streptanthus albidus ssp. peramoenus	0.299	0.758	0.789	0.615	0.034	0.019	0.003	0.021	0.318	0.497
MTC-H Camp Roberts										
Camissoniopsis hardhamiae	0.85	0.825	0.836	0.837	0.017	0.045	0	0.023	0.430	0.672
Chlorogalum purpureum var. purpureum	0.884	0.542	0.773	0.733	0.017	0.059	0	0.029	0.381	0.595
Chorizanthe rectispina	0.741	0.843	0.766	0.783	0.034	0.053	0	0.033	0.408	0.638
Entosthodon kochii **	0.973	0.839	0.906	0.906	0.017	0.250	0	0.100	0.503	0.786
Eriastrum luteum	0.776	0.83	0.758	0.788	0.017	0.030	0	0.018	0.403	0.630
Malacothamnus davidsonii	0.537	0.792	0.836	0.722	0.017	0.015	0	0.012	0.367	0.573
Navarretia prostrata	0.612	0.745	0.797	0.718	0.051	0.053	0.001	0.039	0.379	0.592
Plagiobothrys uncinatus **	0.905	0.781	0.766	0.817	0.034	0.143	0	0.066	0.442	0.691
Stebbinsoseris decipiens	0.871	0.747	0.734	0.784	0.017	0.053	0	0.026	0.405	0.633

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
ARMY RESERVE										
Fort Hunter Liggett										
Abies bracteata	0.456	0.683	0.648	0.596	0.034	0.025	0	0.022	0.309	0.483
Aristocapsa insignis	0.966	0.843	0.781	0.863	0.017	0.200	0	0.081	0.472	0.738
Calycadenia micrantha	0.850	0.691	1	0.847	0.051	0.136	0	0.070	0.459	0.717
Camissoniopsis hardhamiae	0.850	0.825	0.836	0.837	0.034	0.091	0	0.047	0.442	0.691
Chlorogalum purpureum var. purpureum *,**	0.884	0.542	0.773	0.733	0.254	0.882	0.001	0.426	0.580	0.906
Clarkia jolonensis	0.844	0.778	0.82	0.814	0.034	0.087	0	0.045	0.430	0.672
Collinsia antonina *	0.946	0.766	0.836	0.849	0.085	0.625	0	0.266	0.558	0.872
Eriastrum luteum	0.776	0.830	0.758	0.788	0.169	0.303	0	0.177	0.483	0.755
Erythranthe hardhamiae *	0.959	0.826	0.773	0.853	0.051	0.500	0	0.207	0.530	0.828
Fritillaria ojaiensis	0.667	0.701	0.844	0.737	0.051	0.061	0	0.042	0.390	0.609
Fritillaria viridea	0.837	0.694	0.789	0.773	0.068	0.167	0	0.088	0.431	0.673
Layia heterotricha	0.170	0.721	0.789	0.560	0.034	0.016	0	0.019	0.290	0.453
Malacothamnus davidsonii	0.537	0.792	0.836	0.722	0.153	0.132	0	0.107	0.415	0.648
Monardella palmeri	0.837	0.753	0.742	0.777	0.051	0.125	0	0.066	0.422	0.659
Navarretia prostrata	0.612	0.745	0.797	0.718	0.068	0.070	0	0.052	0.385	0.602
Plagiobothrys uncinatus	0.905	0.781	0.766	0.817	0.051	0.214	0	0.099	0.458	0.716
Pogogyne clareana *,*	0.959	0.689	0.797	0.815	0.102	1	0	0.413	0.614	0.959
Streptanthus albidus ssp. peramoenus	0.299	0.758	0.789	0.615	0.119	0.068	0	0.070	0.343	0.536
Tropidocarpum capparideum	0.912	0.862	0.773	0.849	0.068	0.308	0	0.141	0.495	0.773

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
MARINE CORPS ACTIVE										
Choc Mt Air Gunnery Range										
Salvia greatae	0.83	0.667	0.602	0.700	0.169	0.400	0	0.213	0.457	0.714
MCAS Miramar										
Arctostaphylos glandulosa ssp. crassifolia	0.619	0.625	0.648	0.631	0.186	0.196	0.004	0.144	0.388	0.606
Bloomeria clevelandii	0.245	0.766	0.688	0.566	0.441	0.234	0.009	0.255	0.411	0.642
Brodiaea orcuttii	0.129	0.772	0.719	0.540	0.305	0.141	0.006	0.169	0.355	0.555
Ceanothus otayensis	0.823	0.700	0.688	0.737	0.017	0.038	0	0.021	0.379	0.592
Ceanothus verrucosus	0.524	0.814	0.719	0.686	0.051	0.043	0.001	0.036	0.361	0.564
Dudleya variegata	0.259	0.776	0.695	0.577	0.051	0.028	0.001	0.030	0.304	0.475
Eryngium aristulatum var. parishii	0.517	0.676	0.695	0.629	0.203	0.169	0.004	0.141	0.385	0.602
Monardella viminea *	0.803	0.606	0.773	0.727	0.254	0.517	0.005	0.29	0.509	0.795
Navarretia fossalis	0.503	0.698	0.695	0.632	0.068	0.055	0.001	0.046	0.339	0.53
Navarretia prostrata	0.612	0.745	0.797	0.718	0.017	0.018	0	0.013	0.366	0.572
Orcuttia californica	0.776	0.732	0.641	0.716	0.051	0.091	0.001	0.054	0.385	0.602
Pogogyne abramsii *	0.85	0.649	0.664	0.721	0.186	0.500	0.004	0.258	0.490	0.766
MCB Camp Pendleton										
Acmispon prostratus	0.769	0.765	0.68	0.738	0.068	0.118	0	0.070	0.404	0.631
Arctostaphylos rainbowensis	0.395	0.806	0.688	0.630	0.169	0.112	0.001	0.106	0.368	0.575
Astragalus tener var. titi	0.959	0.650	0.656	0.755	0.017	0.167	0	0.069	0.412	0.644
Baccharis vanessae	0.823	0.618	0.695	0.712	0.017	0.038	0	0.021	0.367	0.573

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Brodiaea filifolia	0.129	0.647	0.695	0.490	0.780	0.359	0.003	0.428	0.459	0.717
Brodiaea orcuttii	0.129	0.772	0.719	0.540	0.034	0.016	0	0.019	0.280	0.438
Dudleya multicaulis	0	0.750	0.695	0.482	0.508	0.204	0.002	0.268	0.375	0.586
Dudleya viscida	0.789	0.689	0.727	0.735	0.102	0.194	0	0.111	0.423	0.661
Eryngium aristulatum var. parishii	0.517	0.676	0.695	0.629	0.153	0.127	0.001	0.105	0.367	0.573
Eryngium pendletonense *,**	0.973	0.754	0.688	0.805	0.068	1	0	0.401	0.603	0.942
Erysimum ammophilum	0.605	0.721	0.688	0.671	0.119	0.121	0	0.090	0.381	0.595
Leptosyne maritima	0.673	0.751	0.656	0.693	0.051	0.063	0	0.043	0.368	0.575
Navarretia fossalis	0.503	0.698	0.695	0.632	0.085	0.068	0	0.057	0.345	0.539
Navarretia prostrata	0.612	0.745	0.797	0.718	0.034	0.035	0	0.026	0.372	0.581
Phacelia stellaris	0.898	0.792	0.742	0.811	0.017	0.067	0	0.032	0.422	0.659
MCLB Barstow										
Diplacus mohavensis	0.592	0.700	0.570	0.621	0.017	0.017	0.002	0.013	0.317	0.495
Twentynine Palms Main Base										
Penstemon albomarginatus	0.844	0.790	0.633	0.756	0.017	0.043	0	0.023	0.390	0.609
NAVY ACTIVE										
Former NAVPHIBASE Coronado										
Phacelia stellaris	0.898	0.792	0.742	0.811	0.017	0.067	0.012	0.035	0.423	0.661
NAF El Centro										
Pholisma sonorae	0.905	0.730	0.703	0.779	0.034	0.143	0.001	0.067	0.423	0.661
Naval Medical Center San Diego										
Geothallus tuberosus	0.973	0.731	0.617	0.774	0.017	0.25	0.105	0.126	0.450	0.703

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Pogogyne abramsii	0.85	0.649	0.664	0.721	0.017	0.045	0.105	0.05	0.386	0.603
Sphaerocarpos drewei	0.98	0.712	0.789	0.827	0.017	0.333	0.105	0.158	0.493	0.77
NAVBASE Ventura City Point Mugu										
Chloropyron maritimum ssp. maritimum	0.810	0.473	0.742	0.675	0.051	0.107	0.006	0.061	0.368	0.575
NAVPHIBASE Seal Side										
Astragalus tener var. titi	0.959	0.650	0.656	0.755	0.017	0.167	0.024	0.075	0.415	0.648
Chloropyron maritimum ssp. maritimum	0.810	0.473	0.742	0.675	0.017	0.036	0.024	0.026	0.351	0.548
NAVSUPPDET Monterey										
Chorizanthe pungens var. pungens	0.660	0.615	0.75	0.675	0.017	0.02	0.042	0.024	0.350	0.547
Erysimum ammophilum	0.605	0.721	0.688	0.671	0.017	0.017	0.042	0.023	0.347	0.542
Gilia tenuiflora ssp. arenaria	0.816	0.556	0.719	0.697	0.017	0.037	0.042	0.031	0.364	0.569
NAWS China Lake										
Cymopterus deserticola	0.442	0.854	0.602	0.633	0.017	0.012	0	0.011	0.322	0.503
Trifolium dedeckerae	0.905	0.651	0.750	0.769	0.017	0.071	0	0.033	0.401	0.627
NB Coronado										
Acmispon prostratus	0.769	0.765	0.68	0.738	0.051	0.088	0.009	0.054	0.396	0.619
Phacelia stellaris	0.898	0.792	0.742	0.811	0.017	0.067	0.003	0.032	0.422	0.659
NB Coronado Cleveland NF Survival Training										
Brodiaea orcuttii	0.129	0.772	0.719	0.540	0.034	0.016	0.003	0.020	0.280	0.438
Deinandra mohavensis	0.483	0.688	0.789	0.653	0.085	0.066	0.007	0.058	0.356	0.556

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Symphyotrichum defoliatum	0.395	0.733	0.813	0.647	0.017	0.011	0.001	0.011	0.329	0.514
NB Coronado Imperial Beach										
Chloropyron maritimum ssp. maritimum	0.810	0.473	0.742	0.675	0.017	0.036	0.007	0.022	0.349	0.545
NB Coronado Silver Strand										
Dudleya variegata	0.259	0.776	0.695	0.577	0.017	0.009	0.015	0.014	0.296	0.463
Leptosyne maritima	0.673	0.751	0.656	0.693	0.017	0.021	0.015	0.018	0.356	0.556
NB Point Loma										
Acmispon prostratus	0.769	0.765	0.680	0.738	0.017	0.029	0.007	0.019	0.379	0.592
Agave shawii var. shawii	0.959	0.680	0.703	0.781	0.051	0.500	0.021	0.212	0.497	0.777
Bergerocactus emoryi	0.524	0.730	0.602	0.619	0.034	0.029	0.014	0.027	0.323	0.505
Ceanothus verrucosus	0.524	0.814	0.719	0.686	0.017	0.014	0.007	0.013	0.350	0.547
Chorizanthe orcuttiana	0.912	0.563	0.656	0.710	0.068	0.308	0.027	0.148	0.429	0.670
Erysimum ammophilum	0.605	0.721	0.688	0.671	0.051	0.052	0.021	0.044	0.358	0.559
Leptosyne maritima	0.673	0.751	0.656	0.693	0.034	0.042	0.014	0.032	0.363	0.567
NB San Diego Chollas Heights Hsg										
Bloomeria clevelandii	0.245	0.766	0.688	0.566	0.017	0.009	0.108	0.037	0.302	0.472
Eryngium aristulatum var. parishii	0.517	0.676	0.695	0.629	0.017	0.014	0.108	0.039	0.334	0.522
NB San Diego Murphy Canyon										
Bloomeria clevelandii	0.245	0.766	0.688	0.566	0.017	0.009	0.012	0.013	0.290	0.453
Brodiaea orcuttii	0.129	0.772	0.719	0.540	0.017	0.008	0.012	0.012	0.276	0.431
Pogogyne abramsii	0.850	0.649	0.664	0.721	0.017	0.045	0.012	0.026	0.374	0.584

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
NB San Diego Pomerado Terrace										
Monardella viminea	0.803	0.606	0.773	0.727	0.017	0.034	0.154	0.058	0.393	0.614
NWS Seal Beach										
Chloropyron maritimum ssp. maritimum	0.810	0.473	0.742	0.675	0.017	0.036	0.002	0.020	0.348	0.544
Port Hueneme										
Chloropyron maritimum ssp. maritimum	0.810	0.473	0.742	0.675	0.017	0.036	0.005	0.021	0.348	0.544
San Clemente										
Acmispon dendroideus var. traskiae *,**	0.728	0.537	0.477	0.581	0.678	1	0.007	0.631	0.606	0.947
Bergerocactus emoryi *,**	0.524	0.73	0.602	0.619	0.847	0.714	0.009	0.588	0.604	0.944
Brodiaea kinkiensis *,**	0.884	0.764	0.523	0.724	0.288	1	0.003	0.484	0.604	0.944
Castilleja grisea *,**	0.741	0.49	0.461	0.564	0.644	1	0.007	0.618	0.591	0.923
Cryptantha traskiae	0.884	0.607	0.500	0.664	0.153	0.529	0.002	0.256	0.460	0.719
Delphinium variegatum ssp. kinkiense *	0.871	0.549	0.461	0.627	0.322	1	0.004	0.497	0.562	0.878
Dissanthelium californicum	0.952	0.595	0.484	0.677	0.017	0.143	0	0.060	0.369	0.577
Hazardia cana *,**	0.796	0.759	0.445	0.667	0.508	1	0.006	0.567	0.617	0.964
Lavatera assurgentiflora ssp. glabra	0.918	0.828	0.531	0.759	0.119	0.583	0.001	0.264	0.512	0.800
Lithophragma maximum	0.959	0.563	0.406	0.643	0.102	1	0.001	0.414	0.529	0.827
Malacothamnus clementinus *	0.891	0.526	0.469	0.629	0.271	1	0.003	0.477	0.553	0.864
Phacelia floribunda *,**	0.810	0.700	0.484	0.665	0.475	1	0.005	0.554	0.610	0.953
Sibara filifolia	0.952	0.478	0.461	0.630	0.034	0.286	0	0.120	0.375	0.586

Service/Installation	Criteria			Listing Risk	Criteria			Impact Risk	Priority score	Priority score standardized across all species
	# Species EOs	Species Vulnerability	Overall Threat Impact		# EOs On-site	% Species EOs	EO Density			
Triteleia clementina *,**	0.823	0.784	0.477	0.695	0.441	1	0.005	0.542	0.619	0.967
San Nicolas Island										
Cryptantha traskiae	0.884	0.607	0.500	0.664	0.136	0.471	0.004	0.229	0.447	0.698
Dithyrea maritima	0.830	0.628	0.570	0.676	0.068	0.16	0.002	0.086	0.381	0.595
Lavatera assurgentiflora ssp. assurgentiflora	0.959	0.615	0.391	0.655	0.017	0.167	0.001	0.069	0.362	0.566
Santa Cruz Island										
Berberis pinnata ssp. insularis	0.952	0.297	0.516	0.588	0.102	0.857	0.001	0.360	0.474	0.741
Boechera hoffmannii	0.952	0.303	0.469	0.575	0.068	0.571	0.001	0.240	0.408	0.638
Crocanthemum greenei	0.558	0.334	0.469	0.454	0.729	0.662	0.006	0.523	0.489	0.764
Diplacus brandegeei	0.993	0.532	0.469	0.665	0.017	1	0	0.381	0.523	0.817
Dudleya nesiotica	0.986	0.282	0.469	0.579	0.034	1	0	0.388	0.484	0.756
Galium buxifolium	0.884	0.316	0.500	0.567	0.220	0.765	0.002	0.370	0.469	0.733
Hypogymnia schizidiata	0.980	0.581	0.547	0.703	0.017	0.333	0	0.131	0.417	0.652
Malacothamnus fasciculatus var. nesioticus	0.946	0.327	0.578	0.617	0.136	1	0.001	0.426	0.522	0.816
Malacothrix indecora	0.952	0.279	0.258	0.496	0.034	0.286	0	0.120	0.308	0.481
Malacothrix similis	0.980	0.624	0.555	0.720	0.017	0.333	0	0.131	0.426	0.666
Malacothrix squalida	0.973	0.301	0.313	0.529	0.017	0.250	0	0.100	0.315	0.492
Ribes thacherianum *	0.918	0.532	0.391	0.614	0.203	1	0.002	0.452	0.533	0.833
Sibara filifolia	0.952	0.478	0.461	0.630	0.034	0.286	0	0.120	0.375	0.586
Thysanocarpus conchuliferus	0.898	0.296	0.469	0.554	0.254	1	0.002	0.471	0.513	0.802

REPORT DOCUMENTATION PAGE

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4. TITLE AND SUBTITLE
A Framework for Prioritizing Conservation of Listed and At-Risk Species Across Taxa and Installations: A Demonstration Using the DoD and Plant Biodiversity Hotspot of California

5a. CONTRACT NUMBER

5b. GRANT NUMBER

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14. ABSTRACT

The Department of Defense (DoD) performs proactive conservation of at-risk species as a strategy for minimizing restrictions on land use and management. The majority of listed and at-risk species (60%) on DoD lands are plants, and more than 35% of all at-risk plants occur on or near to 36 military installations and facilities in California. This regional concentration of at-risk species and DoD installations provides an ideal opportunity for a case study to demonstrate a management-prioritization framework based on the risk of species being listed and the potential impacts of listing them on the missions of affected installations. We applied established methods of threat characterization and decision analysis to generate (1) a framework for strategic prioritization of species management that is broadly applicable to other taxa and regions; (2) priority scores for 144 listed and at-risk plants on or near installations; (3) conservation strategies for high priority species; and (4) threat-impacts data.

15. SUBJECT TERMS
Military bases; Habitat conservation; Environmental management; Land use; Decision making; Endangered species; Endangered plants

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