Dune Protected Areas Network 1.0

Creating a Blueprint for Restoration in the Guadalupe Nipomo Dunes Complex

2018

Long-term Work Plan

Prepared by: The Land Conservancy of San Luis Obispo County
Updated in December 2022

Table of Contents

Chapter 1: Introduction

Conservation Strategy Overview

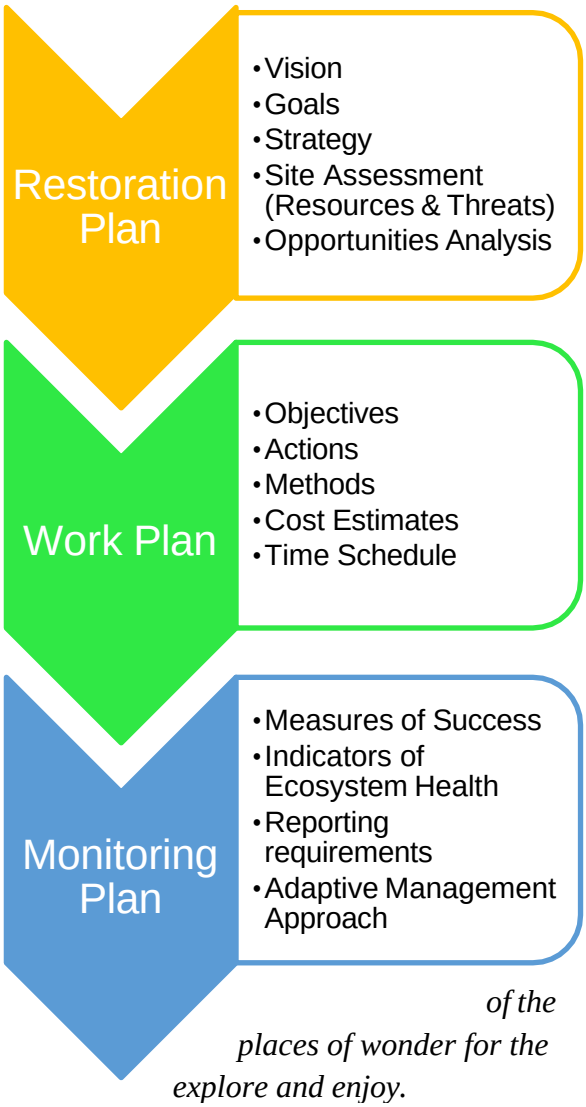
There is a regional effort underway to manage the entire Guadalupe Nipomo Dunes Complex through a partnership known as the Dunes Collaborative. This partnership is made up of federal, state, private, and non-profit organizations such as US Fish and Wildlife Service (USFWS), the Land Conservancy of San Luis Obispo County (LCSLO), Guadalupe Nipomo Dunes Center, Oceano Dunes State Vehicular Recreation Area (ODSVRA), County of Santa Barbara, State of California Coastal Conservancy and California Department of Fish and Wildlife (CDFW).

The primary purpose of this project is to develop a comprehensive Conservation Strategy for the Guadalupe Nipomo Dunes Complex (GNDC). The Conservation Strategy is comprised of three overlapping components, a *Restoration Plan*, *Work Plan*, and *Monitoring Plan*. This document is the *Work Plan* component of this Strategy.

The *Restoration Plan* outlines the concept and design of the Conservation Strategy and answers the question, what will be done? This provides the framework for the work to be accomplished. It is made up of a Vision for future conservation, Goals, and a Strategy to accomplish those Goals. These are fixed for the life of the Conservation Strategy. Also included in the Restoration Plan is a site assessment that identifies existing resources, the threats to those resources and identifies opportunities for conservation and restoration (The Land Conservancy of San Luis Obispo County, 2018).

The *Work Plan* identifies how the Conservation Strategy is implemented. It answers the essential questions: How much effort will the Conservation Strategy take? The *Work Plan* includes Objectives, Actions and Methods to achieve those Objectives as well as cost estimates. These are time dependent and fluid. Work plans are meant to change over time based on adaptive management.

The *Monitoring Plan* measures progress towards achieving our Conservation Vision and informs subsequent actions. It is essential to knowing if your management actions are working or if you need to do something different. This can also be referred to as "adaptive management".



Vision and Goals

The RTF set forth a vision for future conservation of the Guadalupe Nipomo Dunes Complex:

The Dunes Collaborative promotes connected and continuous coastal dune complexes which support a diverse and healthy native ecosystem where plants and wildlife thrive, and the dynamic nature of the dunes is preserved. These dunes will provide places of wonder for the local community, visitors, and future generations to explore and enjoy.

In order to promote this vision, the RTF identified the following goals for effective design of a Conservation Strategy:

Dune Protected Areas Network

The backbone of this conservation strategy is a network of high priority conservation areas which promote the conservations goals, called the "Dune Protected Areas Network", or DPA Network. The DPA Network is based loosely on the "Green Infrastructure Network" concept (Figure 1) used in urban environments to protect natural habitats and pathways. It is an interconnected system of protected natural areas that conserve ecosystem functions while providing benefits for wildlife (Benedict, Edward, & McMahon, 2002). Each DPA consists of *core areas* and *hubs*, which are connected by *linkages*.

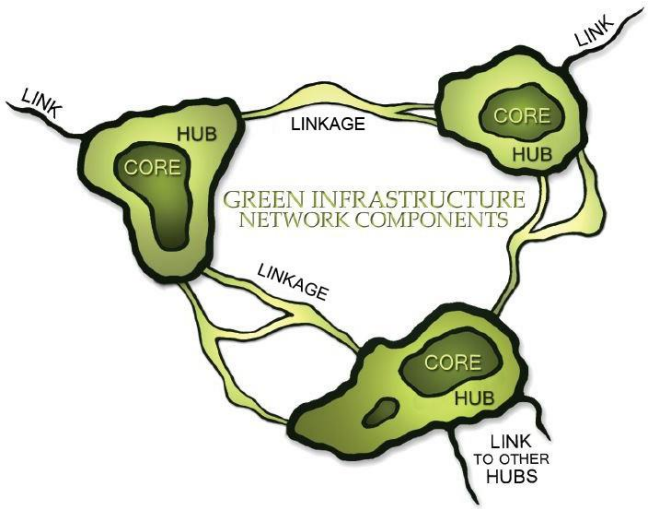


Figure 1: Green Infrastructure Network. The Dune Protected Network is roughly based on the Green Infrastructure Network used to create wildlife pathways through urban areas.

Core areas are the nucleus of the network and are chosen by their biological significance or pristine example of unique habitat. The core areas were first selected using conservation modeling software; a tool being used around the world to efficiently select unbiased areas for conservation. Consultation with the RTF, professional recommendations and available occurrence data of rare and listed species finalized the selection of each core area. These selected core areas are relatively undisturbed and have low invasive species intrusion.

Hubs buffer the core areas to offer additional protection against invasion and disturbance. These extensions of the core areas allow for less fragmentation of habitat types and offer continuous native cover. Hubs may contain multiple core areas, connecting them together as a unit.

Linkages are linear features connecting hubs together to facilitate wildlife movement, seed dispersal, and gene flow between core areas freely. Connectivity between hubs is essential for preservation of species in perpetuity. Connectivity was analyzed using Linkage Mapper software specifically designed to support regional wildlife habitat connectivity analyses (McRae & Kavanagh, 2011). The output of the software was modified to meet the needs of each DPA.

Management Strategy

The RTF has been an important advocate of the restoration and preservation of the GNDC's native ecosystem. The RTF was formed in 2001 in an effort to develop a partnership and maximize resources of federal, state, and private landowners in addressing restoration needs in the dunes following a 1998 settlement between the various State of California agencies and Unocal for injuries from contamination at the Guadalupe Oil Field which is within the GNDC. The Restoration Subcommittee (California Department of Fish and Wildlife, Office of Spill

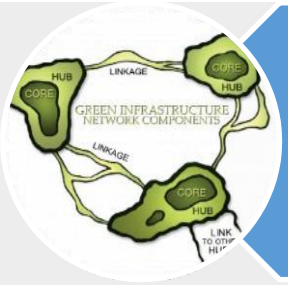
Prevention and Response, and California Coastal Conservancy) oversee the Trust and the RTF assists the Restoration Subcommittee in the restoration planning efforts and restoration project implementation. The trust currently supports both restoration efforts as well as visitor services. Of the remaining trust, 3.6 million remains to support restoration efforts in the GNDC. The Restoration Subcommittee and the RTF have elected to reorganize the trust into two phases:

Phase 1: Major Restoration Projects (~$1.6 million)
A portion of the endowment will be spent quickly (the next 3 years) to supp[illegible]ation projects that will provide a defensible space for long-term management.

BSTAFFORD
2023-03-13 20:43:19
---
check to make sure NFWF funding mat[illegible]

Phase 2: Long-term Endowment ($2 million) (this funding)
The rest will remain intact in an endowment and only the interest will be spent annual for maintenance of selected restoration projects.

Creation and management of this DPA Network is built around four key design elements:



1. Maintain intact (viable) landscapes - The intent of this element is to protect and improve the ecological integrity and long-term viability of the more intact (core) landscapes of the Dunes. Within these areas, priority actions would be to: repair historic impacts, remove threats and reinstate ecological processes.

2. Reverse declines - This element aims to stem species declines and reinstate critical ecological processes (such as ecological succession and pollination). Within these areas, priority actions would reinstate natural dune succession and open space habitat.

3. Recover threatened species and ecological communities - This element ensures the long-term persistence of species and ecosystems at immediate risk of extinction in the wild. The actions required to implement this work are specific to individual species and ecosystems, but typically focus on increasing distribution and abundance and halting declining trends.

4. Control emerging threats - This element addresses threats to our vision of the Dunes before their impacts are fully realised. The more pervasive threats to the Dunes include climate change and invasive species. Actions promoted to adapt to a changing climate include: Passive adaptation to improve resilience of ecosystems by maintaing functional areas (DPAs) and ensuring representativeness of habitats. The other emerging threat is arrival, spread and impact of invasive species. Actions to address this threat include prevention, early detection and rapid response, and containg spread.

Essential to the concept of the DPA Network is flexibility. While initial management may only be able to focus on a handful of priority areas, the concept is that management will expand to other priority areas as resources become available. Management plans for individual DPA's will follow the same general format and contain the following elements:

Element 1 – Site Description

Element 2 – Site Assessment (Assets, Threats & Opportunities)

Element 3 – Opportunity Prioritization

Element 4 – Management Objectives, Actions, Methods, Timeline and Budgets

Element 5 – Preventing or Mitigating Effects to Non-Target Resources

Element 6 – Monitoring, Data Management and Reporting

Element 1 – Site Description (Spatial Scope, Conservation Targets and Management Goals)

This section should start off with a description of the DPA. This will include maps to orient the reader to the site in the context of the entire GNDC. A general site description should include the political locations and boundaries, as well as biological information on ecosystems, communities, and species which occur in the area. Climatic information may also be included. This section should include information on conservation targets, overall management goals and any site-specific management concerns or restrictions. This plan will be read by on-the-ground managers, so if there are specific restrictions, this is the area to document that. In addition, this section should include any kind of management history such as previous habitat restoration work or grants that were received. In addition, any record of management that has succeeded or failed should be documented here. Also, important to include are the biggest threats to management goals and why.

Element 2 – Site Assessment (Assets, Threats & Opportunities)

Comprehensive baseline Site Assessments are critical to the proper management of the Dune Protected Areas Network. Furthermore, geospatial data assists landscape managers in determining what resources should be the focus for restoration or enhancement and which threats should be targeted for management. Site Assessments should include a species inventory as well as geospatial data for habitat types, conservation target, and threats. For data to remain current, site assessments should be done at least once every ten years.

When was the last assessment?

Site Assessments can be resource intensive, so it is best to be strategic about what data you should capture for management and be consistent with how that data is captured. One of the most pervasive threats throughout the DPA network are impacts from non-native invasive species. Given the large number of non-native species in the GNDC it is often difficult to know where to

start. To help in this process, during a 3-day workshop, a target invasive plant list for surveys was selected by the Dunes Collaborative and was informed by the *Invasive Plant Inventory and Early Detection Prioritization Tool* (Olsen et al 2015). However, invasive plants aren't the only species causing widespread damage in the GNDC. Feral pig localities, numbers observed, and habitat damage should also be documented. In addition to invasive species, surveys should also target special status native plants such as Nipomo lupine (*Lupinus nipomensis*), La Graciosa thistle (*Cirsium scariosum* var. *loncholepis)*, beach spectaclepod (*Dithyrea maritima*), and surf thistle (*Cirsium rhothophilum*) which are known to occur throughout the GNDC. A list of species targeted for inventory surveys is found in Table 1.

BSTAFFORD
2023-03-17 15:38:45
---
grid size?

Table 1: Target Species List for Inventory Survey

Method	Species	Common Name	Family	Conservation Status	Cal-IPC Ranking
Documented Invasive Plants *Map Using a Grid System (5 Species)*	*Ammophila arenaria*	European beachgrass	Poaceae	*invasive plant*	High
	Carpobrotus chilensis	ice-plant / sea fig	Aizoaceae		Moderate
	Carpobrotus edulis	freeway ice-plant	Aizoaceae		High
	Concosia pugioniformis	slender leaf ice-plant	Aizoaceae		Limited
	Ehrharta calycina	perennial veldt grass	Poaceae		High
Documented Invasive Plants *Map Using Points & Polygons (12 Species)*	*Arundo donax*	giant reed	Poaceae	*invasive plant*	High
	Delairea odorata	cape ivy	Asteraceae		High
	Thinopyrum junceiforme	russian wheatgrass	Poaceae		Red Alert
	Tamarix sp.	tamerisk	Tamaricaceae		High
	Senecio elegans	purple ragwort	Asteraceae		n/a
	Brassica tournefortii	saharan mustard	Brassicaceae		High
	Hedera sp.	algerian/english ivy	Araliaceae		High
	Lepidium draba	hoary cress	Brassicaceae		Moderate
	Vinca major	greater periwinkle	Apocynaceae		Moderate
	Centaurea solstitalis	yellow star thistle	Asteraceae		High
	Cortaderia jubata	pampas grass	Poaceae		High
	Glebionis coronarium	crowndaisy	Asteraceae		Moderate
Dune Protected Areas Only *(Grasses)* *Map Using a Grid System (4 Species)*	*Bromus madritensis ssp rubens*	red brome	Poaceae	*invasive plant*	High
	Bromus tectorum	downy brome	Poaceae		High
	Cynodon dactylon	bermuudagrass	Poaceae		Moderate
	Cenchrus clandestinus	kikuyugrass	Poaceae		Limited
Dune Protected Areas Only *(Non-grasses)* *Map Using a Grid System (4 Species)*	*Cirsium vulgare*	bull thistle	Asteraceae	*invasive plant*	Moderate
	Conium maculatum	poison hemlock	Apiaceae		Moderate
	Myoporum laetum	ngaio tree	Myoporaceae		Moderate
	Foeniculum vulgare	sweet fennel	Apiaceae		High
Early Detection Invasive Plants (Undocumented) *Map Using Grid, Points or Polygons (9 Species)*	*Eichornia crassipes*	common water-hyacinth	Pontederiaceae	*invasive plant*	High
	Alternanthera philoxeriodes	alligator weed	Amaranthaceae		High
	Genista monspessulana	french broom	Fabacae		High
	Lepidium latifolium	perennial pepperweed	Brassicaceae		High
	Limonium sp.	Algerian sea lavender	Plumbaginaceae		Limited
	Salvinia molesta	giant salvinia	Salviniaceae		High- Alert
	Taeniatherumm caput-medusae	medusahead	Poaceae		High
	Hydrilla verticillata	hydrilla	Hydrocharitaceae		High
	Ludwigia sp.	Uruguay waterprimrose	Onagraceae		High
	Emex spinosa	Spiney emex	Polygonaceae		Moderate
Documented Special Status Native Plants *Map Using Grid, Points or Polygons (6 Species)*	*Cirsium rhothophilum*	surf thistle	Asteraceae	CT; 1B.2	*na*
	Cirsium scariosum var. *loncholepis*	La Graciosa thistle	Asteraceae	FE; CT; 1B.1	
	Dithyrea maritima	beach spectaclepod	Brassicaceae	CT; 1B.1	
	Lupinus nipomoensis	Nipomo Lupine	Fabaceae	FE; CE; 1B.1	
	Nasturitum gambelii	gambel's watercress	Brassicaceae	FE; CE; 1B.1	
	Arenaria paludicola	marsh sandwort	Caryophyllaceae	FE; CE; 1B.1	
Undocumented Special Status Native Plants *Map Using Grid, Points or Polygons (1 Species)*	*Layia carnosa*	Beach layia	Asteraceae	FE; CET; 1B.1	*na*
Non-native Vertebrates *Map Using Points & Polygons (1 Species)*	*Sus scrofa*	Feral Pig	Suidae	invasive animal	*na*

Total- 36 Invasive Plants, 5 Special Status Native Plants & 1 Invasive Animal

In doing surveys in the GNDC, data should be collected in a standardized format to allow data sharing among members of the Dunes Collaborative. A protocol was developed by Wildlands Conservation Science for survey mapping in the GNDC that captures the most important information for management accurately and efficiently (M Ball & Olthof, 2017). For DPA management plans, surveys should follow this format, as outlined in the Monitoring Plan portion of the conservation strategy.

When target species are encountered, their location, distribution and ground cover will be recorded using one of three mapping methods herein referred to as point, polygon, or grid. Point

and polygon mapping is restricted to plant populations with a discernible boundary extent, these mapping units are herein referred to as populations or stands. An individual population is defined by a single contiguous infestation or a cluster of infestations separated by no more than 30-meters.

Descriptions of the three mapping methodologies are provided below:

Point - Discrete populations with easily identifiable (circular) boundaries will be mapped using a single data point collected at the population centroid. For each population, diameter and percent ground cover and attribute information listed in Table 2 will be collected. Plant populations mapped as points will be later buffered by their infestation radius and converted to polygons for the final product. All feral pigs and rare plant occurrences will be mapped using discrete point data.

Polygon – Populations with a discernible, irregular-shaped boundary are mapped using a polygon drawn atop a high-resolution orthophotograph. Additional population attributes listed in Table 2 must be collected.

Grid - European beachgrass (*Ammophilia arenaria*), perennial veldt grass (*Ehrharta calycina*), sea-fig iceplant (*Carpobrotus chilensis*), hottentot fig iceplant (*Carpobrotus edulis*) and Narrow-leaved iceplant (*Conicosia pugioniformis*) cannot be mapped using point or polygon methods because there are no discernible population boundaries to be delineated. Therefore, these widespread and/or diffusely occurring species will be mapped by estimating ground cover within a 100-meter by 100-meter pre-established grid system. Within each grid cell, additional population attribute information is collected (Table 3).

For aerial surveys, a 100-meter grid size was selected because it is a cost-effective scale for large property surveys while allowing for data resolution that is useful for weed population tracking and treatment planning. For surveys done on foot, a 50-meter grid size is more effective. The entire Guadalupe Nipomo Dunes Complex has a working 100-meter grid with nested 50-meter grid cells that should be used for mapping to ensure seamless integration. This grid is available from The Land Conservancy of San Luis Obispo County.

Table 2: Attribute field information associated with polygon data to be recorded during the survey.

Field Name	Attribute Description
Stand_ID	Individual stand identification code
Date	Date in which the survey was preformed
Com_Name	Common name of the documented population stand
Species	Scientific name of documented population stand
Num_Indv	Estimated number of plants within documented population stand
Pop_Dens	The vegetative cover of the documented invasive species within the mapped population based off the CNPS cover class diagrams. The cover-classes are used to visually estimate cover within the polygon. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Age_Class	The common age of plants within the population stand. Age is divided into **seedling**, **immature**, **mature**, mixed classes with more young plants (**MixedYoung**) and mixed age classes with more old plants than young (**MixedOld**).
ID_Confid	Confidence level (**High**, **Med**, **Low**) that the surveyor was able to identify the documented plant to species.
Photo	A photo taken of the population stand, if necessary
Surveyor	The name of the surveyor recording the data
Comment	Miscellaneous notes regarding the documented population stand
Gross_Acres	Total area (Acres) of the polygons including the interstitial spaces between the documented invasive plants within a populations (post-survey).
Net Acres	Net area (acres) covered by the documented invasive plants within the polygon, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of the pop_Dens x the Gross_Acres value (post-survey).
Rank	Plant ranking for the documented invasive species or rare plant (post-survey).
Point_X	X coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet
Point_Y	Y coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet

Table 3: Attribute field information associated with grid data to be recorded during the survey.

Field Name	Attribute Description
ID	Individual grid cell identification code
Date	Date in which the survey was preformed
AMAR_Cover	The vegetative cover of European beachgrass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
CACH_Cover	The vegetative cover of Hottentot fig iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
CAED_Cover	The vegetative cover of sea-fig icelant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
COPU_Cover	The vegetative cover of slender-leaved iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
EHCA_Cover	The vegetative cover of perennial veldt grass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
Gross_Acre	Total area (acres) of each mapped grid cell including the interstitial spaces between documented invasive species within a population (Post-survey).
AMAR_Acres	Net Area (acres) covered by European beachgrass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of AMAR_Cover x the Gross_Acres (Post-survey).
CACH_Acres	Net Area (acres) covered by Hottentot fig iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CACH_Cover x the Gross_Acres (Post-survey).
CAED_Acres	Net Area (acres) covered by sea-fig icelant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CAED_Cover x the Gross_Acres (Post-survey).
COPU_Acres	Net Area (acres) covered by slender-leaved iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of COPU_Cover x the Gross_Acres (Post-survey).
EHCA_Acres	Net Area (acres) covered by perennial veldt grass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of EHCA_Cover x the Gross_Acres (Post-survey).

Element 3 – Opportunity Prioritization

Within the DPA network, the aim is to choose areas and take actions that move us as close to our high-level goals as possible. Given that there are limited resources available for management, it is important to carefully consider which opportunities for restoration are acted upon. Each good project we act upon means that another good project does not get done. This can be a sobering realization and although it is essential to set priorities, doing so does not guarantee decisions are cost effective or optimal for achieving our high-level management goals. Unfortunately, there is no set standard on how to prioritize restoration opportunities and some level of subjective judgement is necessary.

For each DPA, 3 tiers of priority Opportunities (Priority 1, Priority 2, Priority 3) will be identified. The tiers will be set based on careful consideration of the opportunity and how it balances contributions to the higher-level goals while considering social, economic and ecological interests.

Priority 1 opportunities will be those projects that contribute to the high-level goals, are cost efficient to implement and have a certain level of urgency in implementation.

Priority 2 opportunities will be those that contribute to high level goals, have a lower cost/benefit ratio than Priority 1 opportunities, but still achievable within a ten-year time frame.

Priority 3 opportunities, are those that contribute to high level goals, but are difficult to achieve because cost is prohibitive, success is unlikely, or there are political/social reasons that will keep them from being implemented.

When prioritizing opportunities, this element should make a case for how the priority was determined.

Element 4 – Management Objectives, Actions, Method, Timeline and Budgets

It is important to provide details on what you will do, where, when and expected results for priority opportunities. This section is where the work starts to get done.

Management Objectives

Management objectives are stepping stones to reach our high-level management goals. They focus specifically on Priority 1 and Priority 2 Opportunities identified in Element 3. When developing objectives for the site, they should be accomplishable during the life of the plan. All Objectives should be “SMART” which means they possess five properties:

(1) ***Specific*** – A clearly worded objective is easy to understand, and the meaning is difficult to misinterpret. This can be achieved by including WHO will do the action, WHAT we will do, WHEN and WHERE we will do it, and WHY we will do it. Avoid or minimize general phrases like "maintain high-quality habitat", "for the benefit of migratory birds," or "improve the visitor experience," as these phrases are subject to interpretation.

(2) ***Measurable –*** Objectives should contain a measurable element that we can readily monitor to determine success or failure. This is essential to know if we have met an objective, or if we should modify it.

(3) ***Achievable*** – Objectives, no matter how measurable or clearly written, must be achievable. Do not ask more of the land than it can deliver and use sound professional judgment to develop reasonable expectations of time, staff, and funds available to pursue the objective.

(4) ***Results-oriented*** – Objectives should specify an end result. For example, a habitat objective that is results-oriented will provide a detailed description of the desired habitat conditions expected.

(5) ***Time-fixed –*** Objectives should indicate the time period during which we will achieve them, so as not to be open-ended. Consider developing an implementation schedule for objectives and/or strategies, perhaps in 5-year increments.

There are two types of objectives:

1. Target/threshold:

- You have enough information to set a threshold
- You care about the absolute condition of the resource, not relative change over time

2. Change/trend:

- You don't have enough information to set a threshold
- You care about change over time, not absolute condition of the resource

Actions and Methods

Actions are specific well-defined activities or projects to achieve the Objective. Often, an Objective is achieved through multiple inter-related Actions. The Actions are carried out by using specific methods. The Methods chosen will depend on whether there are any limitations to the use of certain tools and techniques. For example, some management areas are too close to urban areas to allow prescribed fire, and some do not allow the use of herbicides. The limitations of a particular site will determine which "tools" are available in a manager's toolbox.

To illustrate the how this all ties together, if your Objective is to restore active foredune migration in an ecosystem invaded by European beachgrass within 10 years, one Action might be to control European beachgrass while the Methods explain exactly how that will be controlled. Will you use herbicide? If so, what type, rate and timing will you use? Once you start to answer those questions, you can move onto establishing timelines for treatment and estimating budgets for work.

Timeline and Budget

Once you have determined which Actions and Methods you will use to achieve your Objectives, they can be integrated into a timeline and overall programmatic schedule. This will give you an indication of the level of effort needed to carry out your Actions and Methods. This should be estimated into a dollar value, to help evaluate if you have sufficient resources to achieve your objective and to help prioritize which Actions you want to devote resources towards. This is also important in identifying if additional resources, such as through grant money, should be pursued.

Element 5 – Preventing or Mitigating Effects to Non-Target Resources

This section should identify non-target resources that could be affected by Restoration methods. Once susceptible targets are identified, Best Management Practices, or BMPs should be identified here to minimize or eliminate those impacts.

Element 6 – Monitoring & Evaluation

Restoration efforts are experiments, from which we can learn lessons to improve future project designs. Over time, we need a way to gauge how well the Actions and Methods are achieving the Objectives. Monitoring is used to answer these essential questions.

There are three types of monitoring applicable to the management of DPA Network:

- Management Activity Monitoring – This is monitoring that tracks what types of Restoration Methods and Activities are happening where. This is meant to track the management itself and not the effects of management.
- Monitoring to Inform Management – This type of monitoring involves defining threshold values or expected responses, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values indicates whether you should initiate, intensify, or alter management actions. An example would be measuring percent cover of an invasive plant to evaluate management actions designed to reduce the cover to a certain threshold value, say 1-5% cover.

- Baseline Monitoring – Essential to the DPA Network management philosophy is maintain viable landscapes and reverse declining trends. To evaluate this, you need some type of monitoring that evaluates baseline conditions and tracks changes through time.

Monitoring methods do not need to be complex or sophisticated. The costs for monitoring should remain a relatively small portion of a project budget. A general rule of thumb should be about 10%.

This section should talk about what monitoring will occur, how monitoring results will be reported and how evaluation of the monitoring results will occur (i.e. adaptive management). There should also be a description of how monitoring data will be collected and managed.

This information is also included in the Monitoring Plan for the DPA Conservation Strategy, but it is also important to provide that information in the Work Plan so that those implementing the plan know exactly what is expected of them, how to collect and manage data, and what the targets for success are.

Chapter 2: Selected Dune Protected Area Work Plans

With limited restoration funds, three DPAs were selected for the creation of work plans to be implemented through the long-term endowment. A prioritization process approved by the RTF and guided by land mangers was created to select which DPAs to focus the limited endowment fund on long-term.

The selected DPAs for work plans are:

Black Lake Ecological Area

National Wildlife Refuge/ Chevron Successional Dune

Point Sal

Within Chapter 2 are the work plans for each of the selected DPAs. All potential restorations projects are prioritized, and description of treatment are given.

Black Lake Ecological Area

Site Description

Black Lake Ecological Area is owned by LCSLO and is bordered by ODSVRA to the south and Dune Lakes Limited (privately owned) to the north. Highway 1 and the California Pacific Railway cuts through this DPA and offers significant challenges to faunal movement throughout the GNDC. This DPA is at the western terminus of Black Lake Canyon, with a relatively intact wetland and creek to the east. The property was once a private ranch and has a large stand of blue gum eucalyptus trees.

Figure 2: Prickly Phlox (*Leptodactylon californicum ssp. tomentosum*) with Black Lake in the background.

This DPA was selected by the conservation planning software (both Marxan and Zonation) and local experts because of its high-quality habitat and inclusion of conservation targets. Black Lake is the deepest lake in the GNDC and is known for its dark color, blackened by peat deposits beneath the lake. The perennial water brought down Black Lake Canyon provides important breeding grounds for many vertebrate species and one of the very few migratory corridors connecting the GNDC with greater California wildlands. The pristine coastal dune scrub habitat (with diligent invasive species removal) has allowed native plant species to flourish with colorful spring annual blooms. A north facing slope of delicate soil crusts enhances the biodiversity value of this DPA.

Figure 3: Monarch butterflies (*Danaus plexippus*) overwintering at Black Lake Ecological Area.

The sole purpose of the Black Lake Ecological Area is to preserve wildlife habitat and protect rare and special status species. It is the conservation site for a satellite population of the critically endangered Nipomo lupine (*Lupinus nipomensis)* overseen by the Cheadle Center for Biodiversity and Ecological Restoration of University of California, Santa Barbara. California Polytechnic State University, San Luis Obispo, also uses the site to conduct research on small mammals and their evolving relationship

with perennial veldtgrass (*Ehrharta calycina*). Blue gum eucalyptus (*Eucalyptus globulus)* on the site offer essential overwintering habitat for monarch butterfly (*Danaus plexippus)* and roosting habitat for raptors. Monarch butterflies have seen declining numbers in the western United States and are currently being petitioned for federal status and protection.

Major management challenges in this DPA include the surrounding threat of invasive species. LCSLO works annually to remove invasive species with special attention to removal of perennial veldtgrass. Neighboring properties provide a constant invasive plant seed source, which requires management each year. The western rim of the DPA is dominated by European beachgrass (*Ammophila arenaria*), which creates an unnatural dune formation but also protects Black Lake from being filled with sand.

Figure 4: Black Lake.

The dune lakes in the GNDC are under constant stress from a lowering water table. The growing neighboring agricultural and urban lands have increased the demand for ground water and it is evident in the water level in Black Lake. As the lake water level falls, important shore habitat for locally rare species, such as Rocky Mountain pond lily (*Nuphar polysephala*), is being lost by the encroachment of bulrush (*Schoenoplectus americanus*). La graciosa thistle (*Cirsium scariosum* var. *loncholepis*) is found in other dune lakes but has not been found in Black Lake since 1970 due to lack of suitable habitat (Hoover, 1970).

Figure 5: Southeast corner of Black Lake Ecological Area.

Management History

The property containing Black Lake was previously owned by Dune Lakes Limited, before being purchased by the California State Coastal Conservancy in 1996 and subsequently transferred to The Nature Conservancy. The Nature Conservancy transferred Black Lake to LCSLO in 2000 as part of their larger consolidation of conservation holdings to local land trusts.

Water Management

While owned by Dune Lakes Ltd., all eleven of the dune lakes were actively managed, including Black Lake. These water management practices were done to aid in flood control, provide irrigation for agricultural purposes, control tulle growth, and maintain lake levels for waterfowl (Hensley, 1995).

Some pumping from Black Lake out to other lakes was done during the 1940s and 1950s to maintain certain lake levels, though the practice was abandoned in the early 1960s (Madsen, 2017). Pumping water into Black Lake was performed throughout the 1960s. Water from White Lake was pumped south to Mud Lake, which was then piped southeast into Black Lake. Adding water to Black Lake was done when there was a need "to compensate for reduced natural drainage resulting from development of Black Lake Canyon" (Hensley, 1995). Pumping has not occurred at Black Lake since then (Madsen, 2017).

Vegetation

In the past, some vegetation management occurred at the Dune Lakes, including management for coastal dune scrub, tulle, algae, and dune stabilization. It is unclear from the literature however, how many of these practices, if any, were directly applied to Black Lake and its immediate

surroundings. Chopping and rolling of coastal dune scrub was done from about 1955 to 1995 in order to enhance California quail habitat (game species for hunting), as well as provide a more accessible trail system for hunters.

Tule around the lake's edge was managed year-round using several techniques. This was done in order to maintain open water for waterfowl. During the spring and summer, the herbicide Rodeo© was used to control tulle species. During the growing season, a tulle cutter, a scow fitted with a mower blade, was used to cut tulle around the edge. Toward the end of summer, a caterpillar tractor was used to knock back the tulle species.

Because of nearby agricultural areas, the lakes may have contained traces of fertilizers, herbicides, and pesticides – all nutrients that allow algae to flourish. Copper sulfate was sprayed into the water at the beginning of the duck hunting season to control these algal blooms.

Open sand sheets and sparse vegetation combined with local wind patterns can result in significant changes to lake levels as sand blows in (Aeolian transport and sedimentation) and encroaches upon lake margins. During the 1930s, the Soil Conservation Service (now the Natural Resources Conservation Service) introduced and planted European beachgrass along the western edge of the property in order to stabilize the dunes and prevent blowouts from trespassing off-highway vehicles (OHVs) and forestall sedimentation. A fence constructed by the California State Parks along that edge reduced blowouts and allowed for fewer plantings of the grass (Hensley, 1995).

Wildlife

Hunting of quails, doves, waterfowl, rabbits, and deer during different seasons occurred throughout the Dune Lakes area while all of the property was owned by Dune Lakes Ltd., a private hunting club. Fishing also took place in the lakes without any seasonal restrictions, with species such as California black bass, bluegill, crappie, bullhead, and three-spine stickleback (Hensley, 1995).

Invasive Plant Management

When LCSLO took ownership of the property, they solicited a grant from San Luis Obispo County, with funds provided by the State, to undertake a stewardship program at Black Lake. This grant facilitated LCSLO's first invasive plant management efforts. Subsequent grants were made available through the Guadalupe Nipomo Dunes Collaborative Restoration Task Force, the Center for Natural Lands Management, and a second grant from San Luis Obispo County.

Activities under these grants at Black Lake Ecological Area focused on eliminating a heavy infestation of perennial veldtgrass, and containment of a eucalyptus grove surrounding Black Lake. In addition, test plots were established to determine the most efficient method to remove perennial veldtgrass and European beachgrass, how removal methods impact native plant species, and whether silver dune lupine could be established through container stock and/or seed.

The test plots offered limited usable results for management. Control at the BLEA DPA has primarily focused on treatment of perennial veldtgrass since 2004. Techniques employed involved manual weed whacking to reduce biomass followed by herbicide treatments with a grass specific herbicide, primarily Fusilade DX (fluazifop-p-butyl) but POAST (sethoxydim) has also been used. In 2014 it was determined that biomass removal was no longer necessary. In addition, to mitigate for the risk of herbicide resistance developing in perennial veldtgrass, herbicide treatments began incorporating spot treatment with the broad-spectrum herbicide Roundup ProConc (glyphosate).

After almost 15 years of treatment, the results are mixed. There is one area that has a good defensible buffer from neighboring infestations where very low levels of perennial veldtgrass occur. Other treated areas that do not have a buffer continue to get re-invaded from neighboring infestations and the level of effort for control is not diminishing. This highlights the need to create defensible spaces with buffers to reduce new invasive plant propagules from becoming established.

Eucalyptus encroaching on Black Lake were initially thinned. This was successful but requires diligent follow-through as new trees continually spread from this source population.
In recent years, control has also focused on containing the spread of Saharan mustard (*Brassica tournefortii*) into the BLEA DPA. During the recent drought years, this plant is exploding in sandy soils along the Central California Coast. Control techniques have employed manual removal, flaming and herbicide applications of Garlon 4 Ultra (triclopyr). Flaming with a propane torch is only successful on seedlings which limits the control window. Garlon 4 Ultra provides good control but there is a small window of opportunity before the plants begin to flower. Once plants are flowering, hand removal is the best option.

Woodlands Mitigation Project to restore Dune Scrub habitat for silvery legless lizard

From 2006 to 2011 a project was implemented to create a coastal dune scrub habitat in the center of the area known as “The Eucalyptus Ring”. The site is approximately 12 acres. It is level in topography and is believed to have been used for agricultural purposes at one time. The eucalyptus trees were planted in the circle to provide a buffer from the westerly winds coming in from the Pacific Ocean. The Restoration Goals were:

- Restore and enhance the functionality of the plant and wildlife habitat in the Black Lake Restoration Project area (i.e. The Eucalyptus Ring”).

- Establish nine acres of coastal dune scrub (using seed and container stock) in phases using an ecological tonal enclave design in which the existing vegetation will be used as a border to encourage seedling recruitment and create contiguous habitat for wildlife.
- Reduce and eliminate in specific areas populations of invasive, non-native species.
- Establish a coastal dune scrub community that will allow for the gradual incursion and establishment of native plant species from the surrounding established coastal dune scrub community.
- Establish a functioning ecosystem in which habitat is provided that is conducive to the natural recruitment of the silvery legless lizard (*Anniella pulchra*).

Results of this project include:

- Treated over nine acres to restore previously disturbed land to dune scrub habitat
- Installed over 10,600 native plants over nine acres
- Sowed over seven acres of Native Seed Mix into the soil to restore dune scrub habitat.
- Site maintenance: perennial veldtgrass was treated using a combination of disking, intensive mowing with weed whackers, and application of herbicide (Fusilade DX).
- Other site maintenance: hand pulling slender-leafed ice plant and Eucalyptus removal on strategic areas of the site to encourage seed recruitment from existing dune scrub.
- Community outreach: volunteers and California Conservation Corps members assisted planting and weeding activities.

This project was successful in establishing coastal dune scrub plants but continues to be invaded by ripgut brome (*Bromus diandrus*) with pockets of perennial veldtgrass and Saharan mustard. Natural recruitment from neighboring coastal dune scrub habitat is hindered by the buffer of blue gum eucalyptus trees.

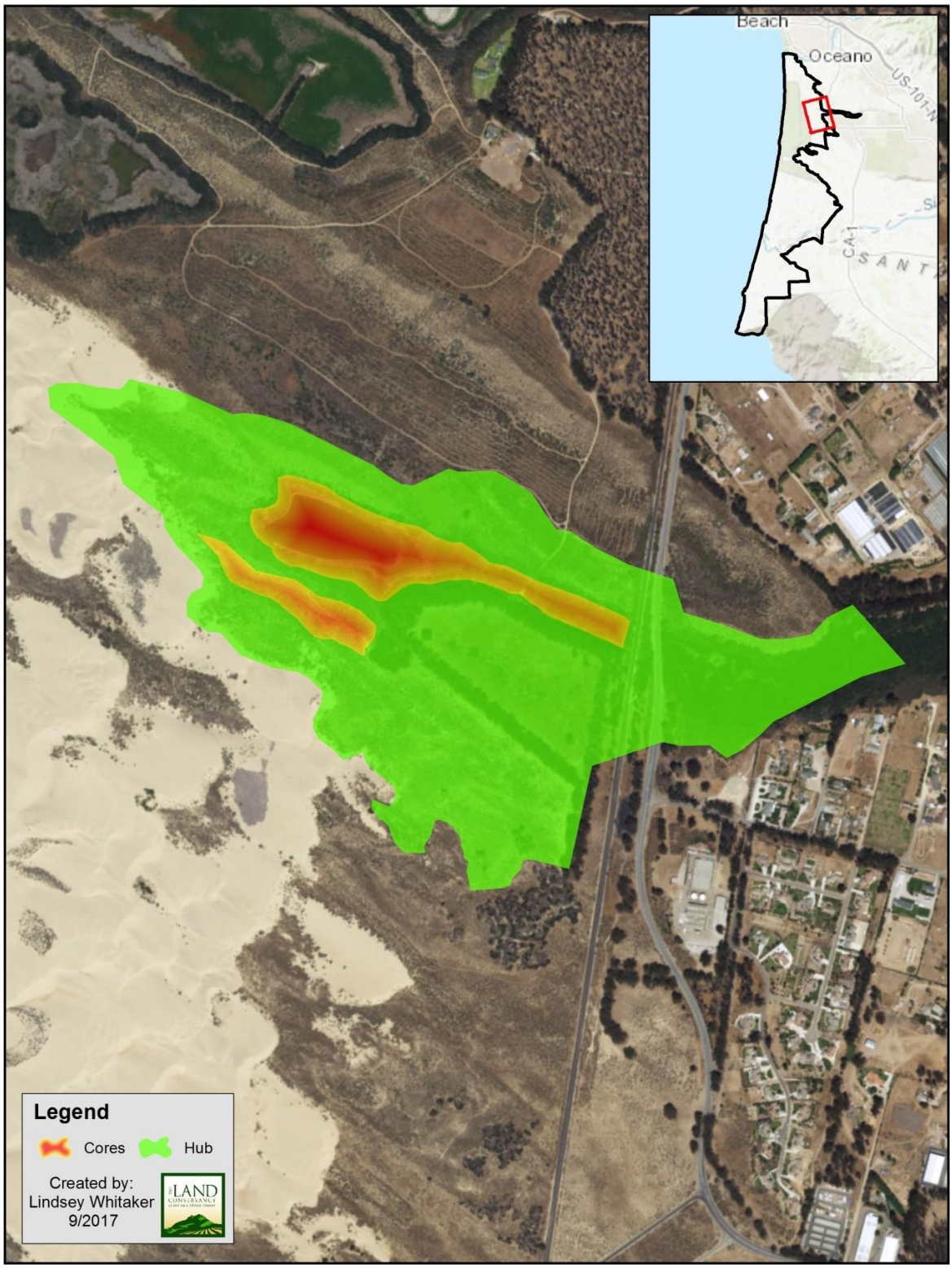


Figure 6: Boundary of the Black Lake Ecological Area DPA.

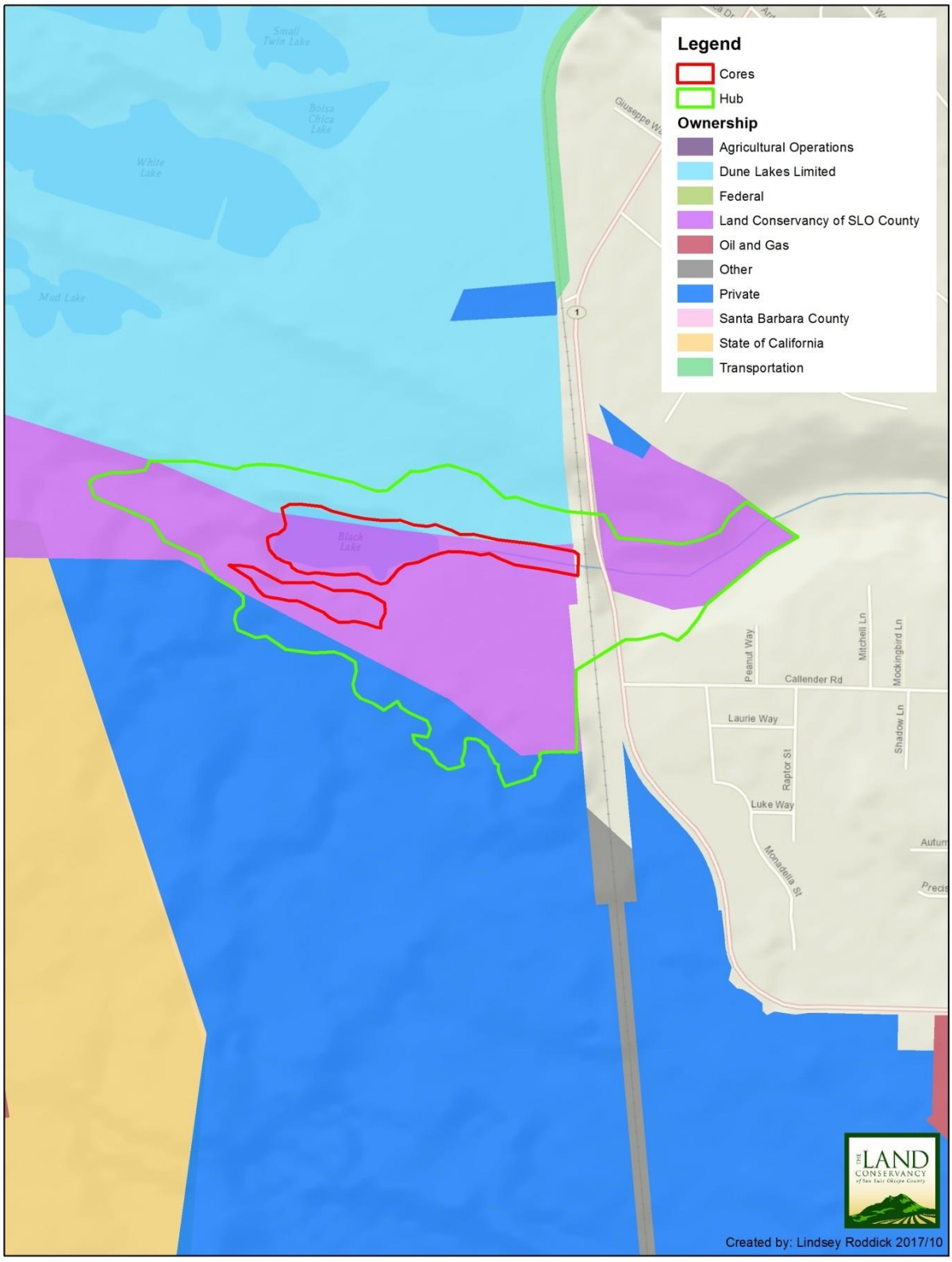


Figure 7: Property Ownership of the Black Lake Ecological Area DPA.

Site Assessment

The site assessment for the Black Lake Ecological Area DPA is a snapshot in time representing a baseline of site conditions during the years 2016-2018. This includes a species inventory as well as geospatial data for habitat types, conservation targets, and threats.

Species Inventory

In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the Black Lake Ecological Area DPA. Those species are included in the table below.

Table 4: Conservation targets known or likely to occur at the BLEA DPA.

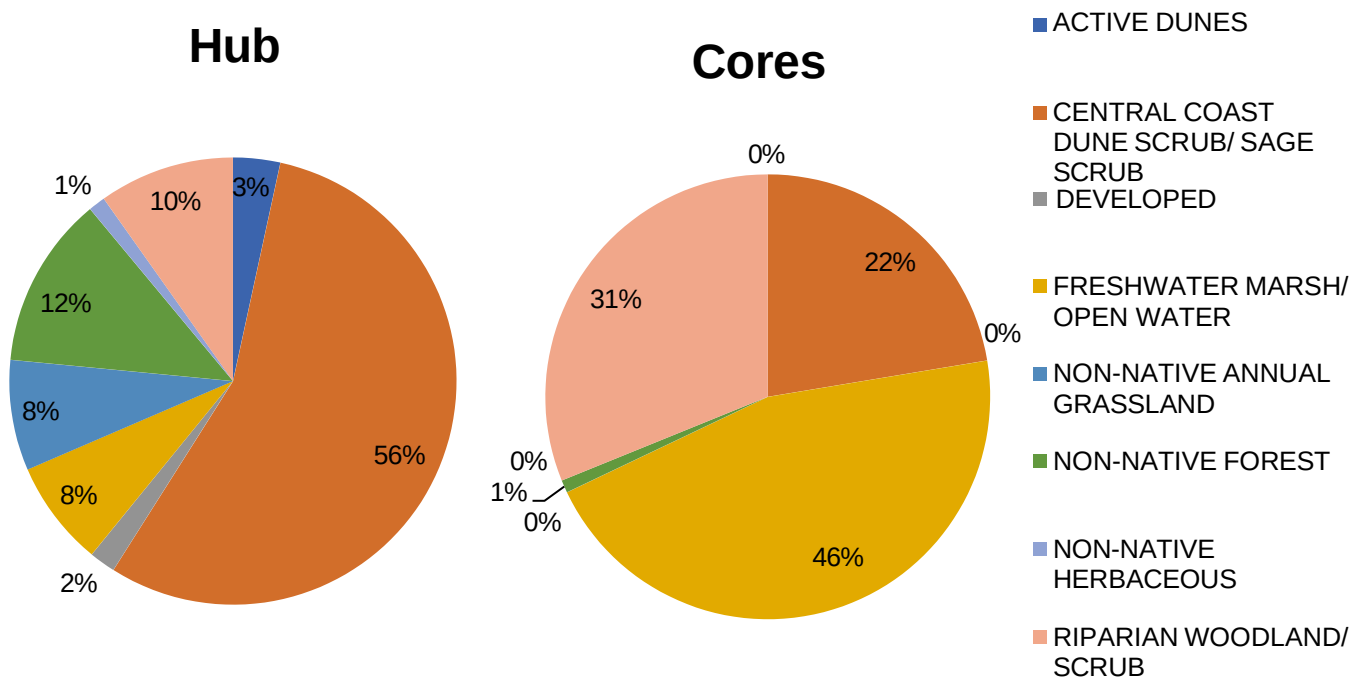
Bird Fine Filter Species	**Flora Fine Filter Species**
American coot	*Astragalus nuttallii* var. *nuttallii* (Nuttall's milkvetch)
American crow	*Cladium californicum* (California sawgrass)
American robin	*Erysimum suffrutescens* (suffrutescent wallflower)
Anna's hummingbird	*Horkelia cuneata* ssp. *puberula* (Mesa horkelia)
barn swallow	*Horkelia cuneata* ssp. *sericea* (Kellogg's horkelia)
Bewick's Wren	*Juncus acutus ssp. leopoldii* (Leopold's rush)
California quail	*Leptodactylon californicum* ssp. *tomentosum* (prickly phlox)
California thrasher	*Monardella undulata* ssp. *crispa* (dune mint)
California towhee	*Monardella sinuata* ssp. *sinuata* (dune mint)
chestnut-backed chickadee	*Monardella undulata* ssp. *undulata* (dune mint)
common yellowthroat	*Mucronea californica* (California spineflower)
downy woodpecker	*Nuphar polysepala* (Rocky Mountain pond lily)
great horned owl	*Orobanche parishii* ssp. *brachyloba* (Parish's broomrape)
house finch	*Scrophularia atrata* (black flowered figwort)
mallard	*Senecio blochmaniae* (Blochman's groundsel)
marsh wren	
northern harrier	**Mammal Species**
Nuttall's woodpecker	*Canis latrans* (coyote)
red-tailed hawk	*Castor canadensis* (American beaver)
spotted towhee	*Chaetodipus californicus* (California pocket mouse)
Swainson's thrush	*Didelphis virginiana* (Virginia opossum)
western scrub jay	*Dipodomys heermanni arenae* (Lompoc kangaroo rat)
white-crowned sparrow	*Felis* (or *Puma*) *concolor* (mountain lion)
Wilson's warbler	*Lepus californicus* (black-tailed jackrabbit)
wrentit	*Lynx rufus* (bobcat)
yellow warbler	*Mephitis mephitis* (striped skunk)
	Microtus californicus (California vole)
Reptile & Amphibian Fine Filter Species	*Mustela frenata* (long-tailed weasel)
Phrynosoma blainvillii (California horned lizard)	*Neotoma macrotis* (dusky-footed woodrat)
	Odocoileus hemionus (mule deer)
Ra ertebrate Species	*Peromyscus californicus* (California mouse)
Danaus plexippus (monarch butterfly)	*Peromyscus maniculatus* (deer mouse)
	Procyon lotor (northern raccoon)
	Reithrodontomys megalotis (western harvest mouse)
	Scapanus latimanus (broad-footed mole)
	Spilogale gracilus (western spotted skunk)
	Sylvilagus audubonii (desert cottontail)
	Sylvilagus bachmani (brush rabbit)
	Thomomys bottae (Botta's pocket gopher)
	Ursus americanus (American black bear)

BSTAFFORD
2023-03-17 15:56:02

Why not anniella?

Habitats

The Black Lake DPA (hubs and cores) is composed of the following habitat types:



Habitat Type	Core Acres	Core %	Hub Acres	Hub %
ACTIVE DUNES	0.00	0.00%	4.83	3.41%
CENTRAL COAST DUNE SCRUB/ SAGE SCRUB	5.32	22.39%	78.64	55.56%
DEVELOPED	0.00	0.00%	2.69	1.90%
FRESHWATER MARSH/ OPEN WATER	10.82	45.54%	10.83	7.65%
NON-NATIVE ANNUAL GRASSLAND	0.00	0.00%	11.31	7.99%
NON-NATIVE FOREST	0.22	0.93%	17.63	12.46%
NON-NATIVE HERBACEOUS	0.00	0.00%	1.72	1.22%
RIPARIAN WOODLAND/ SCRUB	7.40	31.14%	13.89	9.81%
TOTAL	**23.76**		**141.54**	

Figure 8: Types and Percent Cover of Habitats within the Black Lake Ecological Area DPA.

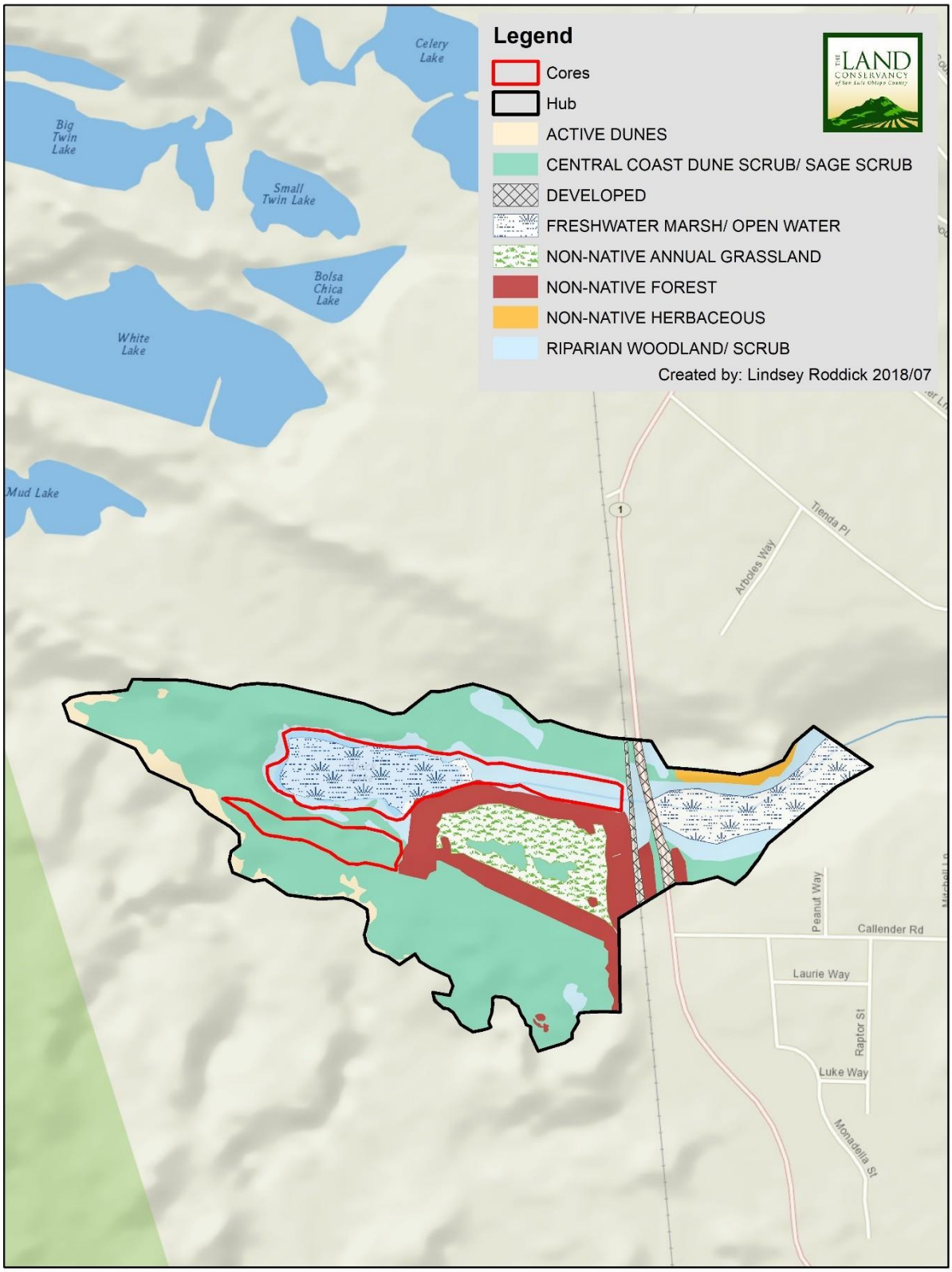


Figure 9: Habitat Types of the Black Lake Ecological Area DPA.

Threats

One of the most pervasive threats throughout the DPA network are impacts from non-native invasive species. Given the large number of non-native species in the Dunes it is often difficult to know where to start. To help in this process, during a 3-day workshop, a target invasive plant list for surveys was selected by the Dunes Collaborative and was informed by the *Invasive Plant Inventory and Early Detection Prioritization Tool* (Olsen & Hall, 2015). However, invasive plants aren't the only species causing widespread damage in the GNDC. Feral pig localities, numbers observed, and habitat damage was also documented. In addition to invasive species, surveys targeted special status native plants such as Nipomo lupine, La Graciosa thistle, beach spectaclepod, and surf thistle which are known to occur throughout the Guadalupe Nipomo Dunes Complex. A list of species targeted for inventory surveys is found in table 8.

Table 5: Species target list for Black Lake Ecological Area DPA assessment.

Method	Species	Common Name	Family	Conservation Status	Cal-IPC Ranking
Documented Invasive Plants *Map Using a Grid System (5 Species)*	*Ammophila arenaria*	European beachgrass	Poaceae	*invasive plant*	High
	Carpobrotus chilensis	ice-plant / sea fig	Aizoaceae		Moderate
	Carpobrotus edulis	freeway ice-plant	Aizoaceae		High
	Concosia pugioniformis	slender leaf ice-plant	Aizoaceae		Limited
	Ehrharta calycina	perennial veldt grass	Poaceae		High
Documented Invasive Plants *Map Using Points & Polygons (12 Species)*	*Arundo donax*	giant reed	Poaceae	*invasive plant*	High
	Delairea odorata	cape ivy	Asteraceae		High
	Thinopyrum junceiforme	russian wheatgrass	Poaceae		Red Alert
	Tamarix sp.	tamerisk	Tamaricaceae		High
	Senecio elegans	purple ragwort	Asteraceae		n/a
	Brassica tournefortii	saharan mustard	Brassicaceae		High
	Hedera sp.	algerian/english ivy	Araliaceae		High
	Lepidium draba	hoary cress	Brassicaceae		Moderate
	Vinca major	greater periwinkle	Apocynaceae		Moderate
	Centaurea solstitalis	yellow star thistle	Asteraceae		High
	Cortaderia jubata	pampas grass	Poaceae		High
	Glebionis coronarium	crowndaisy	Asteraceae		Moderate
Dune Protected Areas Only *(Grasses)* *Map Using a Grid System (4 Species)*	*Bromus madritensis ssp rubens*	red brome	Poaceae	*invasive plant*	High
	Bromus tectorum	downy brome	Poaceae		High
	Cynodon dactylon	bermuudagrass	Poaceae		Moderate
	Cenchrus clandestinus	kikuyugrass	Poaceae		Limited
Dune Protected Areas Only *(Non-grasses)* *Map Using a Grid System (4 Species)*	*Cirsium vulgare*	bull thistle	Asteraceae	*invasive plant*	Moderate
	Conium maculatum	poison hemlock	Apiaceae		Moderate
	Myoporum laetum	ngaio tree	Myoporaceae		Moderate
	Foeniculum vulgare	sweet fennel	Apiaceae		High
Early Detection Invasive Plants (Undocumented) *Map Using Grid, Points or Polygons (9 Species)*	*Eichornia crassipes*	common water-hyacinth	Pontederiaceae	*invasive plant*	High
	Alternanthera philoxeriodes	alligator weed	Amaranthaceae		High
	Genista monspessulana	french broom	Fabacae		High
	Lepidium latifolium	perennial pepperweed	Brassicaceae		High
	Limonium sp.	Algerian sea lavender	Plumbaginaceae		Limited
	Salvinia molesta	giant salvinia	Salviniaceae		High- Alert
	Taeniatherumm caput-medusae	medusahead	Poaceae		High
	Hydrilla verticillata	hydrilla	Hydrocharitaceae		High
	Ludwigia sp.	Uruguay waterprimrose	Onagraceae		High
	Emex spinosa	Spiney emex	Polygonaceae		Moderate
Documented Special Status Native Plants *Map Using Grid, Points or Polygons (6 Species)*	*Cirsium rhothophilum*	surf thistle	Asteraceae	CT; 1B.2	*na*
	Cirsium scariosum var. *loncholepis*	La Graciosa thistle	Asteraceae	FE; CT; 1B.1	
	Dithyrea maritima	beach spectaclepod	Brassicaceae	CT; 1B.1	
	Lupinus nipomoensis	Nipomo Lupine	Fabaceae	FE; CE; 1B.1	
	Nasturitum gambelii	gambel's watercress	Brassicaceae	FE; CE; 1B.1	
	Arenaria paludicola	marsh sandwort	Caryophyllaceae	FE; CE; 1B.1	
Undocumented Special Status Native Plants *Map Using Grid, Points or Polygons (1 Species)*	*Layia carnosa*	Beach layia	Asteraceae	FE; CET; 1B.1	*na*
Non-native Vertebrates *Map Using Points & Polygons (1 Species)*	*Sus scrofa*	Feral Pig	Suidae	invasive animal	*na*

Total- 36 Invasive Plants, 5 Special Status Native Plants & 1 Invasive Animal

In doing surveys in the GNDC, data was collected in a standardized format to allow data sharing among members of the Dunes Collaborative. A protocol was developed by Wildlands Conservation Science for survey mapping in the GNDC that captures the most important information for management accurately and efficiently (Morgan Ball & Olthof, 2016).

When target species were encountered, their location, distribution and ground cover was recorded using one of three mapping methods herein referred to as point, polygon, or grid. Point and polygon mapping is restricted to plant populations with a discernible boundary extent, these mapping units are herein referred to as populations or stands. An individual population is defined by a single contiguous infestation or a cluster of infestations separated by no more than 30-meters.

Descriptions of the three mapping methodologies are provided below:

Point - Discrete populations with easily identifiable (circular) boundaries were mapped using a single data point collected at the population centroid. For each population, diameter and percent ground cover and attribute information listed in Table 9 was also collected. Plant populations mapped as points were later buffered by their infestation radius and converted to polygons for the final product. All feral pigs and rare plant occurrences were mapped using discrete point data.

Polygon – Populations with a discernible, irregular-shaped boundary are mapped using a polygon drawn atop a high-resolution orthophotograph. Additional population attributes listed in Table 9 were collected.

Grid - European beachgrass, perennial veldtgrass, sea-fig iceplant (*Carpobrotus chilensis*), hottentot fig iceplant (*Carpobrotus edulis*) and Narrow-leaved iceplant (*Conicosia pugioniformis*) cannot be mapped using point or polygon methods because there are no discernible population boundaries to be delineated. Therefore, these widespread and/or diffusely occurring species were mapped by estimating ground cover within a 50-meter by 50-meter pre-established grid system. Within each grid cell, additional population attribute information was collected (Table 10).

Table 6: Attribute field information associated with polygon data recorded during the survey.

Field Name	Attribute Description
Stand_ID	Individual stand identification code
Date	Date in which the survey was preformed
Com_Name	Common name of the documented population stand
Species	Scientific name of documented population stand
Num_Indv	Estimated number of plants within documented population stand
Pop_Dens	The vegetative cover of the documented invasive species within the mapped population based off the CNPS cover class diagrams. The cover-classes are used to visually estimate cover within the polygon. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Age_Class	The common age of plants within the population stand. Age is divided into **seedling**, **immature**, **mature**, mixed classes with more young plants (**MixedYoung**) and mixed age classes with more old plants than young (**MixedOld**).
ID_Confid	Confidence level (**High**, **Med**, **Low**) that the surveyor was able to identify the documented plant to species.
Photo	A photo taken of the population stand, if necessary
Surveyor	The name of the surveyor recording the data
Comment	Miscellaneous notes regarding the documented population stand
Gross_Acres	Total area (Acres) of the polygons including the interstitial spaces between the documented invasive plants within a populations (post-survey).
Net Acres	Net area (acres) covered by the documented invasive plants within the polygon, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of the pop_Dens x the Gross_Acres value (post-survey).
Rank	Plant ranking for the documented invasive species or rare plant (post-survey).
Point_X	X coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet
Point_Y	Y coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet

Table 7: Attribute field information associated with grid data recorded during the survey.

Field Name	Attribute Description
ID	Individual grid cell identification code
Date	Date in which the survey was preformed
AMAR_Cover	The vegetative cover of European beachgrass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
CACH_Cover	The vegetative cover of Hottentot fig iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
CAED_Cover	The vegetative cover of sea-fig icelant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
COPU_Cover	The vegetative cover of slender-leaved iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
EHCA_Cover	The vegetative cover of perennial veldt grass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Gross_Acre	Total area (acres) of each mapped grid cell including the interstitial spaces between documented invasive species within a population (Post-survey).
AMAR_Acres	Net Area (acres) covered by European beachgrass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of AMAR_Cover x the Gross_Acres (Post-survey).
CACH_Acres	Net Area (acres) covered by Hottentot fig iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CACH_Cover x the Gross_Acres (Post-survey).
CAED_Acres	Net Area (acres) covered by sea-fig icelant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CAED_Cover x the Gross_Acres (Post-survey).
COPU_Acres	Net Area (acres) covered by slender-leaved iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of COPU_Cover x the Gross_Acres (Post-survey).
EHCA_Acres	Net Area (acres) covered by perennial veldt grass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of EHCA_Cover x the Gross_Acres (Post-survey).

Results of the assessment are depicted in Figure 15.

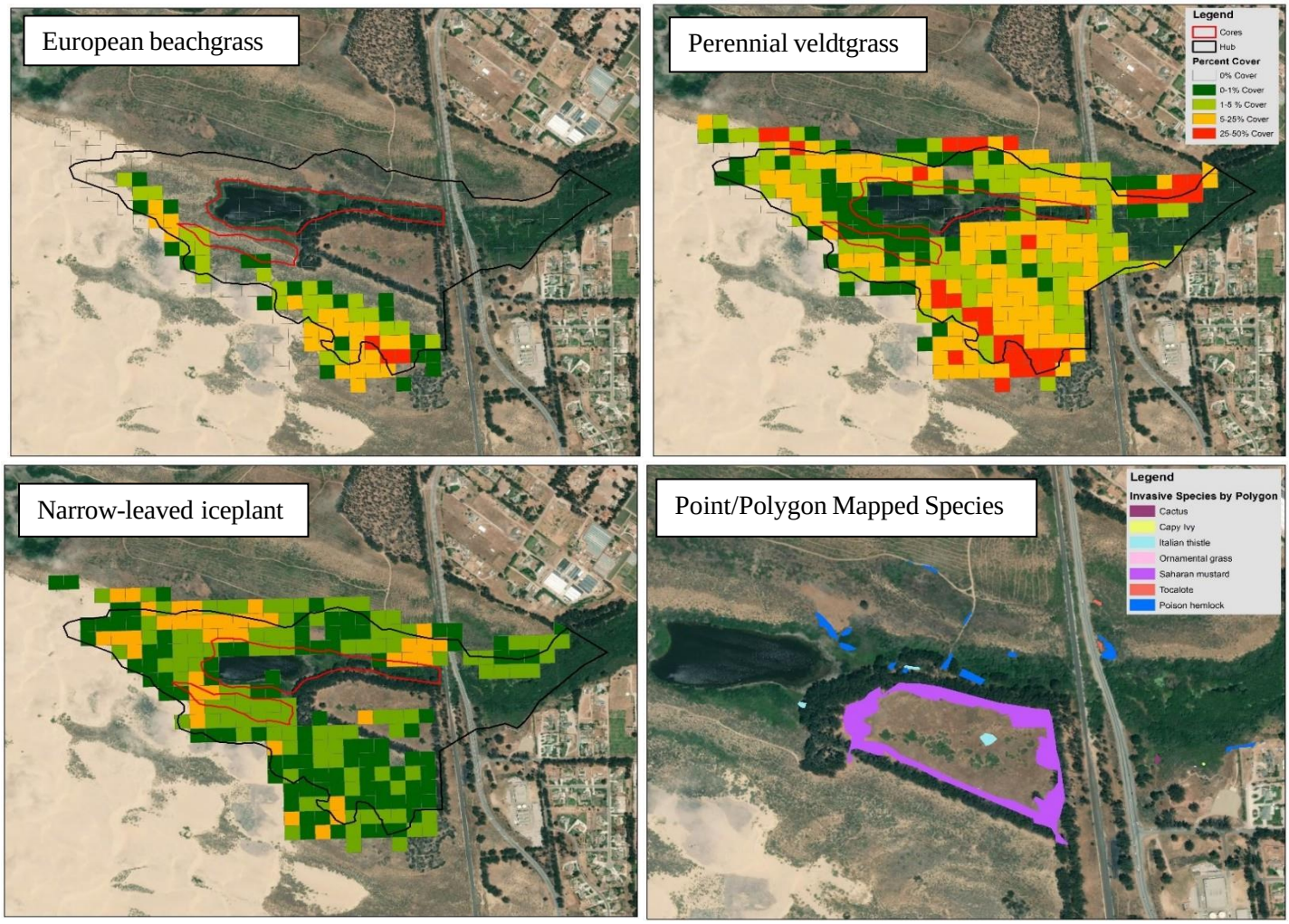


Figure 10: Invasive Species maps for Black Lake Ecological Area DPA.

Table 8: Infestation levels of widespread invasive species within the BLEA DPA.

Species Name	Net Acres		Gross Acres	
	Cores	**Hub**	**Cores**	**Hub**
European beachgrass	0.02	2.21	1.08	30.01
Narrow leaved iceplant	0.45	3.90	11.54	96.44
Perennial veldtgrass	0.27	12.17	11.38	117.81

Opportunity Prioritization

Based on the assets and threats in the BLEA DPA, opportunities for habitat restoration that meet the higher-level management goals were identified. Higher level management goals include:

For management, these opportunities were categorized into three tiers of Priority Opportunities (Priority 1, Priority 2, Priority 3). The tiers were set based on careful consideration of the opportunity and how it balances contributions to the higher-level goals while considering social, economic and ecological interests.

Priority 1 Opportunities will be those projects that contribute to the high-level goals, are cost efficient to implement and have a certain level of urgency in implementation. These are considered the highest priority restoration opportunities if funding is limited.

Priority 2 Opportunities will be those that contribute to high level goals, have a lower cost/benefit ratio than Priority 1 opportunities, but still achievable within a ten-year time frame.

Priority 3 Opportunities are those that contribute to high level goals, but are difficult to achieve because cost is prohibitive, success is unlikely, or there are political/social reasons that will keep them from being implemented.

Priority 1 Opportunities

Perennial veldtgrass control

Perennial veldtgrass is the largest threat to coastal dune scrub habitat in the Guadalupe Nipomo Dunes Complex. It is ranked "High" by California Invasive Plant Council for its severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. It has the ability to completely type convert the shrub dominated coastal dune scrub into a grassland. Veldtgrass is a perennial grass, which releases hundreds to thousands of seed creating extensive seedbanks. It is found throughout the DPA in low percent cover, but surrounding properties provide a constant seed source for re-introduction. Successful control methods use herbicide to kill the plant before going to flower. It is anticipated that this invader can be brought to manageable levels, however due to the extensive infestations throughout the GNDC, eradication will never be feasible and long-term monitoring and control will be required in perpetuity. Widespread threats such as this were the main drivers to creating the Dune Protected Areas Network. To ensure success, defensible spaces must be created to minimize reintroduction from neighboring propagules. Reducing the population to a manageable level is considered highly probable and essential to the health of this DPA.

Nipomo lupine reintroduction

Nipomo lupine was first described near this DPA, but natural populations have since become extirpated. The plant is now present and currently reproducing near Black Lake thanks to efforts of the USCB's Cheadle Center (Figure 16). The reintroduction was part of a strategy identified by the US Fish and Wildlife Service to better protect the species from extinction due to habitat conversion and climate change. It was set up as an experimental design to measure the success of the planting exposed to varying abiotic factors and herbivory levels. Two seed sowing events occurred using greenhouse bulked seed from wild collected *L. nipomensis* seed sources. The first sowing occurred on December 18, 2014 and a second sowing in December of 2015. A total of 1440 seeds were sown in each growing season. The population is small and is still under observation for experimental purposes. Removal of invasive species, especially perennial veldtgrass, is essential to the species protection. A nearby site contiguous with this DPA, Kathleen's Canyon Overlook has been pinpointed as a good site for expanded outplantings. Kathleen's Canyon Overlook offers an additional location to protect this federally endangered species. Proper invasive species control will be necessary at any future Nipomo Lupine outplanting sites. Because the plant has already been introduced to the site, this opportunity largely consists of monitoring and protecting the existing plants to help the population expand. The probability of success is unclear, but the resource investment is minimal.

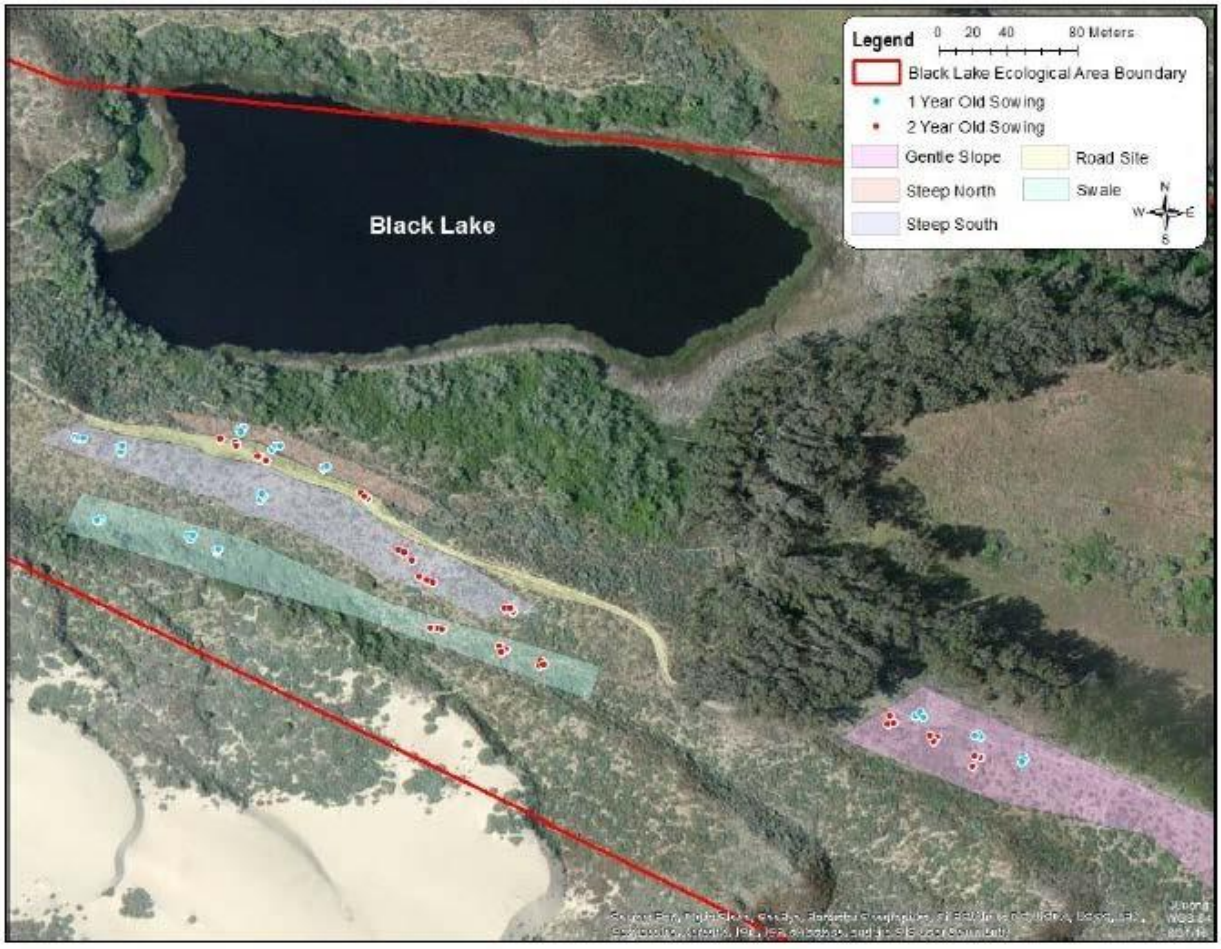


Figure 11: Nipomo lupine out-planting locations at the Black Lake Ecological Area.

Priority 2 Opportunities

European beachgrass control

European beachgrass is found on the southern boundary of this DPA, along the LCSLO and OSDVRA property boundary. European beachgrass forms a dense cover, spreading from rhizomes that excludes many native taxa including reduced arthropod diversity. It is an endophytic nitrogen fixation plant that results in increased ambient dune nitrogen levels. It's largest impact in the dunes is its ability to disrupt Aeolian formation of dunes resulting in altered dune geomorphology and altered dune succession (from Cal-IPC PAF). Controlling European beachgrass is a significant impact, and high probability of success, but still ranks as Priority 2 because it does not develop extensive seedbanks, so is not as immediate a threat as perennial veldtgrass. Because this is a distinct population, there is a high probability to achieve eradication without threat of re-introduction from outside areas if the adjoining population in the OSDVRA was also targeted.

Saharan mustard containment and control

Saharan mustard has been documented in Black Lake Canyon as early as 1984, however it has only recently started to explode in coastal dune scrub habitats. In this DPA it is primarily found near the historic homesite but is beginning to expand into surrounding habitats. Sahara mustard increases fuel loads, not normally found in coastal scrub habitats and encourages transitions to grassland. Seeds are especially sticky and easily tracked by boots and vehicles. Research on the species suggests each individual could produce over 10,000 seeds. It is an aggressive annual plant that has the potential to occupy suitable habitat for the endangered Nipomo lupine and can become a significant competitor for resources. The population is still distinct enough to eliminate from this DPA, however, due to nearby infestations, long term monitoring and removal will be mandatory. Probability for success is considered high.

Narrow leaved iceplant (*Conicosia pugioniformis*) control

Narrow leaved iceplant can be found throughout the DPA in low percent cover. This iceplant is perennial and reproduces by seed. Buried root crowns can resprout after aboveground matter has been removed. Individual capsules produce tens to hundreds of seeds. This species has only become prevalent in the GNDC in the last 20 years and is filling niches of rare and native plant species. It does not form mats like other invasive iceplants, so its impacts are less severe, but it can become locally abundant. It is ranked by Cal-IPC as "limited" meaning that they are invasive but there was not enough information available on ecological impacts to justify a higher score. To-date, this plant has not been directly targeted for control, but is treated opportunistically while treating other higher priority species. It is so widespread in the dunes, eradication is unlikely. Management will consist of maintaining populations at a low threshold level and can be done in conjunction with other invasive plant management in the DPA. Although long-term management is required, the probability of success keeping this species to a low level is considered high.

Blum gum eucalyptus tree containment and removal

Blue gums are present at Black Lake Ecological Area where a historic homesite existed. The historic homesite is surrounded by a mature stand of blue gums that creates a ring. These blue gums display an invasive nature near the riparian corridor entering Black Lake. Small seedling and yearling can be found expanding their range into the riparian area and outcompeting native species for resources and canopy. Any expansion past the historic homesite ring needs to be removed to protect riparian habitats and water levels in Black Lake. Manual removal is the most efficient method of removal for seedling and yearlings.

Inside the blue gum ring was once dominated by annual grasses and habitat restoration efforts have been successful in transforming the center into coastal scrub habitat. Removal of the southern wall of mature blue gums would allow connection to neighboring coastal scrub habitat. Connection between the two areas is currently not possible because of the large amount of dead plant material that covers the ground below the mature blue gums. Although non-native, the

structure of this stand of trees is important for several native species including the monarch butterfly. For this reason, only selective removal and containment is recommended to leave the monarch grove intact. The likelihood of success is high. This is a Priority 2 Opportunity because the spread of eucalyptus is slow, and the majority of impacts have already occurred.

Pond Lily restoration

Pond Lily has not been found at Black Lake since 2015. While not listed as a rare species, this population was once the most southern natural population of the species and was locally rare. It is thought the species has not been seen in recent years because of the loss of appropriate habitat. Much of the shallow banks of Black Lake Canyon have been filled in with bulrushes. Habitat restoration efforts for this species would include removal of the bulrushes along the shores.

Freshwater habitats Enhancement

Black Lake Canyon has a series of small freshwater marshes culminating in the larger marsh areas above Black Lake. This canyon once had substantial flows but now mainly supports large rain flows and ground water seepage. Habitat restoration would include the enhancement of riparian and wetland habitat for listed species, most notably the listed species Marsh Sandwort and Gambel's watercress. Currently, the only major invasive weed impacting wetland habitats in the BLEA DPA is poison hemlock (*Conium maculatum*). In the GNDC, poison hemlock is generally only competitive in areas with abundant moisture. This makes it problematic in dune swales, riparian and wetland habitats. It is ranked by the California Invasive Plant Council as a "Moderate" risk invader.

Priority 3 Opportunities

Dune Succession Restoration

Black Lake is the terminus of Black Lake Canyon and water in this passage never connects to the ocean. As natural dune successional habitat changes progress, sand moves with the wind inland. Sometimes active dunes will migrate inland, but typically, there is a succession of vegetation that slowly stabilizes the sand the farther you go inland. Vehicular traffic in the dunes has altered this natural succession and now active dunes are migrating towards Black Lake and may eventually bury the lake. Foredune and early pioneering coastal scrub species need to be restored to prevent Black Lake from filling with sand. This would require limiting off-road riding areas. This opportunity was assigned a Priority ranking of 3 because it was determined to be infeasible with the current land use.

Highway 1 Culvert Connectivity Enhancement

A culvert runs under Highway 1, connecting waters from Black Lake Canyon to Black Lake. This is one of the few corridors for plants and animals to move into and out of the greater dune system. The condition of the culvert is unknown due to heavy riparian vegetation but is likely in disrepair. Natural flows through the culvert have been decreased because of major debris jams

and deterioration of the culvert. In addition, habitat connectivity is degraded by this constriction point. Upgrades to the culvert would allow for better wetland connectivity in the Black Lake Canyon waterway. Any work in this area would require coordination with Cal Trans. A free span bridge replacement of the culvert would be the ideal scenario. It was ranked Priority 3 because the project is cost prohibitive for current funding levels.

Active Habitat Restoration

Although passive restoration of habitat is expected in areas receiving invasive species removal. In some instances, the native seedbank is not resilient enough to recover the habitat as fast as areas containing robust seedbanks. If long term monitoring shows that natural recruitment is not happening, the application of native seed may be needed to restore ecosystem function and habitat, provide benefits to wildlife, and stabilize the site from wind and water erosion. This was selected as a Priority 3 Opportunity because it will take over five years before we can determine if passive recruitment is not happening.

Management Objectives, Actions, Method, Timeline and Budgets

Priority 1 Opportunities

Opportunity 1A: Perennial veldtgrass control

Objective 1A: Reduce and maintain perennial veldtgrass cover to 1-5% cover class in the BLEA DPA (Hub & Core).

Action 1A.1: Do baseline survey of perennial veldtgrass cover classes throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

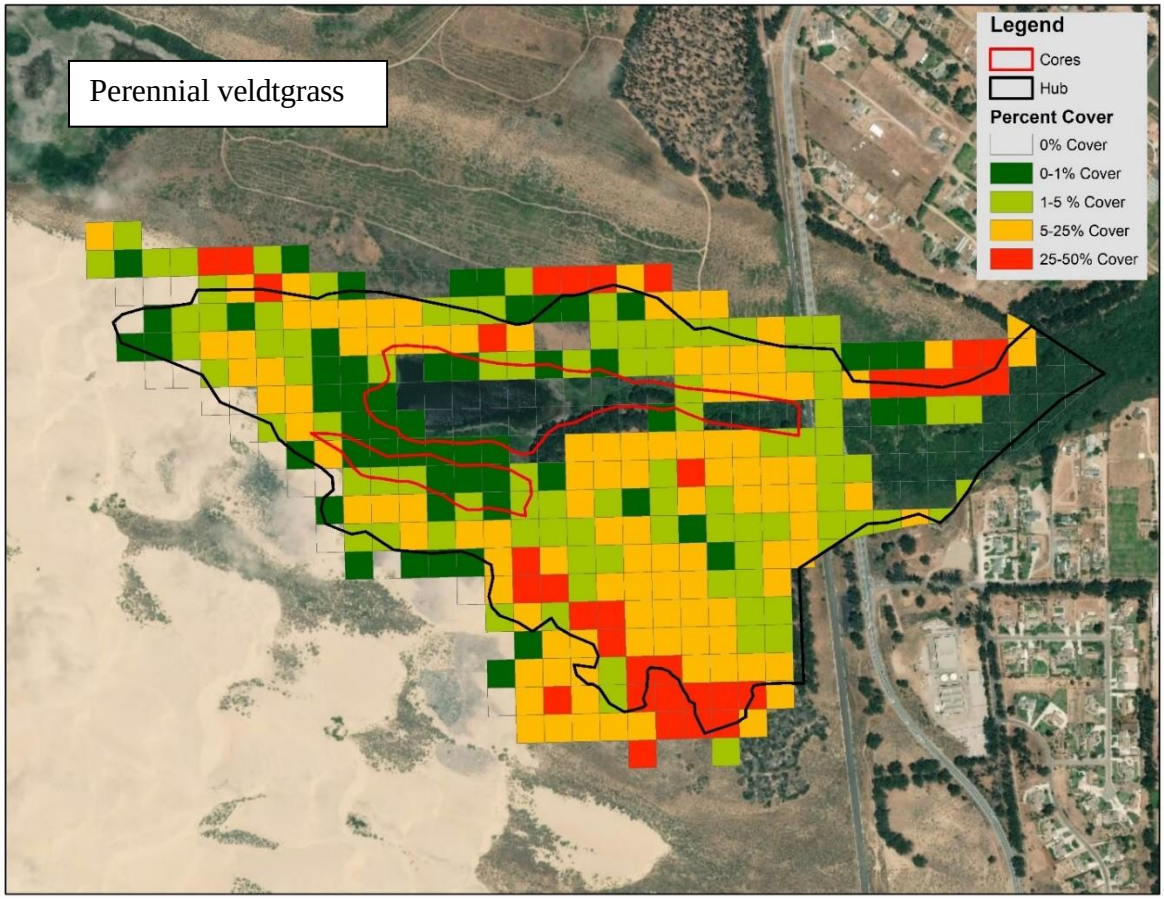


Figure 12: 50-meter grid baseline survey of perennial veldtgrass cover in the BLEA DPA.

Action 1A.2: Control perennial veldtgrass within the BLEA DPA (Cores and Hub) (129.19 acres gross: 12.44 Acres Net) while creating defensible spaces to minimize reintroduction from plant propagules.

Methods:
Perennial veldtgrass is a cool season perennial grass with a C3 photosynthetic pathway. Reproduction is by seed and short rhizome. Dispersal mechanisms include wind, water, birds and mammals. It develops large, but relatively short-lived seedbanks. The seedbank can be significantly reduced within 5 years. The rhizomes are used as a strategy to survive periods of drought and can be a source of resprouting after herbicide treatments. New plants can flower and set seed within 1 year and there can be multiple seeding events throughout the year.

For small infestations, manually remove the plants ensuring crown removal. Dense infestations will be treated with a broadcast application of a grass specific herbicide such as Fusilade DX (fluazifop-p-butyl) to minimize off-target damage to natives. Once the population is reduced to spot treatments, herbicides can be switched to a non-selective herbicide such as Roundup Pro

Conc (glyphosate). Treatments typically occur in two large spraying events with follow-up spot treatments or hand removal to eliminate any plants that escaped the initial treatments. Of the three grass herbicides available for use on veldtgrass, Arrow 2EC (clethodim) shows the most promise for control. Unfortunately, it is currently not labeled for use in wildland areas so is not an option at the BLEA DPA. It is also important to note that herbicide resistance to clethodim by an *Ehrharta* species has been documented in Australia after 7 years of use. This is a good reminder to switch up the herbicide mode of action periodically to ensure herbicide resistance does not develop in the Guadalupe Nipomo Dunes Complex.

Grass herbicide treatment timing typically occurs in the wetter winter season. These herbicides are most effective on actively growing plants before the "boot stage" when flower heads begin to form in the grass. After this time, glyphosate-based herbicides become much more effective than the grass herbicides.

After three years of control, areas not successfully recolonizing through the native seedbank should be augmented with additional native seed applications. Seeding rates will vary based on the species being broadcast.

There are 60 acres of area in this DPA that have dense, previously untreated areas of perennial veldtgrass. Those areas will be treated with an aerial application of herbicide to save money until the population is brought to a manageable level. Follow-up in those areas will be done using ground-based applications.

Treatment Schedule:
Herbicide Treatments will involve two broadcast treatment events per year. Year 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. During this time, there should be a significant drop in the percent cover. Yr. 3-10 will involve follow-up monitoring and spot treatments of any reintroductions. Although the seedbank is short-lived, the chance for re-introduction is high. Treatment of perennial veldtgrass anywhere in the Guadalupe Nipomo Dunes Complex should be considered a long-term endeavor requiring diligent follow-up. The table below highlights the expected timing of treatment strategies.

Table 9: Seasonal treatment strategies for perennial veldtgrass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Perennial Veldtgrass (*Ehrharta calycina*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Poast 1.5 pt product/acre - foliar spray			Poast 1.5 pt product/acre - foliar spray								
	Chemical	not water stressed	5+ Years		Roundup Pro Conc 1.5% v/v foliar spray			Roundup Pro Conc 1.5% v/v foliar spray							
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Fusilade DX 1-1.5 pt product/acre - foliar spray			Fusilade DX 1-1.5 pt product/acre - foliar spray								

Opportunity 1B: Nipomo lupine reintroduction
Objective 1B: Reduce and maintain invasive plant cover to 1-5% within a 25-foot buffer of Nipomo lupine populations.

Action 1B.1: Do baseline survey of invasive plant cover classes within 25 Ft. buffers to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

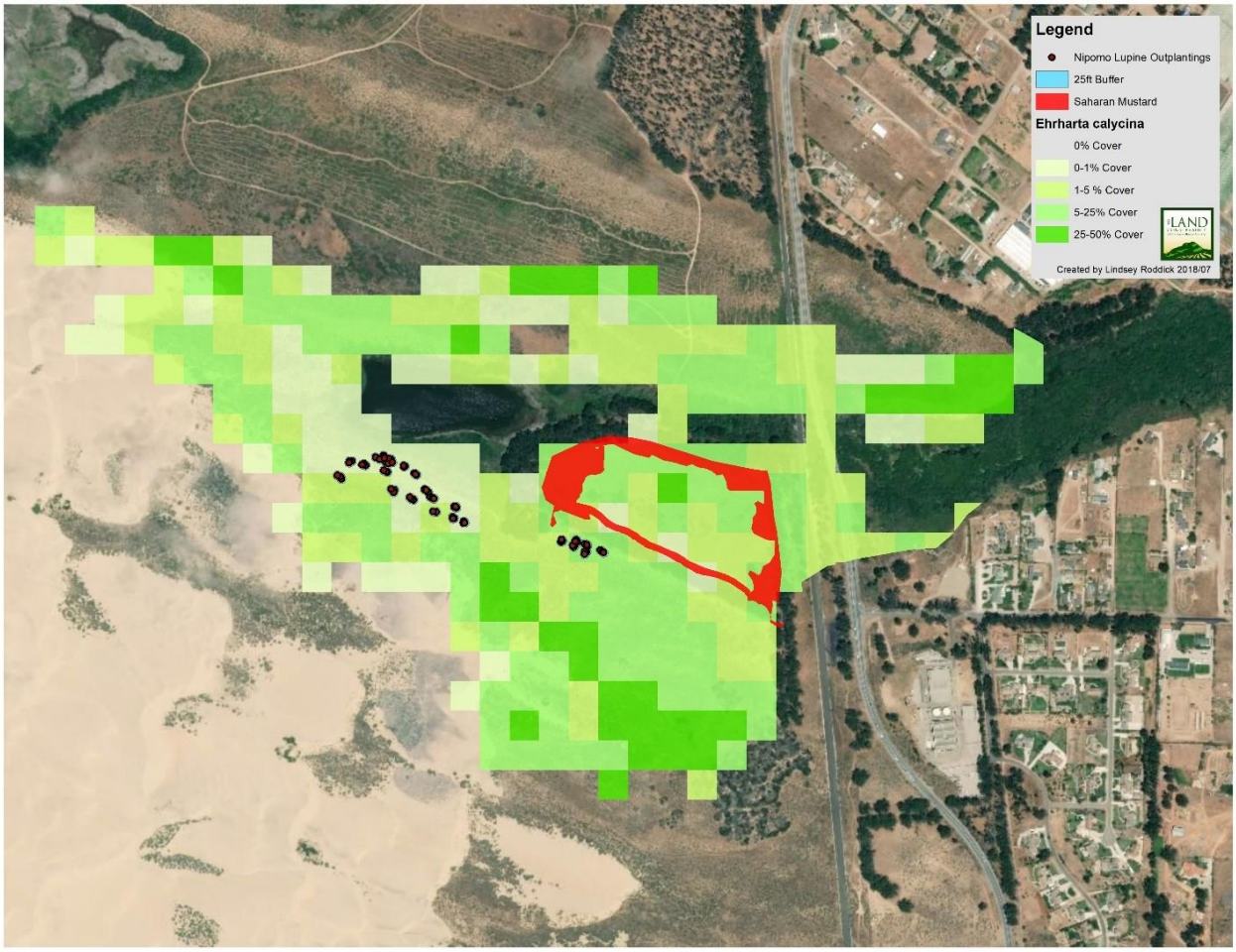


Figure 13: Baseline survey of priority invasive species threats to Nipomo lupine populations.

Action 1B.2: Control invasive plants within the 25 ft. Buffer area of Nipomo lupine populations (8.03 Gross Acres, 0.281 Net Acres)

Methods: According to the Land Conservancy's 2081(a)-15-003-RP Permit with the CA Department of Fish and Wildlife, invasive plant control with a 15-25 ft. buffer of Nipomo lupine plants can only be performed using manual removal techniques. Hand pulling invasive plants can be an effective strategy in small areas, however the site must be revisited several times during the year, especially after big rain events. The predominant weeds impacting Nipomo lupine are perennial veldtgrass and Saharan mustard.

Treatment Schedule:

Table 10: Seasonal timing of manual removal for perennial veldtgrass and Saharan mustard.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Saharan mustard (*Brassica tournefortii*)	Annual Herb -- Life cycle:			Active Growth		Flower	Fruit							Emergent	
	Manual	before seeding	3+ Years		Hand remove plants including root before fruiting.										
Perrenial Veldtgrass (*Ehrharta calycina*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										

Priority 2 Opportunities

Opportunity 2A: European beachgrass control

Objective 2A: Reduce and maintain European beachgrass cover to 1-5% cover class within the BLEA DPA (Hub & Core).

Action 2A.1: Do baseline survey of European beachgrass cover classes throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

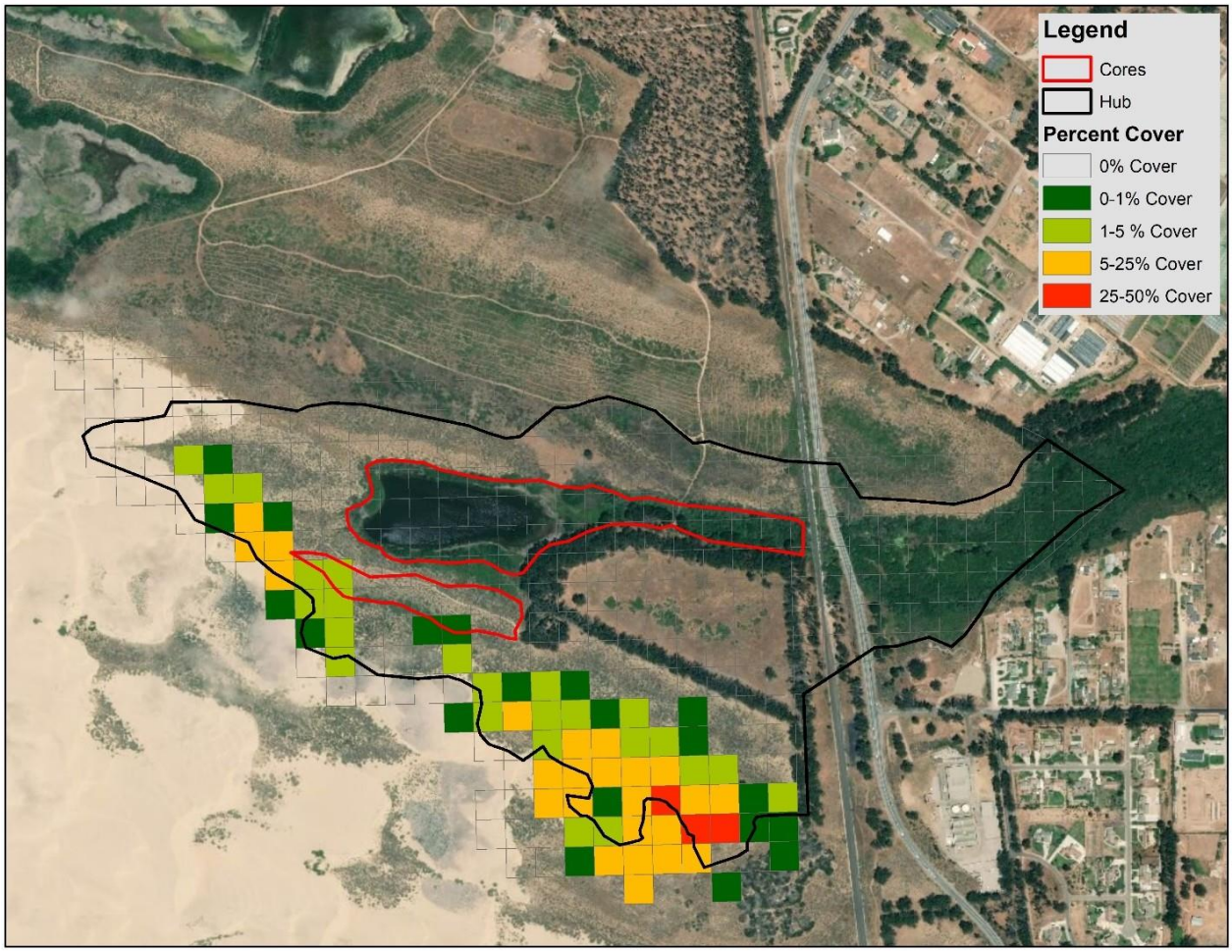


Figure 14: Baseline survey of European beachgrass in the BLEA DPA.

Action 2A.2: Control European beachgrass within the BLEA DPA (31.09 acres gross: 2.23 Acres Net) and coordinate with neighboring State Parks to control beachgrass on their property along the boundary of the DPA.

Methods:
European beachgrass predominantly spreads through underground rhizomes with a limited seedbank. This buried rhizome system can be very dense and can survive sand burial of up to 3.3 meters. Successful control of the plant depends heavily on the ability to kill this underground rhizomatous root structure. Much work has been done evaluating the effects of different treatments on beachgrass in coastal dune systems. Hand removal has proven to be expensive and relatively ineffective as one needs to continually remove biomass until the below ground root system becomes starved. Burning above ground biomass followed by herbicide treatments have proven successful but is difficult in this area due to nearby residences and air quality restrictions in the area. Unfortunately, grass specific herbicides have also proven to be ineffective. Foliar applications of glyphosate can be effective if timed correctly when the plant is actively growing, and the phloem is translocating downward into the roots. Unfortunately, glyphosate applications alone require a high application rate and require several years of follow-up treatment due to re-sprouting from the root-mass. The most effective method currently used involves a foliar application of herbicides containing glyphosate mixed with those containing imazapyr. Imazapyr is an amino acid synthesis inhibitor with soil residual activity that is able to move into the soil profile and kill the extensive root system. This typically requires one large application followed by several years of follow-up treating re-sprouts. The level of effort drops off significantly after the first year. Because imazapyr is a broad-spectrum herbicide, off target damage is expected. Monitoring native plant regeneration after treatment is necessary to ensure good recovery of the native plant community. If this is not happening, supplemental seeding may be required.

In foredune situations, rhizomes should be "ripped" with a bulldozer to break up the unnaturally stabilized dunes and re-establish natural dune processes. However, at this site, the habitat is coastal dune scrub and soil stabilization is desirable. Although extensive ripping of the root structure is not recommended, some biomass removal and raking is needed to facilitate native plant recruitment.

Treatment Schedule:
Herbicide treatments will involve one treatment event per year. Year 1 will be considered the "knock down" phase and will constitute the bulk of the effort. Years 2-3 will involve follow-up monitoring and spot treatments of any re-sprouts. The level of effort in those years should decrease significantly dropping off to negligible by year 5. The table below highlights the expected timing of treatment strategies.

Table 11: Seasonal treatment strategies for European beachgrass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
European beachgrass (*Ammophila arenaria)*	Chemical	not water stressed	2+ Years				Tank Mix Roundup Pro Conc 2.0 % - Imazapyr 1% v/v foliar spray								

Opportunity 2B: Saharan mustard containment and control

Objective 2B: Contain the 2018 infestation of Saharan mustard to its current location and reduce and maintain the infestation level to 0-1% cover within the BLEA DPA (Hub & Core).

Action 2B.1: Do baseline survey of Saharan mustard cover classes throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

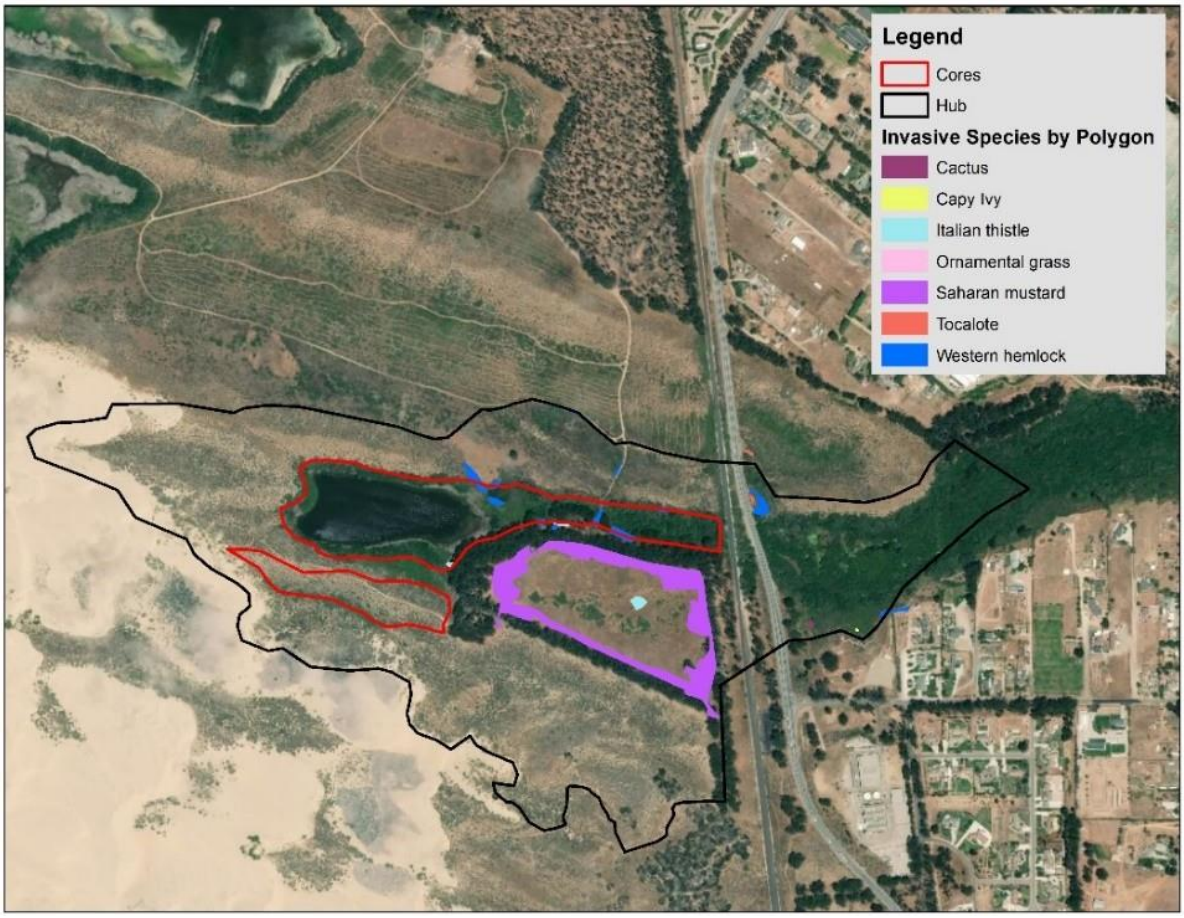


Figure 15: Baseline survey of Saharan mustard in the BLEA DPA.

Action 2B.2: Control Saharan mustard within the BLEA DPA (8.43 Acres Gross: 1.26 Acres Net).

Methods:
Saharan mustard is a winter annual herbaceous plant. It is categorized as highly competitive and has a survival strategy of early and quick growth. It reproduces solely by seed. One plant can produce up to 10,000 seeds, which stay viable for several years in the soil. Seeds are transported by wind, being cached by rodents, or by hitchhiking a ride on contaminated equipment, tools or people.

Physical/Mechanical/Cultural Control Strategies - Hand pulling the plants can be an effective in reducing the population. However, the site must be revisited several times during the year after big rain events. Because the plant is an annual, repeated flaming of seedlings in the cotyledon stage with a propane torch may be effective but has not worked when done to plants already in the basal rosette stage.

Chemical - Herbicides may be an effective method of controlling Sahara mustard, especially those that are selective and allow competition from neighboring plants to increase. If possible, applications should occur before flowering stage. After flowering stage, the technique should switch to hand removal. It is important to note that herbicide resistance has developed in this plant to sulfonylurea herbicides in Australia. Therefore, an integrated approach to control is highly recommended. Herbicides containing glyphosate (Roundup Pro Conc), tricolpyr (Garlon 4 Ultra) and chlorsulfuron (Telar) have all proven successful at controlling annual mustards. The infestation at the BLEA DPA is dense enough to require a broadcast application with follow-up spot treatments and finally hand pulling once plants are flowering. There can be several flushes of the seedbank throughout the short season, so diligence in doing several control treatments is required. The seedbank should be substantially reduced within three years.

Treatment Schedule:
Treatments occur annually throughout the winter and spring. There can be multiple flushes from the seedbank requiring two or more treatment events will be required to prevent plants from germinating.

Table 12: Seasonal treatment strategies for Saharan mustard.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
ANNUAL HERBS															
Saharan mustard (*Brassica tournefortii*)	Annual Herb -- Life cycle:			Active Growth		Flower	Fruit							Emergent	
	Manual & Mechanical	flame early cotyledon stage wet conditions	3+ Years			Hand pull plants missed by other treatments								Re-peat Flaming with propane torch	
	Chemical	early growth before flower	3+ Years	Glyphosate 2% v/v solution spot application										Glyphosate 2% v/v solution spot application	
	Chemical	early growth before flower	3+ Years	Triclopyr 2% v/v solution spot application										Triclopyr 2% v/v solution spot application	
	Chemical	early growth before flower	3+ Years	Chlorsulfuron 0.75-1.5 oz a.i./acre pre or post emergence										Chlorsulfuron 0.75-1.5 oz a.i./acre pre or post emergence	

Opportunity 2C: Narrow leaved iceplant control:

Objective 2C: Reduce and maintain narrow leaved iceplant cover to 1-5% cover class within the BLEA DPA (Hub & Core).

Action 2C.1: Do baseline survey of narrow leaved iceplant cover classes throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

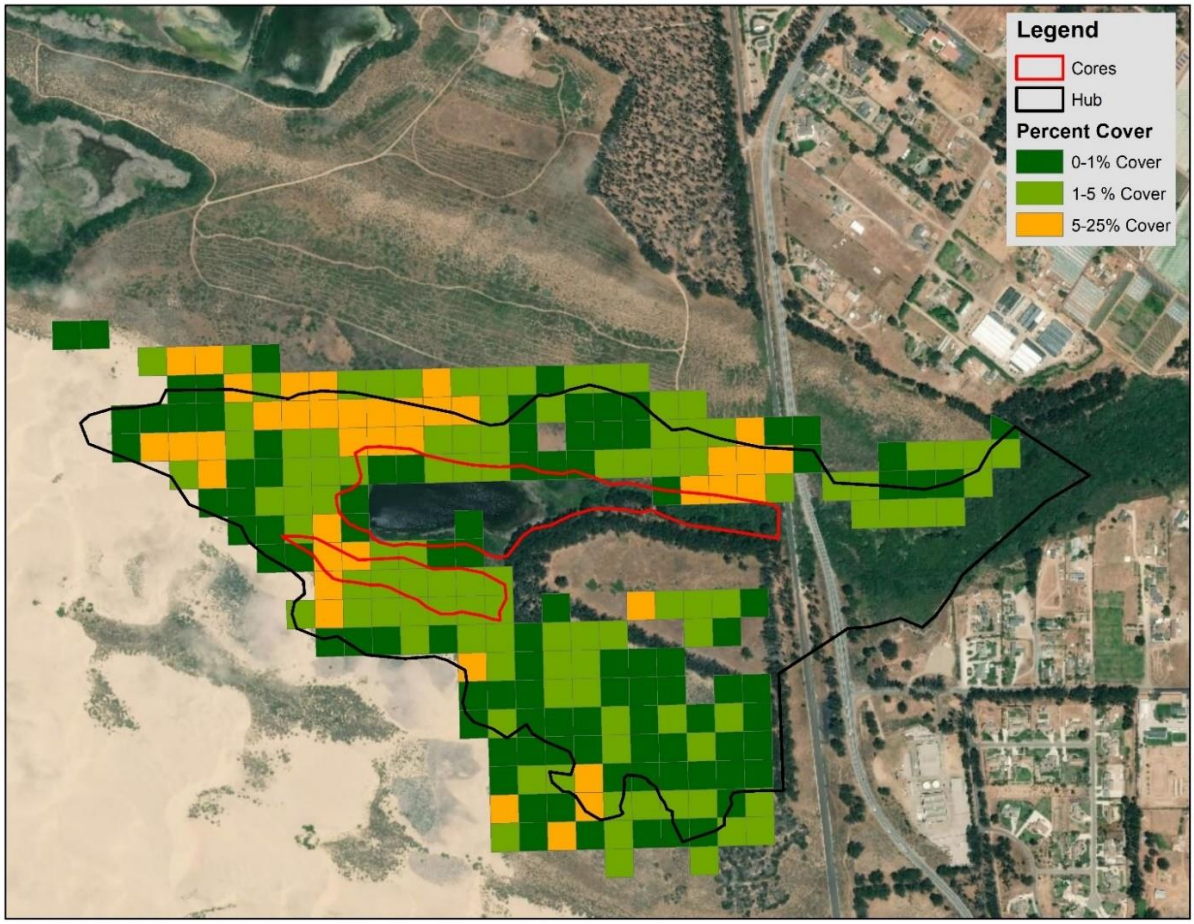


Figure 16: Baseline survey of narrow leaved iceplant in the BLEA DPA.

Action 2C.2: Control narrow leaved iceplant within the BLEA DPA (Cores and Hub) (107.98 acres gross: 4.35 Acres Net), while creating defensible spaces to prevent wind dispersed seeds from re-infesting the BLEA DPA.
Methods:

Narrow leaved iceplant is a relatively short-lived (10 years) herbaceous plant. It can shift between CAM and C3 photosynthetic pathways which allows for growth during periods of high temperature and low water availability. This may increase its invasive ability under some climate change scenarios. The plant can flower in the first or second year. Reproduction is by seed. The predominate dispersal mechanism is wind as the capsules are blown across the ground. Narrow leaved iceplant does not appear to be very competitive with native shrubs or non-native grasses but seems to quickly take advantage of open spaces left after invasive plant control of other species like perennial veldtgrass. The plant is widely distributed throughout the dune system, but in general, appears to exist at low infestation levels with occasional population explosions.

Infestations can be treated by manually removing the plants ensuring crown removal. Plants can also be treated with a non-selective systemic herbicide like glyphosate (ex. Roundup Pro Conc). Only passive restoration is suggested for those areas treated for narrow leaved iceplant.

Treatment Schedule:
Herbicide Treatments will involve one treatment event per year. Years 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. During this time, there should be a significant drop in the percent cover. Ongoing maintenance will involve follow-up monitoring and spot treatments of any reintroductions. Treatment of narrow leaved iceplant anywhere in the Guadalupe Nipomo Dunes Complex should be considered a long-term endeavor requiring diligent follow-up. The table below highlights the expected timing of treatment strategies.

Table 13: Seasonal treatment strategies for narrow leaved iceplant.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment	WINTER			SPRING			SUMMER			FALL			
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
	Perennial Herb -- Life cycle:			Fruit	Active Growth		Flower						Fruit			
Narrow leaved iceplant (*Conicosia pugioniformis*)	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root											
	Chemical	not water stressed	5+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray											

Opportunity 2D: Blum gum eucalyptus tree containment and removal:

Objective 2D: Contain the spread of eucalyptus trees within the BLEA DPA (Hub & Core).

Action 2D.1: Do baseline survey of eucalyptus tree distribution throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years as part of the habitat mapping. Eucalyptus trees are denoted as non-native forest.

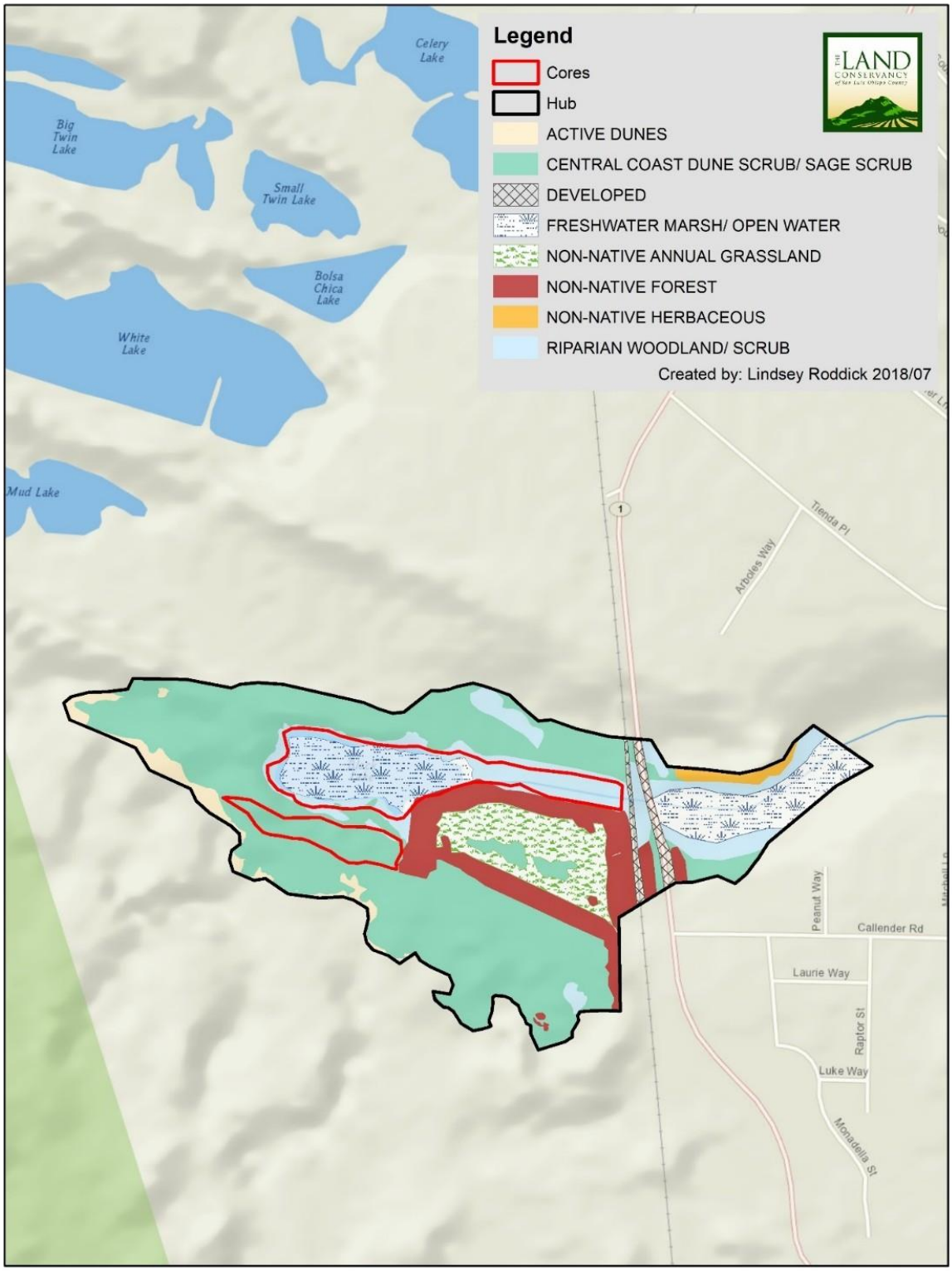


Figure 17: Baseline survey of eucalyptus trees (non-native forest) in the BLEA DPA.

Action 2D.2: Remove trees on the expanding edge of the mapped distribution which are less than eight inches in diameter at four feet above grade (*Note: that size is exempt from tree removal permits). Particular attention will be paid to trees expanding into wetland areas of the BLEA DPA.

Methods:
Eucalyptus seeds have a low germination rate (0.1-1%) and are relatively short lived (1 year). They are dispersed by wind and water. Expansion is not very rapid, making treatments not as critical as Priority 1 species. Vegetative reproduction does occur making control difficult. Re-sprouting occurs from cut stumps as well as underground lignotubers. Smaller saplings of eucalyptus can be removed manually with a "Weed Wrench", a tool that allows mechanical leverage advantage for plant removal, ensuring removal of the root crown. If too large for manual removal, the plant should be cut with a chainsaw and stump treated with an appropriate herbicide to reduce re-sprouting. Only young trees expanding from the main population should be removed. Within the known population, mixed age structures of trees enhance habitat diversity and are considered desirable.

Treatment Schedule:
Treatment timing can occur at any time of the year; however, care should be taken not to disturb overwintering monarch butterflies (late October to February) and nesting birds. This activity can be accomplished in 1 day per year.

Opportunity 2E: Blum gum eucalyptus tree selective removal:

Objective 2E: Remove the southern wall of the "eucalyptus tree homesite ring" to re-establish habitat connectivity of coastal dune scrub in the next five years (approx. 2 acres).

Figure 18: Black Lake (looking east up Black Lake Canyon) with removal location in red.

Figure 19: Eucalyptus Ring Targeted for Removal (View from the North)

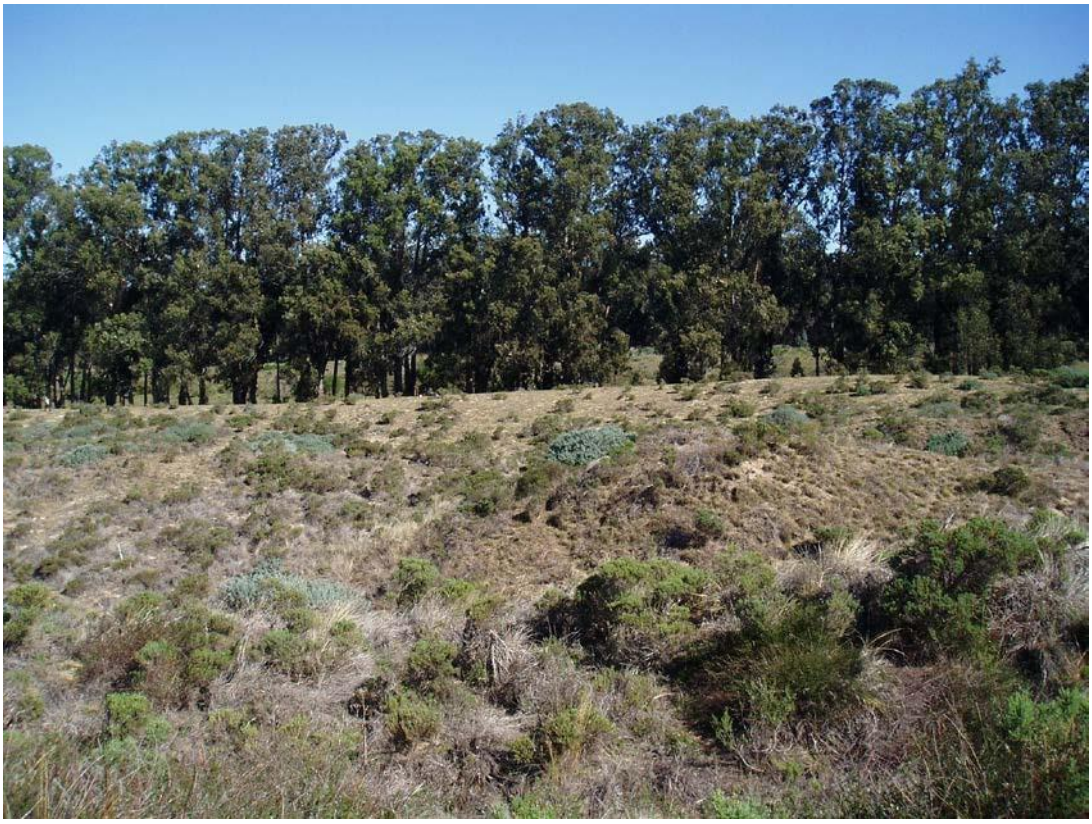


Figure 20: Eucalyptus Ring Targeted for Removal (View from the South)

Action 2E.1: Acquire necessary permits. Before removing trees, there are several permits and approvals that must be secured. Step one would be to consult with monarch butterfly experts to help design tree removal locations to ensure that existing monarch overwintering colonies are not affected. Next contact the San Luis Obispo County Department of Planning and Building to secure a tree removal permit (cost $126 base fee for 5 trees plus $23 for each additional tree). Because of the location of this project in relation to the off-road riding areas, approval should also be secured from the SLO County Air Pollution Control Board.

Action 2E.2: Remove eucalyptus trees along the southern edge of the "Eucalyptus ring".

Methods:
The trees in this area are quite large and best removed by a professional tree removal service. After trees removal, the stumps should be ground out or an herbicide application needs to be made to the cambium layer of the trunk to ensure re-sprouting does not occur. Leftover wood should be "bucked up" and removed or ground into sawdust that can be spread as mulch at the site. Upon removal of eucalyptus trees, considerable leaf litter may be left onsite. This biomass should be collected and distributed under existing forest canopy where the impact is already occurring. In addition, any eucalyptus tree re-sprouts should be treated with an appropriate herbicide.

Treatment Schedule:
Treatment timing can occur at any time of the year however, care should be taken not to disturb overwintering monarch butterflies (late October to February) and nesting birds. Timing should allow for maximum flexibility to get the best price possible for removal. There are several tree removal services in the area and this may also be a good candidate for Cal-Fire training exercises to help mitigate the costs. Follow-up re-sprout treatments will be most effective during the rainy season when the plants are actively growing (October – March). These should occur annually until no re-sprouts are found.

Opportunity 2F: Pond lily restoration:

Objective 2F: Remove bulrushes and maintain ½ acre of open shoreline from select areas around Black Lake to increase habitat for pond lily.

Action 2F.1: Permitting - Determine if permitting is necessary for removal of bulrushes from Black Lake as part of on-going maintenance. Permitting may include a Streambed Alteration Agreement from CA Department of Fish and Wildlife.

Timeline: this action needs to be done before any removal activities happen. If permits are needed, expect one year to secure permits.

Action 2F.2: Remove bulrush along ½ acres of shoreline around Black Lake. This should be done in areas which historically contained pond lily populations.

Methods:
Maintaining areas suitable for pond lily will be a long-term maintenance event. At this time, we do not recommend chemical removal of bulrush because of expensive permitting requirements and potential non-target impacts. Mechanical removal is the preferred strategy. This can be done with "Aquatic Vegetation Groomers" which are essentially weed whackers with a brush blade that are capable of being submerged under water. Plants should be cut below the water for maximum control and preferably at a time when the plant is putting most of its energy into flowering, which will help deplete energy reserves in the roots. This activity may not be required annually, but rather should be done on an "as-needed" basis. After bulrushes are cut, they should be removed from the lake and composted onshore to minimize the effects of vegetation material decay on the aquatic system.

At this time, no sources of pond lily have been found for re-introduction. Therefore, passive restoration of the plant is the desired outcome.

Figure 21: Black Lake shoreline being encroached on by bulrushes.

Figure 22: Last known population of pond lily in Black Lake.

Treatment Schedule:

At this time, mechanical control of bulrush is recommended. Stems should be cut below the water surface when the plant is flowering. This is the best timing to exhaust resources stored in the rhizomes. If pond lily is detected, efforts should be made to collect seeds and/or rhizomes to attempt propagation in a nursery for future outplantings.

Table 14: Treatment strategies for bulrush control at Black Lake.

Treatment Strategies for Hardstem Bulrush in Black Lake																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Hardstem bulrush (*Schoenoplectus acutus*)	Bulrush -- Life cycle:			Active growth						Flower			Fruit		
	Mechanical	submerged for >2wks	Long-term Management							Mowing and cutting with all stubble submerged for >2 weeks					
	Chemical	Best when fruiting and energy is going to rhizomes	Long-term Management							Glyphosate offers excellent control applied Summer and Fall					
	Chemical	Best when fruiting and energy is going to rhizomes	Long-term Management							Imazapyr offers excellent control applied Summer and Fall					
Rocky mountain pond-lily (*Nuphar polysepala*) Conservation Target for Restoration	Pond-lily -- Life cycle			Active Growth			Flower				Fruit		Inactive Growth		
	Restoration activities						Monitor				Collect Seeds in sunken flower heads		Collect Rhizomes for propogation		

Opportunity 2G: Freshwater habitats enhancement:

Objective 2G: Reduce and maintain poison hemlock cover to 1-5% cover class with in the BLEA DPA (Hub & Core).

Action 2G.1: Do baseline survey of poison hemlock cover classes throughout the BLEA DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every five years.

Figure 23: Poison hemlock baseline survey in wetland areas around the BLEA DPA.

Action 2G.2: Control poison hemlock within the BLEA DPA (Cores and Hub) (1.27 acres gross: .16 Acres Net).

Methods:
Poison hemlock is a biennial herbaceous plant. During the first year, growth is limited to a large basal rosette. Plants bloom from spring into summer of its second year and usually dies after setting seed. The dead stems left behind can persist into winter. Reproduction is solely by seed. The seed does not have an effective mechanism for long distance dispersal. Therefore, re-invasion is unlikely. 85% of seeds germinate in the first year, while 15% remain dormant. Seeds germinate from late summer to early spring. Seeds remain viable for only 2-3 years. If the seedbank is managed properly, eradication of this species in the DPA is possible.

For small infestations, manually remove the plants ensuring entire taproot is also removed to prevent re-sprouting. This plant is toxic to humans, so care should be taken to avoid contact with skin or accidental ingestion.

Dense infestations should be treated with herbicide, preferably in the seedling or rosette stage. Care should be taken in applying any herbicides near wetland areas. Depending on the location of the plant, Permits and restrictions may apply. Triclopyr is a broadleaf selective herbicide that has proven effective in controlling poison hemlock. Glyphosate is a non-selective herbicide that has also proven effective when applied to actively growing plants before they bolt. Although the Apiacea Family is not listed on the label, there is some anecdotal evidence that herbicides containing aminopyralid may be effective as well.

Manual and chemical treatments will require repeated applications for a couple of years until the seedbank has been significantly depleted.

Treatment Schedule:
Herbicide Treatments will involve two broadcast treatment events per year. Years 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. During this time, there should be a significant drop in the percent cover. Years 4-10 will involve follow-up monitoring and spot treatments of any reintroductions. The seedbank is short-lived and the chance for re-introduction is low. However, periodic monitoring should occur to ensure plants aren't getting re-introduced. The table below highlights the expected timing of treatment strategies.

Table 15: Treatment strategies for poison hemlock.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL			
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
PERENNIALS & BIENNIALS																
	Biennial Herb -- Life cycle:			Active growth				Flower			Fruit		Reduced growth			
Poison Hemlock (*Conium maculatum*)	Chemical	early rosette	3 Years	Garlon 3A 0.5-1.0 % v/v foliar spray												
	Chemical	early rosette	3 Years	Roundup Custom 2-5 % v/v foliar spray												

Preventing or Mitigating Effects to Non-Target Resources

While implementing habitat restoration activities it is important to make sure that important natural resources you are trying to protect are not negatively affected in the process. Every method of restoration has its benefits and costs that should be carefully weighed before doing any work.

During any activities or monitoring at the site, people involved will be trained in identifying and avoiding wildlife and sensitive resources. Buffers will be placed and clearly identified around known sensitive areas where care must be taken. Resources in considerable need of protection at the BLEA DPA are the endangered Nipomo lupine (*Lupinus nipomensis*), sensitive cryptogamic soil crusts found on north facing stabilized dune slopes, and overwintering monarch butterfly colonies in the eucalyptus tree grove. The following practices will be implemented working around these resources.

Nipomo lupine*:* A 25 buffer will be identified around any known populations. No herbicide treatments are to occur in these buffer zones. While working in these zones during the Nipomo lupine growing season (October-June), considerable care will be taken to avoid trampling.

Cryptogamic soil crusts: These soil crusts are microscopic non-vascular assemblages of lichens and mosses. Intact soil crusts can prevent erosion from wind and water and increase soil moisture and seedling establishment. They are extremely fragile and breaking soil crusts by walking on them can take decades to recover. Symbolic fencing with signage will be placed around intact soil crusts. Those areas will be avoided if at all possible. If travel is necessary in these areas, work will be done by the least amount of people necessary with special care taken to minimize impacts.

Monarch butterfly: Monarch butterflies rely on a dense stand of blue gum eucalyptus trees at the BLEA DPA for overwintering. Although this tree is non-native and a target of selective removal, considerable care will be taken to ensure the overwintering colony is not affected. Before removal of trees, surveys will be done to identify areas important for overwintering habitat and local experts will be consulted on the optimal strategy to avoid impacts to the habitat. This will most likely involve working outside of the overwintering season, and ensuring an adequate buffer is in place to ensure proper protection of colonies from wind is maintained.

One of the management tools that has the potential for non-target damage is chemical control through herbicides. When herbicides are used, a recommendation from a state-licensed Pest Control Advisor should be used and in most cases is required. An herbicide's potential risk to aquatic and terrestrial wildlife is assessed by the EPA before the product is registered for use in

wildlands. Therefore, it is extremely important to closely follow the label for handling and using pesticides.

In most cases though, just following the label isn't enough. The land manager and PCA must carefully weigh the toxicity of the herbicide and the likelihood of exposure to non-target organisms. Only then can the Land Manager decide if an herbicide can be used without undue risk and develop mitigation measures to reduce that risk. Specific mitigation measures will be identified in the written PCA recommendation.

Exposure to non-target organisms increases with broadcast applications of herbicide. Broadcast applications increase exposure through direct herbicide contact and feeding on contaminated plants. Organisms that are browsers are most at risk from increased exposure through feeding on contaminated foliage, seeds or fruits. When possible, spot treatment of herbicide significantly reduces the exposure level to non-target organisms. The following tables provide information on herbicides most frequently used in the GNDC. They contain information important to evaluate and select herbicides based on efficacy, toxicity, exposure potential and fate in the environment. Any adjuvants used to enhance herbicide efficacy will be put through the same level of scrutiny as the herbicides.

Table 16: Herbicide characteristics.

Herbicide	Active Ingredient	Other Ingredients	Target Species	Mode of Action	Adsorption Potential	Primary Degradation Mech	Average Soil Half-life
Fusilade DX	Fluazifop-P-Butyl	Napthalene (<5%)	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	high	microbial metabolism and hydrolysis	15 days
Poast	Sethoxydim	Napthalene 7.32%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	Microbial metabolism and photolysis	5 Days
Arrow 2EC	Clethodim	Napthalene 2.2%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	microbial metabolism slight photolysis	3 Days
Roundup Pro Conc	Glyphosate	POEA 13%	Most Annual and Perennial Plants	Amino acid synthesis inhibitor	high	slow microbial metabolism	47 Days
Habitat	Imazapyr		Most Annual and Perennial Plants	Amino acid synthesis inhibitor	low	slow microbial metabolism and photolysis (in water)	25-141 Days
Garlon 4 Ultra	Triclopyr		Annual and Woody Broadleaf Weeds	Auxin mimic	Intermediate	microbial metabolism, photolysis and hydrolysis	30 Days
Milestone	Aminopyralid		Broadleaf Plants Particularly in Asteraceae and Fabaceae Familys	Auxin mimic	low (10.8 Koc)	slow microbial metabolism and photolysis (in water)	34.5 Days

Table 17: Herbicide toxicity comparison.

Herbicide	Toxicity			Effects to cryptogamic soils	Human Risk		
	Dermal LD50 (rabbits)	Oral LD50 for rats:	LC50 for bluegill sunfish		Irritating to Skin	Eye Damage	Toxic if Inhaled
Fusilade DX	>2,420 mg/kg	4,096 mg/kg	0.53 mg/L	inhibits growth of fungi at levels higher than recommended rates	X	X	X
Poast	>5,000 mg/kg	>2,676 mg/kg	100 mg/L	little noticeable impact on soil microbe populations	X	X	
Arrow 2EC	>5,000 mg/kg	2,920 mg/kg	33 mg/L	insufficient data	X	X	
Roundup Pro Conc	>5,000 mg/kg	5,600 mg/kg	120 mg/L	Initial impacts to microbial populations, but recover rapidly and thought to pose no long-term threat to microbial activities.		X	
Habitat	>2,000 mg/kg	>5,000 mg/kg	>100 mg/L	insufficient data	X	X	
Garlon (Amine and Ester)	>2,000 mg/kg	713 mg/kg	148 mg/L	Inhibits growth of ectomycorrhizal fungi at concentrations of 1,000 parts per million and higher. Some evidence of inhibition of fungal growth was detected in bioassys with as little as 100 ppm triclopyr.	X	X	
Milestone	Negative for rabbits, >5,000 mg/kg in rats	>5,000 mg/kg	>100 mg/L	insufficient data			
** Caffeine LD50 127 mg/kg							
Table salt LD50 3000 mg/kg							
1 espresso shot has 64mg of caffeine							

Monitoring and Evaluation

There are three types of monitoring applicable to the management of the DPA Network:

- Management Activity Monitoring – This is monitoring that tracks what types of Restoration Methods and Activities are happening where. This is meant to track the management itself and not the effects of management.
- Monitoring to Inform Management – This type of monitoring involves defining threshold values or expected responses, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values indicates whether you should initiate, intensify, or alter management actions. An example would be measuring percent cover of an invasive plant to evaluate management actions designed to reduce the cover to a certain threshold value, say 1-5% cover.
- Baseline Monitoring – Essential to the DPA Network management philosophy is the need to maintain viable landscapes and reverse declining trends. To evaluate this, we identify a type of monitoring that evaluates baseline conditions and tracks changes through time.

Management Activity Monitoring

All management activities will be tracked using AgTerra Technologies GIS data management platform. The AgTerra platform integrates mobile mapping, data collection and reporting solutions. Data is collected in the field each day using smartphones or tablets and then uploaded to a cloud-based server. Data is then easily exported into an ESRI ArcGIS format or GoogleEarth. This occurs at the end of each work day and is considered part of daily management activities.

Monitoring to Inform Management

This monitoring type is specific for each Objective. Objectives are listed below with expected values and descriptions of monitoring protocols.

Objective 1A: **Reduce and maintain perennial veldtgrass cover to 1-5% cover class within the BLEA DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the BLEA DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

***Objective 1B*: Reduce and maintain invasive plant cover to 1-5% within a 25-foot buffer of Nipomo lupine populations.**

Performance monitoring will occur every 5 to document progress towards meeting the objective of *invasive plant cover* maintained at a 1-5% cover class value within the Nipomo lupine buffer zones.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

***Objective 2A:* Reduce and maintain European beachgrass cover to 1-5% cover class within the BLEA DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of European beachgrass maintained at a 1-5% cover class value throughout the BLEA DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a

change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2B: **Contain the 2018 infestation of Saharan mustard to its current location and reduce and maintain the infestation level to 0-1% cover with in the BLEA DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of Saharan mustard maintained at a 0-1% cover class value throughout the BLEA DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2C: **Reduce and maintain narrow leaved iceplant cover to 1-5% cover class within the BLEA DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of narrow leaved iceplant maintained at a 1-5% cover class value throughout the BLEA DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2D: **Contain the spread of eucalyptus trees within the BLEA DPA (Hub & Core).**

Performance monitoring will occur once every five years. Eucalyptus trees will be mapped in the BLEA DPA and compared to the original baseline to determine if the population is being contained. An expansion of zero acres will be considered a success.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2E: **Remove the southern wall of the "eucalyptus tree homesite ring" to re-establish habitat connectivity of coastal dune scrub (approx. 2 acres).**

Performance monitoring: Once the southern wall of the eucalyptus tree ring is removed, performance monitoring will focus on tracking coastal dune scrub habitat colonizing the eucalyptus removal site and reconnecting the two disjunct habitats. Monitoring will occur in every 5 years.

Protocol: Monitoring will consist of 3 (100m) point intercept line transects. Transects will run perpendicular to the eucalyptus tree southern wall that is removed. Readings will be taken every meter along the transect length and document the plant species detected. Other information collected will include, bare ground, duff/dead material, or cryptogamic soils. Photos of the plot will also be taken at each end of the transect line.

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2F: **Remove bulrushes and maintain ½ acre of open shoreline from select areas around Black Lake to increase habitat for pond lily.**

Performance monitoring: This objective is specifically tied to the success of enhancing populations of pond lily. Monitoring will involve a yearly qualitative assessment if open shoreline is being maintained and Presence Absence surveys for pond lily.

Protocol: Yearly population assessment for pond lily will be made during the flowering season. This will be a presence/absence survey in areas cleared of bulrush. If the target species is detected, populations will be documented and tracked using the online geographic database Calflora (calflora.org).

Actions if Objective is not met: If pond lily is not detected by year three, work under this Objective will be terminated. If the Objective is successful, a formal long-term management plan will be drafted to enhance the pond lily population.

Objective 2G: **Reduce and maintain poison hemlock cover to 1-5% cover class within the BLEA DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of poison hemlock maintained at a 1-5% cover class value throughout the BLEA DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dunes Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Baseline Monitoring

To determine if the Conservation Strategy is achieving its higher-level goals, it is important to set up a monitoring program that will track changes over time. Ecosystems are dynamic, none more so than the coastal dune environment. There will be multiple successional trajectories that are possible but tracking species composition and functional groups as they change through time will help us evaluate if our management actions are indeed keeping the dune ecosystem viable and sustainable through time.

The most efficient way to achieve this is by setting up and monitoring vegetation releves. All releve monitoring will follow California Native Plant Society standardized releve protocols. This

monitoring method allows for quick classification over a large area. It relies on ocular estimates of plant cover rather than counts of the "hits" of particular species along a transect line or precise measurements of cover/biomass by planimetric or weighing techniques. Monitoring will take place every 5 years to assess how native biodiversity is changing throughout management as well as assist in adaptive management.

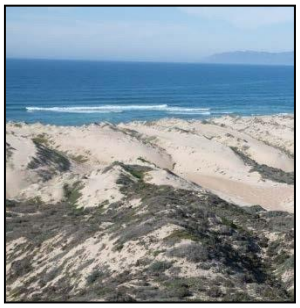
Adaptive Management

Adaptive management is essentially a process for evaluating how well the methods of a plan are meeting the stated objectives and using these evaluations to refine future methods and approaches of the plan. In real life, this happens in the field. On a day to day basis, land practitioners are evaluating the tools and techniques they are using and determining ways to increase productivity while meeting the desired goals. Decisions are made quickly and typically by those that are present. Adaptive management essentially happens without having to name it or formalize the process. However, there is also merit in having a formalized way of gathering information to have more formal processes to reflect on the success of a program and if changes in method, strategy or direction are warranted. This allows more time to work with experts to ensure management is based on the best available science and critical thought.

For the DPA Network Conservation Strategy, formal program evaluations will occur every 5 years coinciding with years that monitoring occurs. In those years, monitoring reports will be prepared to evaluate:

- What happened (Management Activity Monitoring),
- are we meeting our stated Objectives (Monitoring to Inform Management),
- and is our Conservation Strategy working (Baseline Monitoring).

Meetings will be held in those years to discuss the monitoring evaluations and refine our management methods and Conservation Strategy based on the findings. Changes will be incorporated into new workplans to guide management in the field.



National Wildlife Refuge/ Chevron Successional Dune

Site Description

This DPA spans the entire longitude of the Guadalupe Dunes region including both major properties of the Guadalupe Dunes landscape unit, Guadalupe-Nipomo Dunes National Wildlife Refuge (GNDNWR) and the Chevron Restoration Site. It includes important shore habitat to the west and is bordered by agricultural buffer lands to the east.

Management resources for the two major landowners are very different in this DPA. The GNDNWR has limited resources which have led to an expansive invasion of perennial veldtgrass in the backdunes. South of the GNDNWR, is a privately-owned Chevron Restoration Site, originally the Guadalupe Oil Field (Unocal) but later decommissioned after a significant diluent spill (*Santa Maria River Estuary Enhancement and Management Plan*, 2004). Chevron inherited the site in a Unocal company acquisition and it is now strictly a restoration site. Chevron's land management is directed by permit conditions and governmental oversight of the clean-up effort. Chevron implements a comprehensive nonnative plant abatement program throughout the site, which has resulted in low cover of nonnative plants such as iceplants (*Carpobrotus* ssp) and reduced cover of perennial veldtgrass (*Ehrharta calycina*).

The DPA protects the widest successional dune in the GNDC, reaching 3 miles from shore to the eastern GNDC boundary edge. Preserving the successional changes within the dune habitats is a major element of this DPA. All the habitats from the shore and foredunes back to the stabilized coastal dune scrub are preserved as one element. This allows for species adaptability, as habitats change successionally and creates natural corridors through this region of the GNDC.

This DPA was selected because of the high density of special status species and the diversity of habitats needed to sustain them. It includes very important foredune nesting habitat for the Western snowy plover (*Charadrius alexandrinus nivosus)* and robust populations of California special status species, surf thistle (*Cirsium rhothophilum*) and beach spectaclepod (*Dithyrea maritima*). The backdune system includes newly created freshwater wetland inhabited by the federally threatened California red-legged frog (*Rana draytonii*) . This site is an excellent potential site for future plantings of the federally endangered La graciosa thistle (*Cirsium scatiosum* var. *loncholepis*) (Berry, 2017).

Figure 24: Surf thistle (Cirsium rhothophilum) and Beach spectaclepod (Dithyrea maritima).

The selection of this DPA features the region of the GNDNWR which has low invasive species but also highlights the well-managed pristine habitats of the Chevron Restoration Site. The GNDNWR was recently surveyed by helicopter to document the percent cover of major invasive and rare species (Morgan Ball & Olthof, 2016). The results of the survey confirmed the dense cover of invasive species on the GNDNWR. The results of this survey paired with invasive species data from the Chevron Restoration Site was heavily weighed when selecting the boundary of this DPA.

Invasive species pose the largest management challenge in this DPA. While there are regionally low levels of invasive plant species in this DPA, it is still high for the overall GNDC and there is a strong threat of invasion of perennial veldtgrass from northern regions of the GNDNWR. The constant advance of European beachgrass from northern foredune regions threatens important Western snowy plover habitat. Wild pigs and pig damage to vegetation is also a major challenge that is currently being addressed by the GNDNWR. Pigs have an especially broad presence in the GNDNWR, which is likely due to their access from neighboring agricultural fields.

Management History

This DPA has two land owners: Guadalupe-Nipomo National Wildlife Refuge and Chevron. The land now known as the Guadalupe-Nipomo National Wildlife Refuge was acquired by The Nature Conservancy in 1989 from the Mobil Oil Company. The Nature Conservancy managed the property along with other properties in the GNDC (known as the Dunes Preserve) until 2000. At that time, the property was transferred to the United States to be managed as lands in the Refuge System.

The neighboring property was also owned by the Mobil Oil Company and has since changed hands multiple times, currently owned by Chevron. The property was an active oil production

site from 1947 to 1994, piping crude oil from offshore drilling locations. Chevron is currently executing a restoration and cleanup of the site after a massive diluent leak between 1955-1990. A settlement was reached to restore the site as well as provide a $9,000,000 trust to support restoration and visitor services within the GNDC (Interactive Planning and Management, 2001). Restoration efforts on the Chevron restoration site continue onsite to remove contaminated soils and material. No restoration opportunities within the Chevron restoration site are included in this work plan as restoration activities are heavily monitored and evacuated by the Guadalupe restoration project team.

Invasive Plant Management

Invasive species control within the GNDNWR portion of this DPA has historically focused on three regions: Milepost Foredunes, Southern Firewall, and Dee Peak (Skinner, Cleveland, Holmes, Stewart, & Watts, 2003). Management of invasive species in these regions took place between 2000-2009, with minimal treatment since.

Milepost Foredunes is located along western border of this DPA, in the foredune habitat. Manually removal of iceplant species was completed in 2002 and 2003. Additional management activities took place north of this DPA, controlling jubatagrass and European beachgrass.

Southern Firewall refers to the southern boundary of the large infestation of European beach grass on the Refuge. Chemical treatment with glyphosate was completed in 2000-2009. No treatment of this region was made after 2009.

Dee Peak is located on the southern boundary of the GNDNWR in a small valley with low veldtgrass percent cover and a small patch of European beachgrass. Treatment began in 2000 and continue through 2003 and intermittent treatment there after due to accessibility (treatment is documented in 2007). No management has happened at this site since 2007.

The Refuge has worked with Chevron Environmental Management Company and other Dunes Collaborative partners since 2011 to design and plan a research study to evaluate the efficacy of aerial herbicide application to control invasive perennial veldt grass. In this research study, a helicopter equipped with a spray boom applied a monocot-specific herbicide on up to 20 acres of Refuge land. Also, herbicide drift beyond the spray zone was assessed to establish appropriate buffers for future treatments that may be in proximity to sensitive ecological areas (Hall, Whitaker, Stienmaus, & Berry, 2016). Aerially applicated herbicide was successful in removing veldtgrass with most significant results seen in the Clethodim treatment (Arrow 2EC). No significant effect was seen on native vegetation density but an increase in native cover was visually observed in sprayed sites.

Habitat Restoration Projects

During February 2013, two new ponds were constructed on the Refuge. Myrtle Pond, named after the presence of wax myrtle (Morella californica) in the vicinity, is about 300 yards inland from the ocean. Colorada Pond, named for the presence of its reddish-colored water (colorado/colorada means red-colored in Spanish), is about 2.5 miles inland from the ocean. The ponds were constructed primarily to create high-quality, long-term habitat for the federally threatened California red-legged frog. The secondary purpose was to provide high quality habitat for three federally endangered plant species: marsh sandwort, Gambel's watercress, and La Graciosa thistle (U.S. Fish and Wildlife Service, 2016).

From 2007 to 2010, more than 7 miles of wire fencing was installed along the Refuge southern and eastern boundaries to protect La Graciosa thistle and Refuge wetlands from trespassing cattle. This fencing successfully excluded cattle from the Refuge. An exclosure fence was placed around the perimeter of sensitive habitat that had a majority of the La Graciosa thistle on the Refuge. The fence serves as a backup to protect La Graciosa thistle from cattle that could breach the Refuge boundary fence, as well as from visitors who might unknowingly trample these plants. During December 2014, Service biologists planted La Graciosa thistle seeds obtained from the Refuge at several locations near Myrtle Pond and Colorada Pond.

Approximately 200 marsh sandwort propagules were outplanted at six ponds and marshes on the Refuge in October 2008 (U.S. Fish and Wildlife Service, 2016). While most survived the move, grazing mammals consumed nearly all of the plants within two years. In August 2013, as part of the Wildlife Ponds Project approximately 90 marsh sandwort propagules were outplanted at the new Colorada Pond and 90 at the new Myrtle Pond. Exclusion fencing minimized the plants from threat of herbivory by mammals, and at least 50 percent survived through at least October 2013.Their current status is unknown.

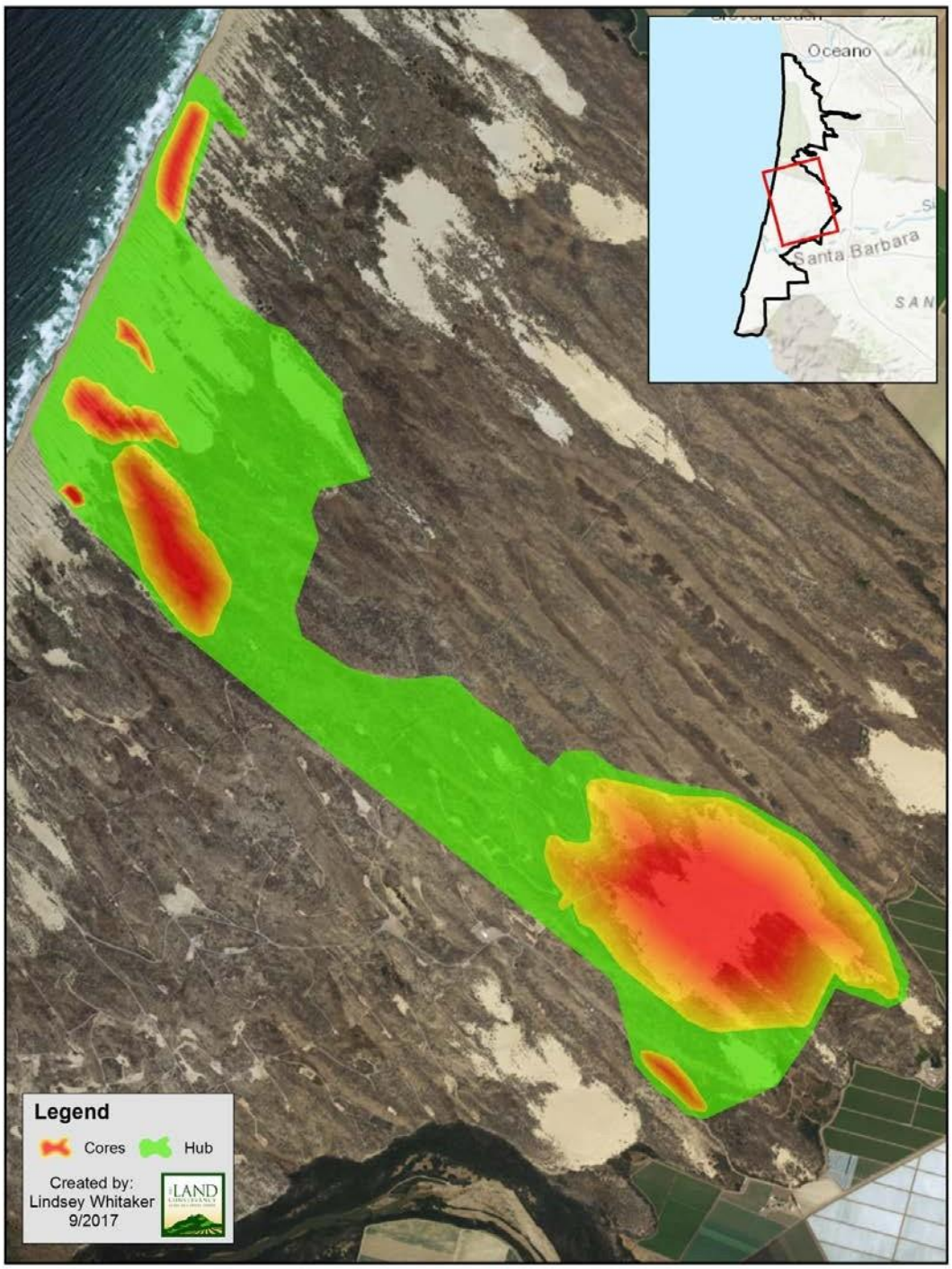


Figure 25: Boundary of the National Wildlife Refuge/ Chevron Successional Dune DPA.

Figure 26: Property Ownership in the National Wildlife Refuge/ Chevron Successional Dune DPA.

Site Assessment

The site assessment for National Wildlife Refuge/Chevron Successional Dune DPA is a snapshot in time setting representing a baseline of site conditions during the years 2016-2018. This includes a species inventory as well as geospatial data for habitat types, conservation targets, and threats.

Species Inventory

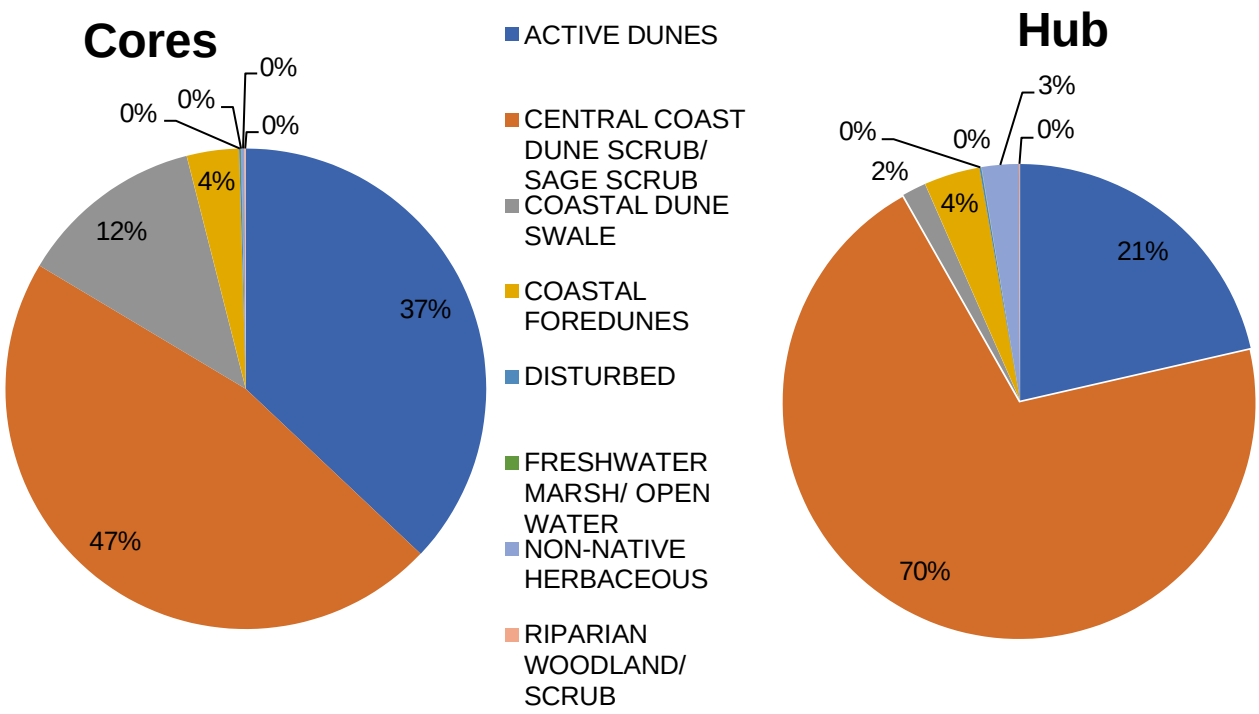
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the National Wildlife Refuge/Chevron Successional Dune DPA. Those species are included in the table below.

Table 18: Conservation Targets likely to occur at the National Wildlife Refuge/ Chevron Successional Dune DPA.

Bird Fine Filter Species	**Flora Fine Filter Species**
Anna's hummingbird	*Abronia maritima* (beach sand verbena)
Bewick's Wren	*Astragalus nuttallii* var. *nuttallii* (Nuttall's milkvetch)
bushtit	*Chenopodium littoreum* (coastal goosefoot)
California quail	*Cirsium scariosum* var. *loncholepis* (La graciosa thistle)
California thrasher	*Cirsium rhothophilum* (surf thistle)
California towhee	*Cladium californicum* (California sawgrass)
chestnut-backed chickadee	*Delphinium parryi* var. *blochmaniae* (dune larkspur)
common yellowthroat	*Dithyrea maritima* (beach spectaclepod)
downy woodpecker	*Erysimum suffrutescens* (suffrutescent wallflower)
spotted towhee	*Horkelia cuneata* ssp. *puberula* (Mesa horkelia)
Swainson's thrush	*Horkelia cuneata* ssp. *sericea* (Kellogg's horkelia)
western scrub jay	*Juncus acutus* ssp. *leopoldii* (Leopold's rush)
western snowy plover	*Leptodactylon californicum* ssp. *tomentosum* (prickly phlox)
Wilson's warbler	*Leptosyne gigantea* (giant coreposis)
wrentit	*Malacothrix incana* (dunedelion)
yellow warbler	*Monardella undulata* ssp. *crispa* (dune mint)
	Monardella sinuata ssp. *sinuata* (dune mint)
Mammal Species	*Monardella undulata* ssp. *undulata* (dune mint)
Canis latrans (coyote)	*Mucronea california* (California spineflower)
Castor Canadensis (American beaver)	*Nasturtium gambelii* (Gambel's watercress)
Chaetodipus californicus (California pocket mouse)	*Nemacaulis denudata* var. *denudata* (coastal woolly heads)
Didelphis virginiana (Virginia opossum)	*Orobanche parishii* ssp. *brachyloba* (Parish's Broomrape)
Dipodomys heermanni arenae (Lompoc kangaroo rat)	*Scrophularia atrata* (black flowered figwort)
Felis (or *Puma*) *concolor* (mountain lion)	*Senecio blochmaniae* (Blochman's groundsel)
Lepus californicus (black-tailed jackrabbit	
Lynx rufus (bobcat)	**Reptile & Amphibian Fine Filter Species**
Mephitis mephitis (striped skunk)	*Rana draytonii* (California red-legged frog)
Microtus californicus (California vole)	
Mustela frenata (long-tailed weasel)	
Neotoma macrotis (dusky-footed woodrat)	
Odocoileus hemionus (mule deer)	
Ondatra zibethicus (common muskrat)	
Peromyscus californicus (California mouse)	
Peromyscus maniculatus (deer mouse)	
Peromyscus truei (Pińon mouse)	
Procyon lotor (northern raccoon)	
Reithrodontomys megalotis (western harvest mouse)	
Scapanus latimanus (broad-footed mole)	
Sorex ornatus (ornate shrew)	
Spilogale gracilus (western spotted skunk)	
Sylvilagus audubonii (desert cottontail)	
Sylvilagus bachmani (brush rabbit)	
Thomomys bottae (Botta's pocket gopher)	
Ursus americanus (American black bear)	

Habitats

The National Wildlife Refuge/ Chevron Successional Dune DPA (Hubs and Cores) is composed of the following habitat types:



Habitat Type	Core Acres	Core %	Hub Acres	Hub %
ACTIVE DUNES	162.81	37.04%	162.22	21.42%
CENTRAL COAST DUNE SCRUB/ SAGE SCRUB	204.48	46.52%	532.73	70.36%
COASTAL DUNE SWALE	54.82	12.47%	12.35	1.63%
COASTAL FOREDUNES	15.43	3.51%	29.01	3.83%
DISTURBED	0.53	0.12%	1.00	0.13%
FRESHWATER MARSH/ OPEN WATER	0.18	0.04%	0.16	0.02%
NON-NATIVE HERBACEOUS	0.89	0.20%	19.10	2.52%
RIPARIAN WOODLAND/ SCRUB	0.38	0.09%	0.57	0.08%
TOTAL	**439.52**		**757.16**	

Figure 27: Types and Percent Cover of Habitats within the National Wildlife Refuge/ Chevron Successional Dune DPA.

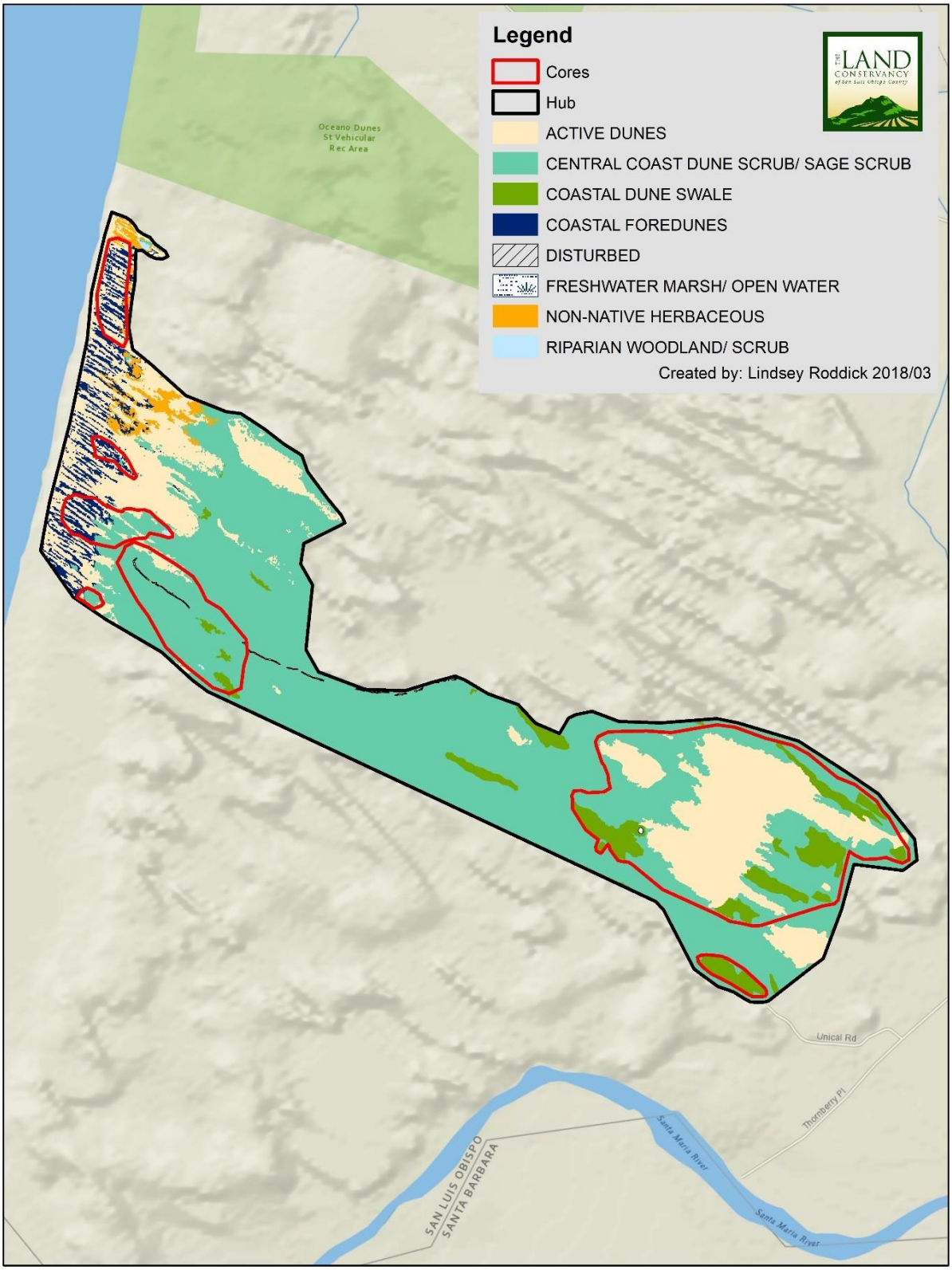


Figure 28: Habitat Types within the National Wildlife Refuge/ Chevron Successional Dune DPA.

Threats

One of the most pervasive threats throughout the DPA network are impacts from non-native invasive species. Given the large number of non-native species in the Dunes it is often difficult to know where to start. To help in this process, during a 3-day workshop, a target invasive plant list for surveys was selected by the Dunes Collaborative and was informed by the *Invasive Plant Inventory and Early Detection Prioritization Tool* (Olsen & Hall, 2015). However, invasive plants aren't the only species causing widespread damage in the GNDC. Feral pig localities, numbers observed, and habitat damage was also documented. In addition to invasive species, surveys targeted special status native plants such as Nipomo lupine, La Graciosa thistle, beach spectaclepod, and surf thistle which are known to occur throughout the Guadalupe Nipomo Dunes Complex. A list of species targeted for inventory surveys is found in Table 32.

Table 19: Hit List of Species Targeted for Inventory Surveys.

Method	Species	Common Name	Family	Conservation Status	Cal-IPC Ranking
Documented Invasive Plants *Map Using a Grid System (5 Species)*	*Ammophila arenaria*	European beachgrass	Poaceae	*invasive plant*	High
	Carpobrotus chilensis	ice-plant / sea fig	Aizoaceae		Moderate
	Carpobrotus edulis	freeway ice-plant	Aizoaceae		High
	Concosia pugioniformis	slender leaf ice-plant	Aizoaceae		Limited
	Ehrharta calycina	perennial veldt grass	Poaceae		High
Documented Invasive Plants *Map Using Points & Polygons (12 Species)*	*Arundo donax*	giant reed	Poaceae	*invasive plant*	High
	Delairea odorata	cape ivy	Asteraceae		High
	Thinopyrum junceiforme	russian wheatgrass	Poaceae		Red Alert
	Tamarix sp.	tamerisk	Tamaricaceae		High
	Senecio elegans	purple ragwort	Asteraceae		n/a
	Brassica tournefortii	saharan mustard	Brassicaceae		High
	Hedera sp.	algerian/english ivy	Araliaceae		High
	Lepidium draba	hoary cress	Brassicaceae		Moderate
	Vinca major	greater periwinkle	Apocynaceae		Moderate
	Centaurea solstitalis	yellow star thistle	Asteraceae		High
	Cortaderia jubata	pampas grass	Poaceae		High
	Glebionis coronarium	crowndaisy	Asteraceae		Moderate
Dune Protected Areas Only *(Grasses)* *Map Using a Grid System (4 Species)*	*Bromus madritensis ssp rubens*	red brome	Poaceae	*invasive plant*	High
	Bromus tectorum	downy brome	Poaceae		High
	Cynodon dactylon	bermuudagrass	Poaceae		Moderate
	Cenchrus clandestinus	kikuyugrass	Poaceae		Limited
Dune Protected Areas Only *(Non-grasses)* *Map Using a Grid System (4 Species)*	*Cirsium vulgare*	bull thistle	Asteraceae	*invasive plant*	Moderate
	Conium maculatum	poison hemlock	Apiaceae		Moderate
	Myoporum laetum	ngaio tree	Myoporaceae		Moderate
	Foeniculum vulgare	sweet fennel	Apiaceae		High
Early Detection Invasive Plants (Undocumented) *Map Using Grid, Points or Polygons (9 Species)*	*Eichornia crassipes*	common water-hyacinth	Pontederiaceae	*invasive plant*	High
	Alternanthera philoxeriodes	alligator weed	Amaranthaceae		High
	Genista monspessulana	french broom	Fabacae		High
	Lepidium latifolium	perennial pepperweed	Brassicaceae		High
	Limonium sp.	Algerian sea lavender	Plumbaginaceae		Limited
	Salvinia molesta	giant salvinia	Salviniaceae		High- Alert
	Taeniatherumm caput-medusae	medusahead	Poaceae		High
	Hydrilla verticillata	hydrilla	Hydrocharitaceae		High
	Ludwigia sp.	Uruguay waterprimrose	Onagraceae		High
	Emex spinosa	Spiney emex	Polygonaceae		Moderate
Documented Special Status Native Plants *Map Using Grid, Points or Polygons (6 Species)*	*Cirsium rhothophilum*	surf thistle	Asteraceae	CT; 1B.2	*na*
	Cirsium scariosum var. *loncholepis*	La Graciosa thistle	Asteraceae	FE; CT; 1B.1	
	Dithyrea maritima	beach spectaclepod	Brassicaceae	CT; 1B.1	
	Lupinus nipomoensis	Nipomo Lupine	Fabaceae	FE; CE; 1B.1	
	Nasturitum gambelii	gambel's watercress	Brassicaceae	FE; CE; 1B.1	
	Arenaria paludicola	marsh sandwort	Caryophyllaceae	FE; CE; 1B.1	
Undocumented Special Status Native Plants *Map Using Grid, Points or Polygons (1 Species)*	*Layia carnosa*	Beach layia	Asteraceae	FE; CET; 1B.1	*na*
Non-native Vertebrates *Map Using Points & Polygons (1 Species)*	*Sus scrofa*	Feral Pig	Suidae	invasive animal	*na*

Total- 36 Invasive Plants, 5 Special Status Native Plants & 1 Invasive Animal

In doing surveys in the Guadalupe Nipomo Dunes Complex, data was collected in a standardized format to allow data sharing among members of the Dunes Collaborative. A protocol was developed by Wildlands Conservation Science for survey mapping in the Guadalupe Nipomo Dunes Complex that captures the most important information for management accurately and efficiently.

When target species were encountered, their location, distribution and ground cover was recorded using one of three mapping methods herein referred to as point, polygon, or grid. Point and polygon mapping is restricted to plant populations with a discernible boundary extent, these mapping units are herein referred to as populations or stands. An individual population is defined

by a single contiguous infestation or a cluster of infestations separated by no more than 30-meters.

Descriptions of the three mapping methodologies are provided below:

Point - Discrete populations with easily identifiable (circular) boundaries were mapped using a single data point collected at the population centroid. For each population, diameter and percent ground cover and attribute information listed in Table 33 was also collected. Plant populations mapped as points were later buffered by their infestation radius and converted to polygons for the final product. All feral pigs and rare plant occurrences were mapped using discrete point data.

Polygon – Populations with a discernible, irregular-shaped boundary are mapped using a polygon drawn atop a high-resolution orthophotograph. Additional population attributes listed in Table 33 were collected.

Grid - European beachgrass (*Ammophilia arenaria*), perennial veldt grass (*Ehrharta calycina*), sea-fig iceplant (*Carpobrotus chilensis*) and hottentot fig iceplant (*Carpobrotus edulis*) cannot be mapped using point or polygon methods because there are no discernible population boundaries to be delineated. Therefore, these widespread and/or diffusely occurring species were mapped by estimating ground cover within a 100-meter by 100-meter pre-established grid system. Within each grid cell, additional population attribute information was collected (Table 34).

Table 20: Attribute field information associated with polygon data recorded during the survey.

Field Name	Attribute Description
Stand_ID	Individual stand identification code
Date	Date in which the survey was preformed
Com_Name	Common name of the documented population stand
Species	Scientific name of documented population stand
Num_Indv	Estimated number of plants within documented population stand
Pop_Dens	The vegetative cover of the documented invasive species within the mapped population based off the CNPS cover class diagrams. The cover-classes are used to visually estimate cover within the polygon. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Age_Class	The common age of plants within the population stand. Age is divided into **seedling**, **immature**, **mature**, mixed classes with more young plants (**MixedYoung**) and mixed age classes with more old plants than young (**MixedOld**).
ID_Confid	Confidence level (**High**, **Med**, **Low**) that the surveyor was able to identify the documented plant to species.
Photo	A photo taken of the population stand, if necessary
Surveyor	The name of the surveyor recording the data
Comment	Miscellaneous notes regarding the documented population stand
Gross_Acres	Total area (Acres) of the polygons including the interstitial spaces between the documented invasive plants within a populations (post-survey).
Net Acres	Net area (acres) covered by the documented invasive plants within the polygon, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of the pop_Dens x the Gross_Acres value (post-survey).
Rank	Plant ranking for the documented invasive species or rare plant (post-survey).
Point_X	X coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet
Point_Y	Y coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet

Table 21: Attribute field information associated with grid data recorded during the survey.

Field Name	Attribute Description
ID	Individual grid cell identification code
Date	Date in which the survey was preformed
AMAR_Cover	The vegetative cover of European beachgrass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
CACH_Cover	The vegetative cover of Hottentot fig iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
CAED_Cover	The vegetative cover of sea-fig icelant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
COPU_Cover	The vegetative cover of slender-leaved iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
EHCA_Cover	The vegetative cover of perennial veldt grass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Gross_Acre	Total area (acres) of each mapped grid cell including the interstitial spaces between documented invasive species within a population (Post-survey).
AMAR_Acres	Net Area (acres) covered by European beachgrass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of AMAR_Cover x the Gross_Acres (Post-survey).
CACH_Acres	Net Area (acres) covered by Hottentot fig iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CACH_Cover x the Gross_Acres (Post-survey).
CAED_Acres	Net Area (acres) covered by sea-fig icelant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CAED_Cover x the Gross_Acres (Post-survey).
COPU_Acres	Net Area (acres) covered by slender-leaved iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of COPU_Cover x the Gross_Acres (Post-survey).
EHCA_Acres	Net Area (acres) covered by perennial veldt grass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of EHCA_Cover x the Gross_Acres (Post-survey).

The results of the survey are presented in the maps and graphs below.

Table 22: Results of the invasive species survey in the NWR/CSD DPA.

	Hub		Cores	
	Net Acres	Gross Acres	Net Acres	Gross Acres
Refuge- measured by grid				
Ammophila arenaria	7.998	114.149	8.988	14.654
Carpobrotus edulis	0.463	20.972	0.031	6.209
Carpobrotus chilensis	17.544	368.606	16.039	114.933
Ehrharta calycina	8.879	146.933	2.7	45.291
Chevron- measured by polygon				
Ammophila arenaria	0.000	0.000	0.000	0.000
Carpobrotus ssp.	1.225	244.976	1.366	273.141
Ehrharta calycina	36.451	244.976	26.645	273.144
Conicosia pugioniformis	1.225	244.976	1.366	273.141
Refuge- measured by polygon				
Conicosia pugioniformis	0.144	28.091	0.023	4.548
Senecio elegans	0.089	4.3	0.03	1.026
Nonnative grass	0.000	0.000	0.003	0.096
Conium maculatum	0.0004	0.001	0.000	0.000
Cortaderia jubata	0.000	0.0003	0.000	0.000

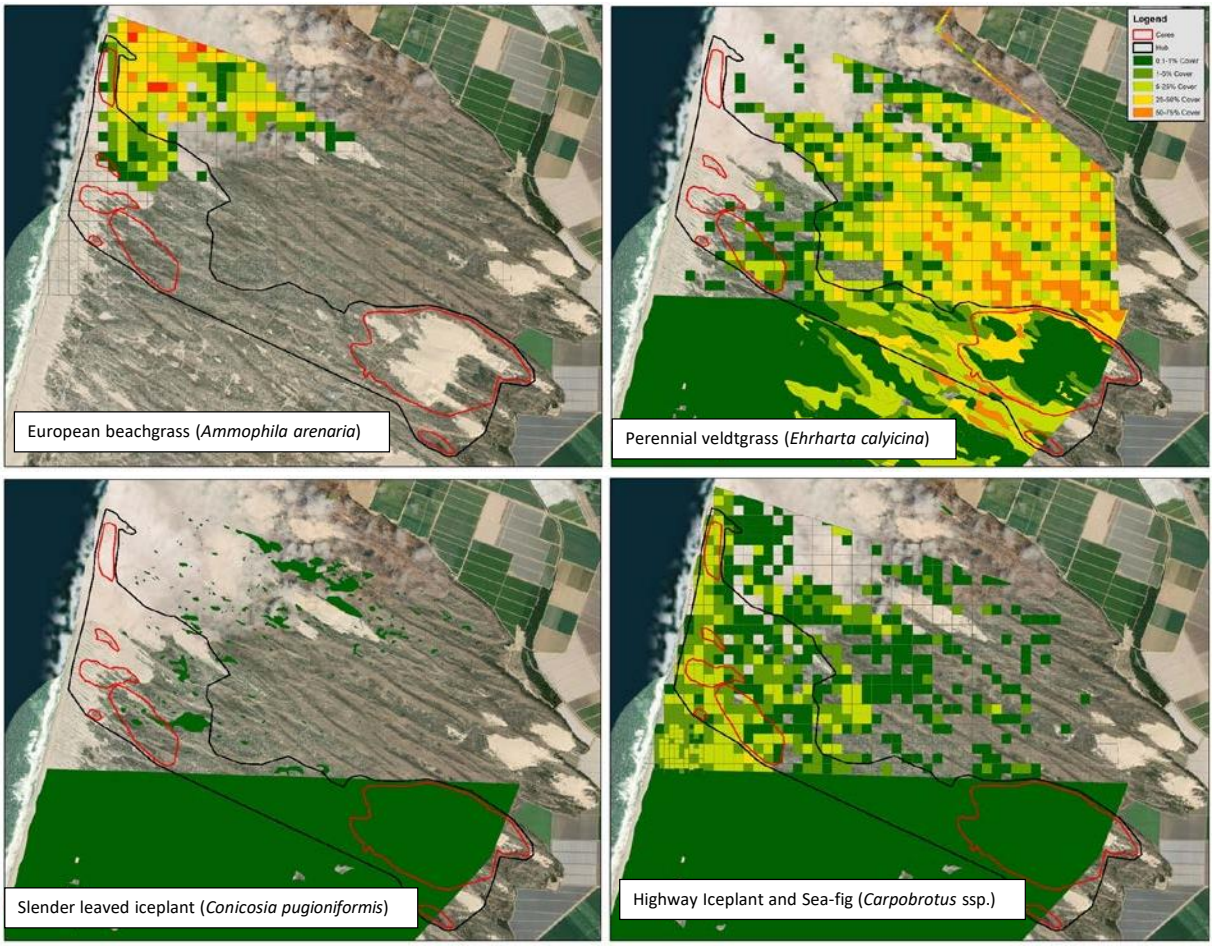


Figure 29: Distribution and abundance maps of dominant invasive species in the NWR/CSD DPA.

Opportunity Prioritization

Based on the assets and threats in the NWR/CSD DPA, opportunities for habitat restoration that meet the higher-level management goals were identified. Higher level management goals include:

For management, these opportunities were categorized into three tiers of Priority Opportunities (Priority 1, Priority 2, Priority 3). The tiers were set based on careful consideration of the opportunity and how it balances contributions to the higher-level goals while considering social, economic and ecological interests.

Priority 1 Opportunities will be those projects that contribute to the high-level goals, are cost efficient to implement and have a certain level of urgency in implementation. These are considered the highest priority restoration opportunities if funding is limited.

Priority 2 Opportunities will be those that contribute to high level goals, have a lower cost/benefit ratio than Priority 1 opportunities, but still achievable within a ten-year time frame.

Priority 3 Opportunities are those that contribute to high level goals, but are difficult to achieve because cost is prohibitive, success is unlikely, or there are political/social reasons that will keep them from being implemented.

Priority 1 Opportunities

European beachgrass control

European beachgrass was intentionally planted in the GNDC to stabilize sand dunes. It is found in northwest region of this DPA, with dense populations to the north. European beachgrass forms a dense cover, spreading from rhizomes that excludes many native taxa and unnaturally stabilizes moving sand. Most notably, it reduces the nesting habitat available for the Western snowy plover, a ground nesting bird listed as Threatened under the Federal Endangered Species Act. This plant also has ecosystem level effects by altering natural dune succession. In addition, by creating continuous, steep barrier dunes in place of natural lower, discontinuous dunes, it increases ocean erosion and limits the dunes natural ability to adapt to rising sea level. Treatment of European beachgrass on the GNDNWR was completed in 2005-2010 and is a current target with additional grants funds. Restoration efforts should work in conjunction with these efforts to improve success. Control and eradication are most successful with a combination of both mechanical removal and chemical control. ODSVRA has also had success with prescribed burn followed by herbicide treatment. Although this population is quite large and dense, the lack of a long-term seedbank makes total eradication a possibility. However, due to the non-selective nature of suitable control strategies, to achieve the landscape level control needed, substantial off-target damage to native resources will occur. However, rapid recolonization by native flora and fauna is expected based on similar efforts on Vandenburg Airforce Base to the south (Morgan Ball, 2017).

Western snowy plover nesting habitat enhancement

Western snowy plover nest annually on the coastal strand and foredunes of this DPA. The primary cause of their decline is loss of habitat. European beachgrass contributes to habitat loss by reducing the amount of open sand, sandy habitat and contributing to the steepened beaches and increase habitat for predators. Removal of European beachgrass can increase potential nesting habitat.

Myrtle pond wetland enhancement

Myrtle pond was created in February 2013, providing needed wetland habitat during the prolonged drought. It is located in the north-western region of the DPA and is about 300 yards inland from the ocean. California toads have been found breeding in the marsh surrounding Myrtle pond. The pond offers important habitat for other reptiles and amphibian, such as California red-legged frog and California pond turtle. This has also become an important introduction site for several threatened and endangered plants species. Preservation of this pond is essential. Invasive species removal, fence management, and future dredging are potential management actions necessary at this site.

Priority 2 Opportunities

Highway Iceplant (*Carpobrotus edulis*) and Sea fig (*C. chilensis*) control

Both species of *Carpobrotus* create a dense mat on the surface of the ground, displacing native plant and animal species. The foredunes throughout this DPA are densely populated with these species. It propagates by seed and vegetatively. Successful control has included both mechanical and chemical control. Work is currently being done to remove all iceplant species from the very northwest corner of the refuge through other grant funds. Restoration efforts should work in conjunction with these efforts to improve success.

Perennial veldtgrass control

Perennial veldtgrass is a perennial grass which releases hundreds to thousands of seed which fall near the parent plant and disperses short distances with wind. Inland, coastal dune scrub habitats within this DPA have relatively low percent cover of Perennial veldtgrass compared to neighboring regions (approximately 5-25% on average). It is important to protect the DPA from neighboring Perennial veldtgrass seed brought in from the wind. Successful control methods use herbicide to kill the plant before going to flower. The GNDNWR is dense with perennial veldtgrass and would be an excellent candidate for an aerial herbicide application.

Rare plant species habitat enhancement

The foredunes of this DPA are home to well established populations of state-listed species, surf thistle and beach spectaclepod. Removal of invasive species, most importantly European beachgrass and iceplants, allow for natural recruitment and establishment.

Purple ragwort (*Senecio elegans*) control

This annual species escaped cultivation as a popular ornamental plant. It throughout the back foredunes of the GNDNWR. Eradication is possible, as the population is small. Hand removal or herbicide treatment before flowering can be implemented for success. To be successful, control should target the entire GNDNWR and coordinate with neighboring landowners to control outlier populations.

Feral Pig control

While performing aerial plant surveys, Wild Lands Conservation Science documented the presence of ten feral pigs (ranging from approximately 80 to 250 pounds) on GNDNWR (M Ball & Olthof, 2017). All pigs were observed inland of the primary dune ridge running north-south along the western one-third of the Refuge. This region of the preserve has numerous steep east-facing slopes where accreted sand spills off the primary dune ridge towards the back dunes to the east. These slopes are often covered in dense back dune vegetation with pockets of moisture dependent scrub vegetation such as poison oak (*Toxicodendron diversilobum*), California blackberry (*Rubus ursinus*) and arroyo willow (*Salix lasiolepis*). The feral pigs appear to utilize this dense vegetation for cover bedding. Routine use of these sites by feral pigs has resulted in

disturbance to the soil crust and vegetation structure. Impacts such as this may upset bird breeding activities, limit available habitat for nesting, as well as reduce the biodiversity of the vegetation community (Browning, 2008; Crooks, 2017).

Pig rooting (ground disturbance caused by pigs tilling the soil in search of forage) was not easily documented in the loose substrate of the dunes and pigs were generally kept out of wetland sites by exclusionary wire fencing. However, pigs appeared to find a way through the fences at two dune swale wetlands in the southeastern portion of the Refuge. At each of these sites, pigs rooted up basin bottom vegetation around the lowest point of each wetland and excavated mud wallow holes.

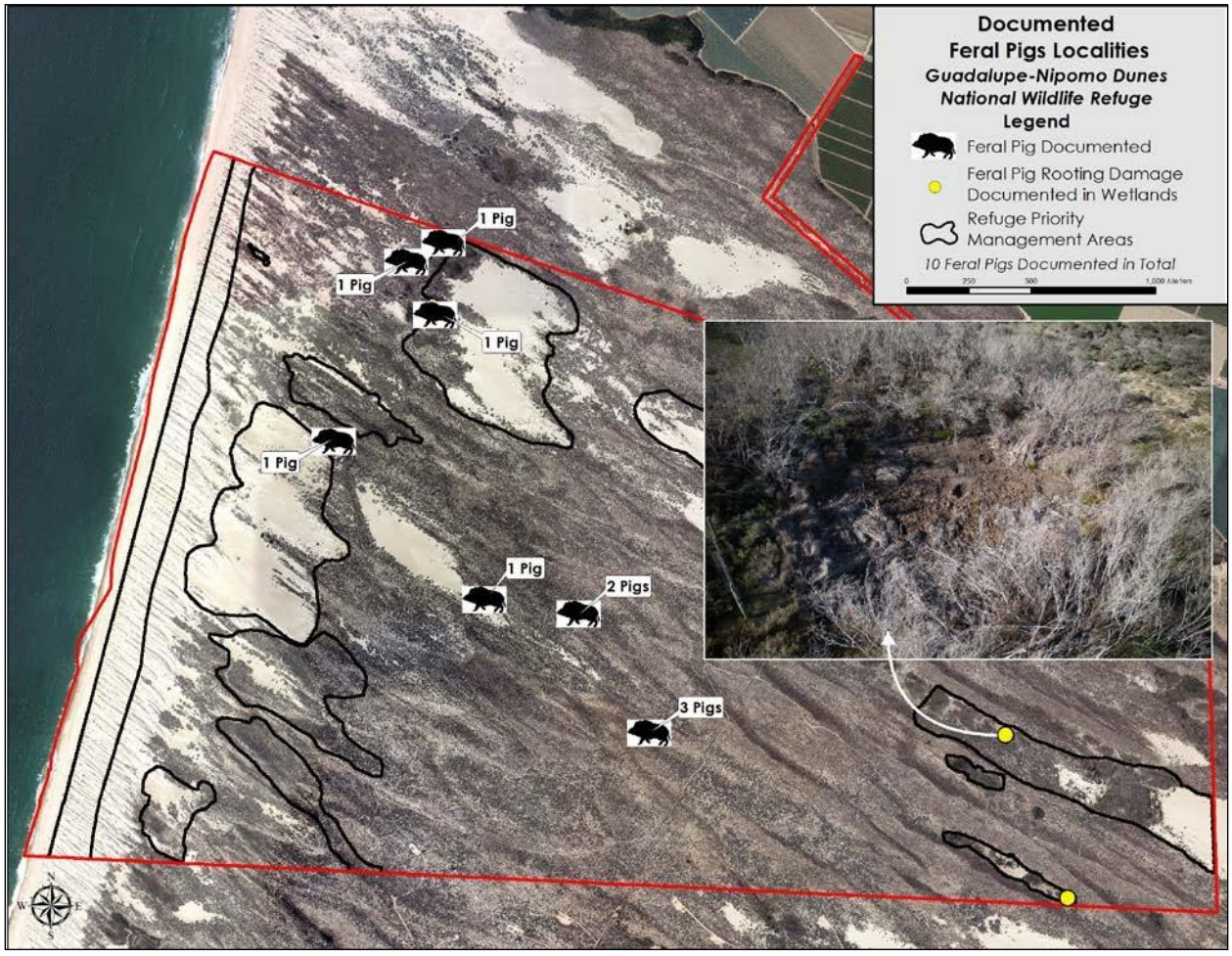


Figure 30: Map of documented feral pigs and rooting damage to wetland habitats on the GNDNWR.

La graciosa thistle habitat protection and enhancement

La graciosa thistle seeds were planting near Myrtle Pond in December 2014, which is within the boundaries of the DPA. No survey has been conducted since to see if the planting was

successful. Myrtle pond is in need of a strong and more permanent fence to protect the pond from ferial pigs, grazing animals and hikers who might trample them.

Marsh sandwort habitat protection and enhancement
Marsh sandwort is a small perennial plant which naturally occurred in the region's wetlands. Marsh sandwort's only extant natural occurrences are in Oso Flaco Lake and Black Lake Canyon (Black Lake Canyon occurrence has not been fully evaluated). In August 2013, 90 propagules were placed in Myrtle Pond and 50% were alive in October 2013. The livelihood of those remaining is unknown. Myrtle pond is in need of a strong and more permanent fence to protect the pond from ferial pigs, grazing animals and hikers who might trample them.

Gambel's watercress habitat protection and enhancement
Gambel's watercress is perennial wetland plant originally found throughout the GNDC. It is nearly extinct with only four occurrences, one of which was introduced to the GNDNWR in 2008 and then again in August 2013 (Black Lake Canyon occurrence has not been seen since 1998 and Oso Flaco Lake occurrence last seen in 2011). The population located at Myrtle pond status in unknown. Myrtle pond is in need of a strong and more permanent fence to protect the pond from ferial pigs, grazing animals and hikers who might trample them.

Priority 3 Opportunities

Currently, there are no Priority 3 Opportunities identified.

Management Objectives, Actions, Method, Timeline and Budgets

Priority 1 Opportunities

Opportunity 1A: European beachgrass control

Objective 1A: Reduce and maintain European beachgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).

Action 1A.1: Do baseline survey of European beachgrass cover classes throughout the NWR/CSD DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

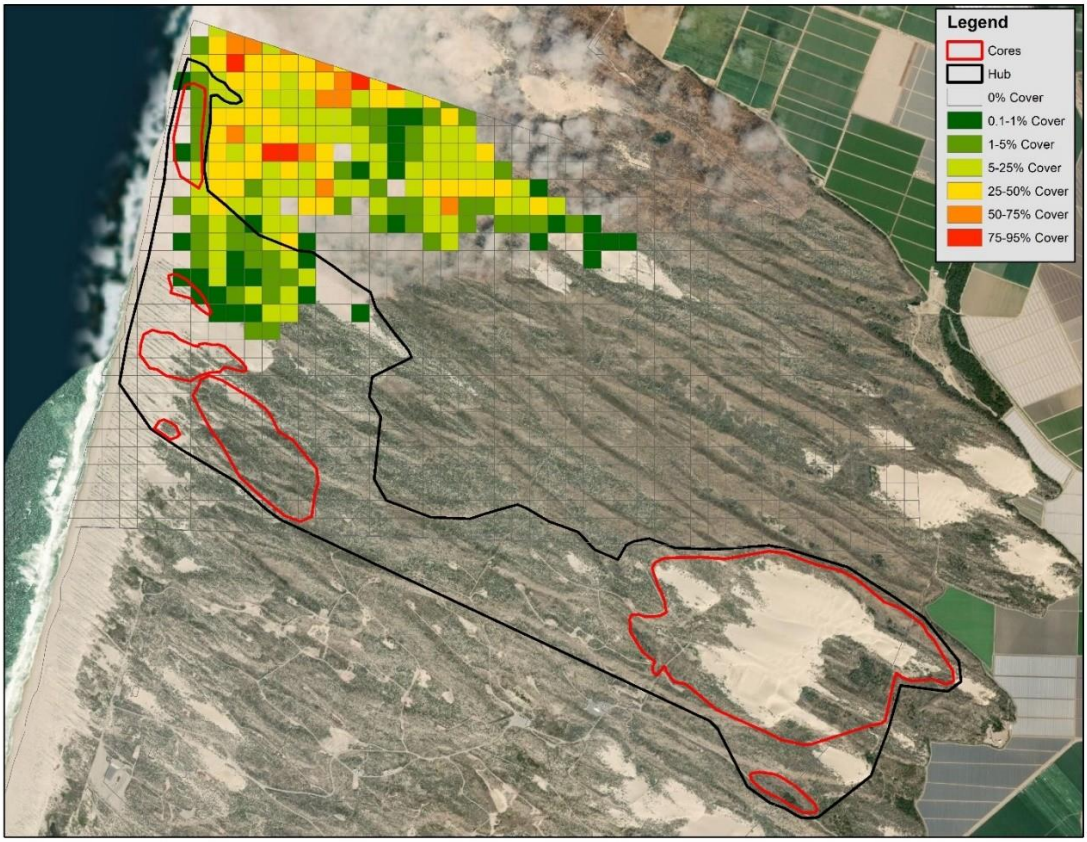


Figure 31: 100-meter grid baseline survey of European beachgrass.

Action 1A.2: Control European beachgrass within the NWR/CSD DPA (128.81 acres gross: 16.99 Acres Net).

Methods:
European beachgrass predominantly spreads through underground rhizomes with a limited seedbank. This buried rhizome system can be very dense and can survive sand burial of up to 3.3 m. Successful control of the plant depends heavily on the ability to kill this underground rhizomatous root structure.

Much work has been done evaluating the effects of different treatments on beachgrass in coastal dune systems. Hand removal has proven to be expensive and relatively ineffective as one needs to continually remove biomass until the below ground root system becomes starved. Burning above ground biomass followed by herbicide treatments have proven successful but is difficult in this area due to nearby residences and air quality restrictions in the area. Unfortunately, grass specific herbicides have also proven to be ineffective. Foliar applications of glyphosate can be effective if timed correctly when the plant is actively growing, and the phloem is translocating downward into the roots. But, experience has shown glyphosate applications alone require a high application rate and require several years of follow-up treatment due to re-sprouting from the root-mass.

The most effective method currently used involves a foliar application of herbicides containing glyphosate mixed with those containing imazapyr. Imazapyr is an amino acid synthesis inhibitor that has soil residual activity that is able to move into the soil profile and kill the extensive root system. This typically requires one large application followed by several years of follow-up treating re-spouts. The level of effort drops off significantly after the first year. Because imazapyr is a broad-spectrum herbicide, off target damage must be expected. Monitoring native plant regeneration after treatment is necessary to ensure good recovery of the native plant community. If this is not happening, supplemental seeding may be required.

In foredune situations, rhizomes should be "ripped" with a bulldozer to break up the unnaturally stabilized dunes and re-establish natural dune processes.

Treatment Schedule:
Herbicide Treatments will involve one treatment event per year. Year 1 will be considered the "knock down" phase and will constitute the bulk of the effort. Yr. 2-3 will involve follow-up monitoring and spot treatments of any re-sprouts. The level of effort in those years should decrease significantly dropping off by year 3. The table below highlights the expected timing of treatment strategies.

Table 23: Seasonal treatment strategies for European beachgrass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
European beachgrass (*Ammophila arenaria)*	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Chemical	not water stressed	2+ Years				Tank Mix Roundup Pro Conc 2.0 % - Imazapyr 1% v/v foliar spray								

Action 1A.3: Re-establish dune succession within areas previously treated for European beachgrass at the NWR/CSD DPA (128.81 acres gross: 16.99 Acres Net).

Methods: TBD if determined that this is needed

Treatment Schedule: Rhizome ripping will occur if determined to be necessary. This will occur outside of Western snowy plover nesting season. It is anticipated that this would be a one-time treatment.

Opportunity 1B: **Western snowy plover nesting habitat enhancement**

Objective 1B: Reduce and maintain European beachgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core) to improve nesting habitat for Western snowy plover.
*Note: This is essentially an expansion of Objective as Opportunity 1A.

Action 1B.1: Monitor Western snowy plover throughout treatment area to gauge the success of the restoration efforts.

Methods:
Western snowy plover monitoring will be performed by a qualified biologist. Observations of foraging CA least tern will also be recorded. Surveys will be conducted by one biological monitor on foot. Surveys will focus on the beach and foredune area within a quarter mile of the beach, focusing inland monitoring on areas treated.

The monitoring will record observations of breeding WSPL by identifying all scrapes, nests, juveniles, adults, and band combinations. Each nest will be numbered in the order of discovery date. The monitor will record a description of the nest location based on markers on the beach and other landmarks. A GPS waypoint will also be recorded for each nest.

Schedule: Monitoring will occur between March 1st-September 30th of each year.

Opportunity 1C: Myrtle pond wetland enhancement

Objective 1C: Exclude wild pigs and Reduce priority invasive plant cover to 1-5% cover class within a previously fenced buffer around Myrtle Pond.

Action 1C.1: Maintain 1160 ft. of existing fence to exclude wild pigs.

Figure 32: Existing fence location at newly created wetland "Myrtle Pond".

Methods:
Assess current condition of the fence and fenceposts to determine if any material is reclaimable. Install 28-34-inch-high graduated hog paneling with smaller openings closest to the ground. These heights have been shown to exclude feral hogs while still allowing adult deer to access. Panels should be sunk at least 1 foot below ground to deter feral hogs from digging under the fence. To protect sensitive plants from grazing rabbits and deer, smaller exclusionary fencing can be installed around core populations. Due to the remoteness of this site, materials will most likely have to be staged using helicopters.

Schedule: Work can happen any time, however, it is best to do work outside of Western snowy plover nesting season if at all possible.

Action 1C.2: Do baseline survey of target invasive plant cover classes within the Myrtle Pond fence exclosure to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

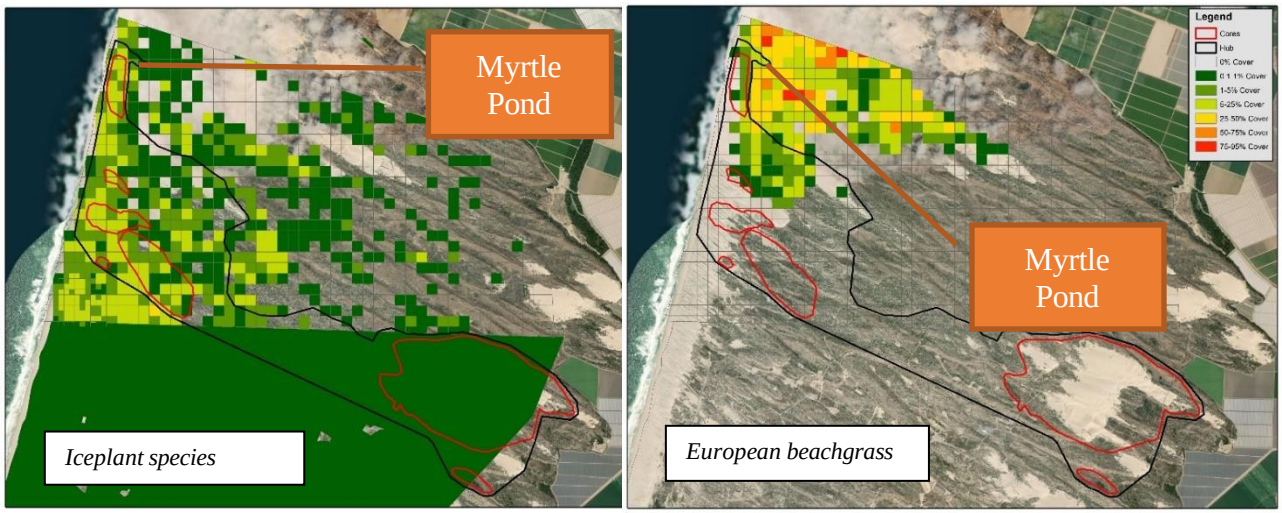


Figure 33: Baseline invasive plant surveys around Myrtle pond.

Action 1C.3: Secure Permits if applicable.

Methods:
Any invasive plant control in wetlands may require additional permitting. In CA this could require an Aquatic Pesticide Application Plan and NPDES Permit through the Water Quality Control Board. It is unclear if this requirement is necessary on Federal Land. Regardless, there is a certain amount of permitting required to do work on Federal property, especially in sensitive resource areas such as this.

Schedule: Permitting requirements should be determined before any work begins.

Action 1C.3: Control: Invasive plants threatening this area are predominantly European beachgrass with secondary invasion occurring by iceplants (*Carpobrotus* spp.).

Methods:
European beachgrass predominantly spreads through underground rhizomes with a limited seedbank. This buried rhizome system can be very dense and can survive sand burial of up to 3.3 m. Successful control of the plant depends heavily on the ability to kill this underground rhizomatous root structure.

Much work has been done evaluating the effects of different treatments on beachgrass in coastal dune systems. Hand removal has proven to be expensive and relatively ineffective as one needs to continually remove biomass until the below ground root system becomes starved. Burning above ground biomass followed by herbicide treatments have proven successful but require a significant amount of coordination and unknown costs.

Unfortunately, grass specific herbicides have proven to be ineffective. Foliar applications of glyphosate can be effective if timed correctly when the plant is actively growing, and the phloem is translocating downward into the roots. However, experience has shown that glyphosate applications alone require a high application rate and require several years of follow-up treatment due to re-sprouting from the rootmass. The most effective method currently used involves a foliar application of herbicides containing glyphosate mixed with those containing imazapyr. Imazapyr is an amino acid synthesis inhibitor that has soil residual activity that is able to move into the soil profile and kill the extensive root system. This typically requires one large application followed by several years of follow-up treating respouts. The level of effort drops off significantly after the first year. Because imazapyr is a broad-spectrum herbicide, off target damage must be expected. Monitoring native plant regeneration after treatment is necessary to ensure good recovery of the native plant community. If this is not happening, supplemental seeding may be required.

In foredune situations, rhizomes should be "ripped" with a bulldozer to break up the unnaturally stabilized dunes and re-establish natural dune processes. However, at this site, migrating sand may encroach into the wetland. Therefore, after A. arenaria is controlled, above ground biomass should be broken up, however ripping the root mass to destabilize the sand may be undesirable.

Iceplant reproduces both vegetatively through stem fragments and by seed. Seeds are inside "berry-like" capsules that may persist for months on the plant. Fruits primarily spread when animals such as deer, rabbits and rodents feed on them. Seeds that pass through an animal's gut germinate more readily than those that do not. Fruits not eaten become hard making seeds dormant until the fruit decomposes in about three years (DiTomaso et al., 2013).

Hand removal has proven effective but is labor intensive. Removal can also be done with heavy machinery if available, like a skid steer. All live plants and stem fragments must be removed from contact with soil to remove re-sprouts. For the initial treatment, we recommend herbicide applications of glyphosate containing products. This has proven to be the most effective control strategy in CA. Applications should be made to actively growing plants. This will be timed to avoid nesting season for Western snowy plover and CA least tern (March-September). The dead biomass from iceplant can make the normally harsh dune system more susceptible to secondary invaders. It will be important to monitor treated areas to ensure secondary invaders don't replace the iceplant.

Treatment Schedule:

Herbicide Treatments will involve one treatment event per year. Year 1 will be considered the "knock down" phase and will constitute the bulk of the effort. Yr. 2-3 will involve follow-up monitoring and spot treatments of any re-sprouts. The level of effort in those years should decrease significantly dropping off to negligible by year 3. The table below highlights the expected timing of treatment strategies.

Table 24: Seasonal treatment strategies for European beachgrass and iceplant.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex														
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
European beachgrass (*Ammophila arenaria)*	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Chemical	not water stressed	2+ Years				Tank Mix Roundup Pro Conc 2.0 % - Imazapyr 1% v/v foliar spray								
Sea fig (*Carpobrotus chilensis*)	Perennial Herb -- Life cycle:				Active Growth			Flower					Senescence		
	Manual	before seeding	2+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed	2+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray										
Iceplant (*Carpobrotus edulis*)	Perennial Herb -- Life cycle:			Growth	Flower			Fruit							Active
	Manual	not water stressed	2+ Years	Hand remove plants including root before fruiting. Plants left on-site may re-root											
	Chemical	not water stressed	2+ Years	Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray											

Priority 2 Opportunities

Opportunity 2A: Highway Iceplant (*Carpobrotus edulis*) and Sea fig (*C. chilensis*) control

Objective 2A: Reduce and maintain iceplant cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).

Action 2A.1: Do baseline survey of iceplant cover classes throughout the NWR/CSD DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

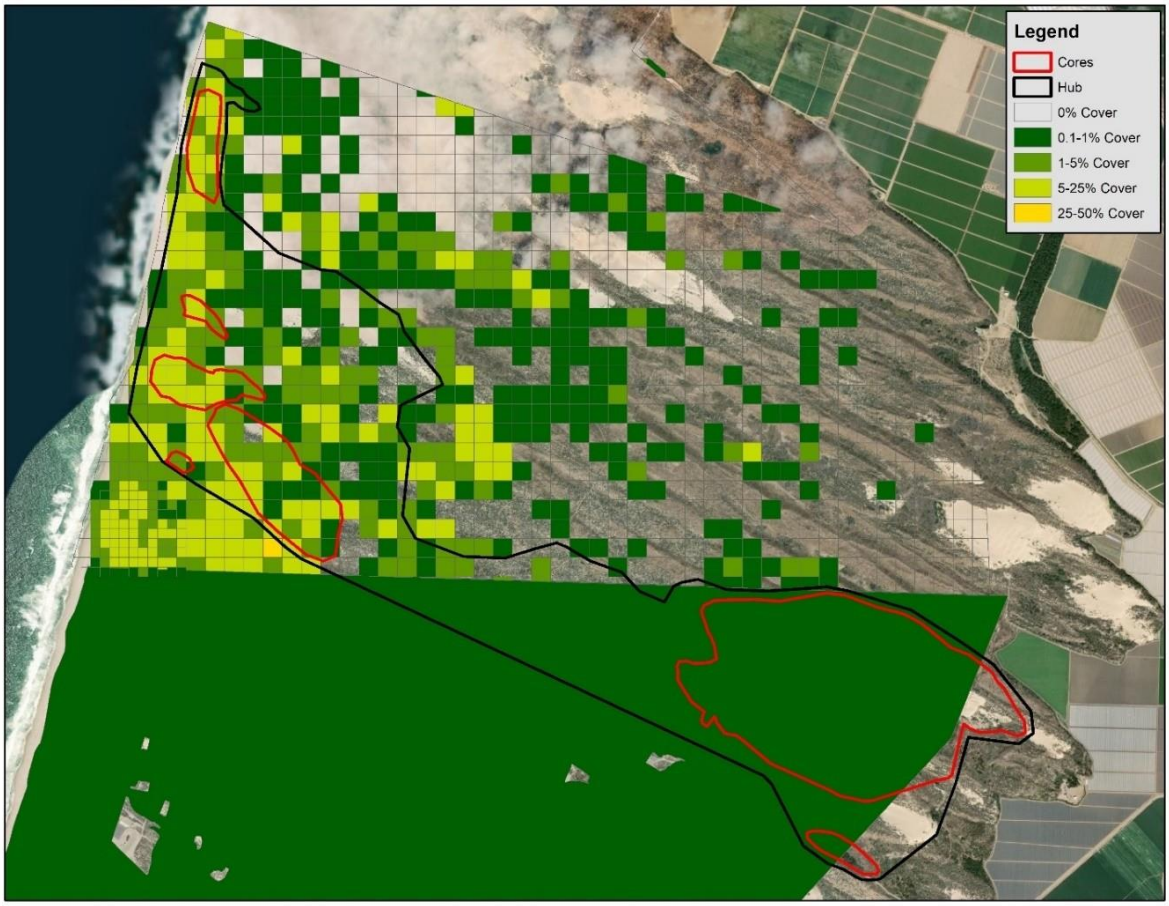


Figure 34: Distribution and abundance of iceplant species mapped in 2017 within the NWR/CSD DPA (Hubs and Cores).

Action 2A.2: Control iceplant within the NWR/CSD DPA (510.72 acres gross: 34.08 Acres Net).

Methods:
Iceplant reproduces both vegetatively through stem fragments and by seed. Seeds are inside "berry-like" capsules that may persist for months on the plant. Fruits primarily spread when animals such as deer, rabbits and rodents feed on them. Seeds that pass through an animal's gut germinate more readily than those that do not. Fruits not eaten become hard making seeds dormant until the fruit decomposes in about three years (DiTomaso, J.M., G.B. Kyser et. Al 2013).

Hand removal has proven effective but is labor intensive. Removal can also be done with heavy machinery if available, like a skid steer. All live plants and stem fragments must be removed from contact with soil to remove re-sprouts. For the initial treatment, we recommend herbicide applications of glyphosate containing products. This has proven to be the most effective control strategy in CA. Applications should be made to actively growing plants. This will be timed to avoid nesting season for Western snowy plover and CA least tern (March-September). The dead biomass from iceplant can make the normally harsh dune system more susceptible to secondary invaders. It will be important to monitor treated areas to ensure secondary invaders don't replace the iceplant.

Treatment Schedule:
Broadcast applications will occur once per year for three years, with follow-up monitoring and spot treatments in year 3-5. After year five monitoring and removal can be reduced to every other year.

Table 25: Seasonal treatment strategies for iceplant species.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																	
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Sea fig (*Carpobrotus chilensis*)	Perennial Herb -- Life cycle:				Active Growth			Flower					Senescence		
	Manual	before seeding	2+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed	2+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray										
Iceplant (*Carpobrotus edulis*)	Perennial Herb -- Life cycle:			Growth	Flower					Fruit					Active
	Manual	not water stressed	2+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed	2+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray										

Opportunity 2B: Perennial veldtgrass control

Objective 2B: Reduce and maintain perennial veldtgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).

Action 2B.1: Do baseline survey of perennial veldtgrass cover classes throughout the NWR/CSD DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

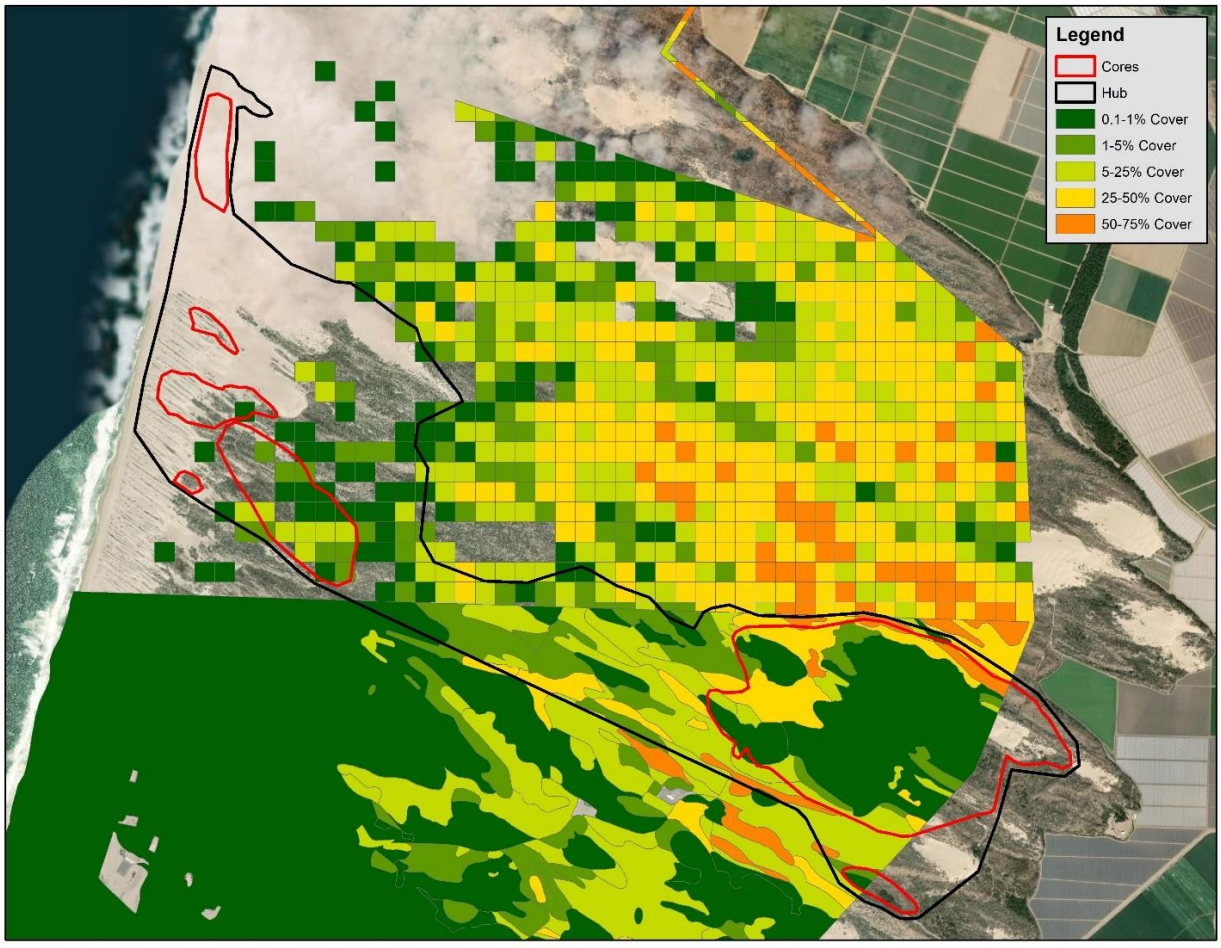


Figure 35: Distribution and abundance of perennial veldtgrass mapped in 2017 within the NWR/CSD DPA (Hubs and Cores).

Action 2B.2: Control perennial veldtgrass within the NWR/CSD DPA (Cores and Hub) (192.23 acres gross: 11.58 Acres Net) while creating defensible spaces to minimize reintroduction from plant propagules.

Methods:
Perennial veldtgrass is a cool season perennial grass with a C3 photosynthetic pathway. Reproduction is by seed and short rhizome. Dispersal mechanisms include wind, water, birds and mammals. It develops large, but relatively short-lived seedbanks. The seedbank can be significantly reduced within 5 years. The rhizomes are used as a strategy to survive periods of drought and can be a source of resprouting after herbicide treatments. New plants can flower and set seed within 1 year and there can be multiple seeding events throughout the year.

For small infestations, manually remove the plants ensuring crown removal. Dense infestations should be treated with a broadcast application of a grass specific herbicide such as fluazifop-p-butyl (ex. Fusilade DX) to minimize off-target damage to natives. Once the population is reduced to spot treatments, herbicides can be switched to a non-selective herbicide such as glyphosate (ex. Roundup Pro Conc). Treatments typically occur in two large spraying events with follow-up spot treatments or hand removal to eliminate any plants that escaped the initial treatments. Of the three grass herbicides available for use on veldtgrass, clethodim (ex. Arrow 2EC) shows the most promise for control. Unfortunately, it is currently not labeled for use in wildland areas so is not an option on the Refuge side of the NWR/CSD DPA. It is also important to note that herbicide resistance to clethodim by an *Ehrharta* species has been documented in Australia after 7 years of use. This is a good reminder to switch up the herbicide mode of action periodically to ensure herbicide resistance does not develop in the Guadalupe-Nipomo Dunes Complex.

Grass herbicide treatment timing typically occurs in the wetter winter season. These herbicides are most effective on actively growing plants before the "boot stage" when flower heads begin to form in the grass. After this time, glyphosate becomes much more effective than the grass herbicides.

After three years of control, areas not successfully recolonizing through the native seedbank should be augmented with additional native seed applications. Seeding rates will vary based on the species being broadcast.

Treatment Schedule:
Herbicide Treatments will involve two broadcast treatment events per year. Year 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. During this time, there should be a significant drop in the percent cover. Long-term management will involve follow-up monitoring and spot treatments of any reintroductions. Although the seedbank is short-lived, the chance for re-introduction is high. Treatment of perennial veldtgrass anywhere in the Guadalupe-Nipomo Dunes Complex should be considered a long-term endeavor requiring diligent follow-up. The table below highlights the expected timing of treatment strategies.

Table 26: Seasonal treatment strategies for perennial veldtgrass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																	
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Perennial Veldtgrass (*Ehrharta calycina*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Poast 1.5 pt product/acre - foliar spray			Poast 1.5 pt product/acre - foliar spray								
	Chemical	not water stressed	5+ Years		Roundup Pro Conc 1.5% v/v foliar spray			Roundup Pro Conc 1.5% v/v foliar spray							
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Fusilade DX 1-1.5 pt product/acre - foliar spray			Fusilade DX 1-1.5 pt product/acre - foliar spray								

Opportunity 2C: Rare plant species habitat enhancement

Objective 2C: Reduce and maintain non-native invasive plant cover to 1-5% cover class within the Core areas of the NWR/CSD DPA to enhance habitat for surf thistle and beach spectaclepod.

Action 2C.1: Survey - Map invasive plants threatening habitat for surf thistle and spectaclepod.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

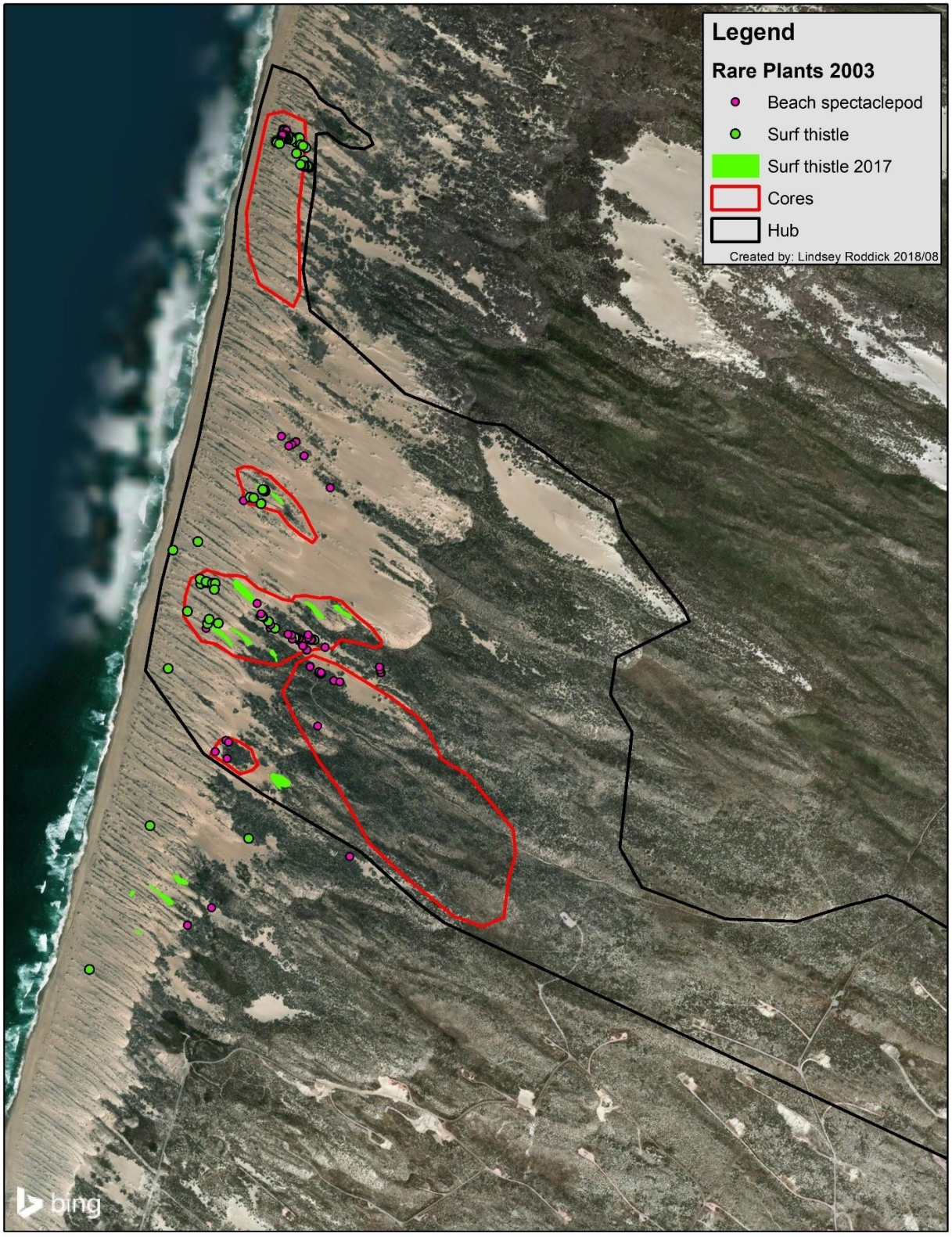


Figure 36: Surf thistle and Beach spectaclepod found in the NWR/CSD DPA.

Action 1E.2: Control – Reduce priority invasive plant infestations to 1-5% cover within the Core of the NWR/CSD DPA.

Table 27: Priority invasive species cover in "core" areas of DPA.

Species Name	Cores	
	Net Acres	Gross Acres
Refuge- measured by grid		
Ammophila arenaria	8.988	14.654
Carpobrotus edulis	0.031	6.209
Carpobrotus chilensis	16.039	114.933
Ehrharta calycina	2.7	45.291
Refuge- measured by polygon		
Conicosia pugioniformis	0.023	4.548
Senecio elegans	0.03	1.026

Methods:

European beachgrass predominantly spreads through underground rhizomes with a limited seedbank. This buried rhizome system can be very dense and can survive sand burial of up to 3.3 m. Successful control of the plant depends heavily on the ability to kill this underground rhizomatous root structure.

Much work has been done evaluating the effects of different treatments on European beachgrass in coastal dune systems. Hand removal has proven to be expensive and relatively ineffective as one needs to continually remove biomass until the below ground root system becomes starved. Burning above ground biomass followed by herbicide treatments have proven successful, would not be appropriate for the smaller sparse acreage of beachgrass seen in the "core" areas of the DPA. It could be pursued as part of a larger scale effort.

Unfortunately, grass specific herbicides have proven to be ineffective. Foliar applications of glyphosate can be effective if timed correctly when the plant is actively growing, and the phloem is translocating downward into the roots. However, experience has shown that glyphosate applications alone require a high application rate and require several years of follow-up treatment due to re-sprouting from the root-mass. The most effective method currently used involves a foliar application of herbicides containing glyphosate mixed with those containing imazapyr. Imazapyr is an amino acid synthesis inhibitor that has soil residual activity that is able to move into the soil profile and kill the extensive root system. This typically requires one large application followed by several years of follow-up treating re-spouts. The level of effort drops off significantly after the first year. Because imazapyr is a broad-spectrum herbicide, off target damage must be expected. Monitoring native plant regeneration after treatment is necessary to

ensure good recovery of the native plant community. If this is not happening, supplemental seeding may be required.

In foredune situations, rhizomes should be "ripped" with a bulldozer to break up the unnaturally stabilized dunes and re-establish natural dune processes.

Perennial veldtgrass is a cool season perennial grass with a C3 photosynthetic pathway. Reproduction is by seed and short rhizome. Dispersal mechanisms include wind, water, birds and mammals. It develops large, but relatively short-lived seedbanks. The seedbank can be significantly reduced within 5 years. The rhizomes are used as a strategy to survive periods of drought and can be a source of re-sprouting after herbicide treatments. New plants can flower and set seed within 1 year and there can be multiple seeding events throughout the year.

For small infestations, manually remove the plants ensuring crown removal. Dense infestations should be treated with a broadcast application of a grass specific herbicide such as fluazifop-p-butyl (ex. Fusilade DX) to minimize off-target damage to natives. Once the population is reduced to spot treatments, herbicides can be switched to a non-selective herbicide such as glyphosate (ex. Roundup Pro Conc). Treatments typically occur in two large spraying events with follow-up spot treatments or hand removal to eliminate any plants that escaped the initial treatments. Of the three grass herbicides available for use on veldtgrass, clethodim (ex. Arrow 2EC) shows the most promise for control. Unfortunately, it is currently not labeled for use in wildland areas so is not an option on the Refuge side of the NWR/CSD DPA. It is also important to note that herbicide resistance to clethodim by an *Ehrharta* species has been documented in Australia after 7 years of use. This is a good reminder to switch up the herbicide mode of action periodically to ensure herbicide resistance does not develop in the GNDC.

Grass herbicide treatment timing typically occurs in the wetter winter season. These herbicides are most effective on actively growing plants before the "boot stage" when flower heads begin to form in the grass. After this time, glyphosate becomes much more effective than the grass herbicides.

After three years of control, areas not successfully recolonizing through the native seedbank should be augmented with additional native seed applications. Seeding rates will vary based on the species being broadcast.

Narrow leaved iceplant is a relatively short-lived (10 yrs) herbaceous plant. It can shift between CAM and C3 photosynthetic pathways which allows for growth during periods of high temperature and low water availability. This may increase its invasive ability under some climate change scenarios. The plant can flower in the first or second year. Reproduction is by seed. The predominate dispersal mechanism is wind as the capsules are blown across the ground. Narrow

leaved iceplant does not appear to be very competitive with native shrubs or non-native grasses but seems to quickly take advantage of open spaces left after invasive plant control of other species like perennial veldtgrass. The plant is widely distributed throughout the dune system, but in general appears to exist at low infestation levels with occasional population explosions. Infestations can be treated by manually removing the plants ensuring crown removal. Plants can also be treated with a non-selective systemic herbicide like glyphosate (ex. Roundup Pro Conc). Only passive restoration is suggested for those areas treated for narrow leaved iceplant.

Iceplant (Carpobrotus spp.) reproduce both vegetatively through stem fragments and by seed. Seeds are inside "berry-like" capsules that may persist for months on the plant. Fruits primarily spread when animals such as deer, rabbits and rodents feed on them. Seeds that pass through an animal's gut germinate more readily than those that do not. Fruits not eaten become hard making seeds dormant until the fruit decomposes in about three years (DiTomaso et al., 2013).

Hand removal has proven effective but is labor intensive. Removal can also be done with heavy machinery if available, like a skid steer. All live plants and stem fragments must be removed from contact with soil to remove resprouts. This is a great option for volunteer groups once the population is reduced to a long-term management level. For the initial treatment, we recommend herbicide applications of glyphosate containing products. This has proven to be the most effective control strategy in CA. Applications should be made to actively growing plants. This should be timed to avoid nesting season for Western snowy plover and CA least tern (March-September). The dead biomass from iceplant can make the normally harsh dune system more susceptible to secondary invaders. It will be important to monitor treated areas to ensure secondary invaders don't replace the iceplant.

***Purple ragwort* (*Senecio elegans*)** is a small short-lived annual that reproduces by seed. Seed is wind dispersed. There is not much information on seed longevity for purple ragwort, however based on research on other annual senecios, seedbanks can last up to 6 years if in the upper 2 cm of soil and allowed to lose seed through germination. If the seedbank is buried deeper, it may remain dormant for up to 14 years.

Control can be performed manually for small populations. For larger populations, chemical control can be done with the herbicide Milestone (aminopyralid). This is a selective herbicide with good effects on Asteraceae plants that has some soil residual activity. It also has an excellent toxicological profile. This plant can also be treated with the non-selective herbicides containing glyphosate or imazapyr if done in conjunction with treatments for other invasive plants. The plant grows during the nesting season closures for the Western snowy plover, making control and detection difficult.

Treatment Schedule:

Treatment schedules will vary based on the target species. In general, Herbicide Treatments will involve one treatment event per year. Year 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. Yr. 4-5 will involve follow-up monitoring and spot treatments of any resprouts. The level of effort in those years should decrease significantly dropping off to negligible by yr. 5. Core areas containing perennial veldtgrass will require two treatments a year. The table below highlights the expected timing of treatment strategies. Purple ragwort grows at a different timing that the other plants and may require a specific focused effort. This plant will have to be assessed if it is merely naturalized with no significant impact to higher-level management goals, or if it causes ecologically significant impacts commensurate with the cost of control.

Table 28: Seasonal treatment strategies for priority invasive plant species.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																	
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
European beachgrass (*Ammophila arenaria)*	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Chemical	not water stressed	2+ Years				Tank Mix Roundup Pro Conc 2.0 % - Imazapyr 1% v/v foliar spray								
Perennial Veldtgrass (*Ehrharta calycina*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Poast 1.5 pt product/acre - foliar spray			Poast 1.5 pt product/acre - foliar spray								
	Chemical	not water stressed	5+ Years		Roundup Pro Conc 1.5% v/v foliar spray			Roundup Pro Conc 1.5% v/v foliar spray							
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Fusilade DX 1-1.5 pt product/acre - foliar spray			Fusilade DX 1-1.5 pt product/acre - foliar spray								
Narrow-leaved iceplant (*Conicosia pugioniformis*)	Perennial Herb -- Life cycle:			Fruit	Active Growth		Flower						Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed	5+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray										
Sea fig (*Carpobrotus chilensis*)	Perennial Herb -- Life cycle:				Active Growth			Flower					Senescence		
	Manual	before seeding	2+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed	2+ Years		Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray										
Iceplant (*Carpobrotus edulis*)	Perennial Herb -- Life cycle:			Growth	Flower			Fruit							Active
	Manual	not water stressed	2+ Years	Hand remove plants including root before fruiting. Plants left on-site may re-root											
	Chemical	not water stressed	2+ Years	Roundup Pro Conc (glyphosate) @ 1.6 qt/acre broadcast or 1.6% v/v foliar spot spray											
ANNUAL HERBS															
Purple ragwort (*Senecio elegans*)	Annual Herb -- Life cycle:			Fruit					Active growth		Flower				Fruit
	Manual	Remove up until early flowering stage. Remove root crown.	5+ Years							Hand remove isolated/small populations					
	Chemical	Apply before stem elongation.	5+ Years							Milestone (aminopyralid) @ 5 oz/acre.					

Opportunity 2D: Purple ragwort (*Senecio elegans*) control

Objective 2D: Reduce and maintain infestation of *Senecio elegans* to 1-5% cover class with no range expansion within the NWR/CSD DPA.

Action 2D.1: Survey – Do a pre-project survey to determine the extent of the Senecio elegans infestation within the Guadalupe-Nipomo Dunes National Wildlife Refuge to estimate level of effort for control and use as a baseline for success criteria.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

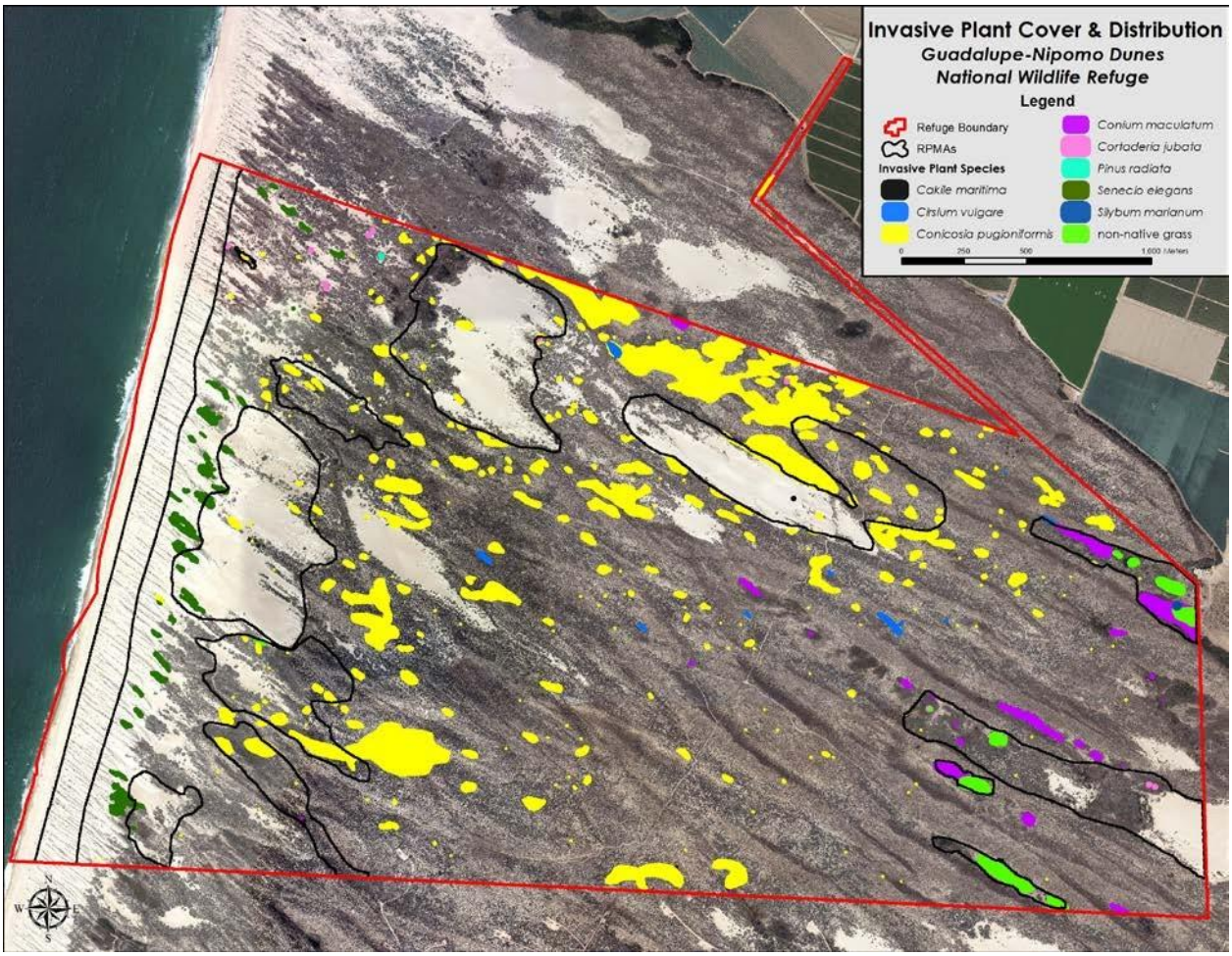


Figure 37: Map of invasive plant cover and distribution documented during February 2016 GNDNWR aerial surveys.

Action 2D.2: Control purple ragwort populations throughout the NWR/CSD DPA.

Methods:
Purple ragwort is a small short-lived annual that reproduces by seed. Seed is wind dispersed. There is not much information on seed longevity for purple ragwort, however based on research on other annual senecios, seedbanks can last up to 6 years if in the upper 2 cm of soil and allowed to lose seed through germination. If the seedbank is buried deeper, it may remain dormant for up to 14 years.

Control can be performed manually for small populations. For larger populations, chemical control can be done with the herbicide Milestone (aminopyralid). This is a selective herbicide with good effects on Asteraceae plants that has some soil residual activity and an excellent toxicological profile. This plant can also be treated with the non-selective herbicides containing glyphosate or imazapyr if done in conjunction with treatments for other invasive plants. The plant grows during the nesting season closures for the Western snowy plover, making control and detection difficult. Anybody working on this plant during the Western snowy plover closure season will have to be approved by the US Fish and Wildlife Service.

Treatment Schedule:
Treatment schedules will involve one treatment event per year. Years 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. Yr. 4-5 will see a significant reduction in the seedbank, however search time for this small species will require a similar level of effort as the knock-down phase. After this, the population will be in a long-term maintenance and monitoring phase requiring annual visits and control if eradication is the target control method. The table below highlights the expected timing of treatment strategies.

Table 29: Seasonal treatment strategies for purple ragwort.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																	
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
ANNUAL HERBS															
Purple ragwort (*Senecio elegans*)	Annual Herb -- Life cycle:			Fruit					Active growth		Flower				Fruit
	Manual	Remove up until early flowering stage. Remove root crown.	5+ Years							Hand remove isolated/small populations					
	Chemical	Apply before stem elongation.	5+ Years							Milestone (aminopyralid) @ 5 oz/acre.					

Opportunity 2E: Feral Pig control

Objective 2E: Reduce and maintain feral pig populations by 90% annually on the entire GNDNWR.

Action 2E.1: Aerial culling of feral pig populations.

Methods: Based on results of the aerial survey, feral pigs play an active role in utilizing and inadvertently modifying dune habitats that they exploit. While the boundary of the Refuge is too porous to maintain a sustained feral pig eradication, efforts should be made to cull pigs on the Nipomo Dune Complex whenever possible. The current *Feral Swine Control and Monitoring Plan* within the GNDNWR CCP calls for a comprehensive ground-based management of feral pigs through maintenance of high quality resource exclusion fencing, targeted trapping, hunting with dogs and vigilant monitoring (U.S. Fish and Wildlife Service, 2016).

Neighboring property owners (California State Parks on the GNDNWR northern boundary and Chevron on the southern boundary) both utilize the United State Department of Agriculture-Wildlife Services to trap pigs. Both properties have well established infrastructure, which makes trapping the preferred option. However, GNDNWR is not structured in a way that favors trapping as an optimal method for feral pig control. Rather, the open habitat on the Refuge is ideal for an aerial hunting approach like that which was performed on Santa Cruz Island in 2006 (Parkes, Ramsey, Macdonald, & Morrison, 2010). Regular culling events could be done in less than two hours from a low-flying helicopter. WCS's helicopter subcontractor, Native Range Inc., performed the feral pig eradication of Santa Cruz Island and their chief pilot is confident that feral pig numbers can be kept to a minimum on the Refuge if two to three culling events were to be performed on the Refuge each year. Results could be further enhanced if aerial culling efforts were conducted across most the greater Nipomo Dunes Complex and combined with persistent trapping efforts.

Treatment Schedule: 2-3 culling events per year. Reassess treatment interval after 5 years.

Opportunity 2F – 2H: The objectives for these three Opportunities are covered under Opportunity 1C: Myrtle Pond Enhancement.

Opportunity 2F: La graciosa thistle habitat protection and enhancement
Opportunity 2G: Marsh sandwort habitat protection and enhancement
Opportunity 2H: Gambel's watercress habitat protection and enhancement

Preventing or Mitigating Effects to Non-Target Resources

While implementing habitat restoration activities it is important to make sure that important natural resources you are trying to protect are not negatively affected in the process. Every method of restoration has its benefits and costs that should be carefully weighed before doing any work.

During any activities or monitoring at the site, people involved will be trained in identifying and avoiding wildlife and sensitive resources. Buffers will be placed and clearly identified around known sensitive areas where care must be taken. Resources in considerable need of protection at the National Wildlife Refuge / Chevron Successional Dune DPA is the Western snowy plover. This is a Federally listed species under the endangered species act. Western snowy plover is a ground nester within this DPA. To avoid impacts to this species, whenever possible, work should occur outside of the breeding season in the nesting habitat. Nesting season is between March 1 and September 27th. If work must occur during the nesting season, workers and activities should be approved by USFWS.

One of the management tools that has the potential for non-target damage is chemical control through herbicides. When herbicides are used, a recommendation from a state-licensed Pest Control Advisor should be used and in most cases is required. An herbicide's potential risk to aquatic and terrestrial wildlife is assessed by the EPA before the product is registered for use in wildlands. Therefore, it is extremely important to closely follow the label for handling and using pesticides.

In most cases though, just following the label isn't enough. The land manager and PCA must carefully weigh the toxicity of the herbicide and the likelihood of exposure to non-target organisms. Only then can the Land Manager decide if an herbicide can be used without undue risk and develop mitigation measures to reduce that risk. Specific mitigation measures will be identified in the written PCA recommendation.

Exposure to non-target organisms increases with broadcast applications of herbicide. Broadcast applications increase exposure through direct herbicide contact and feeding on contaminated plants. Organisms that are browsers are most at risk from increased exposure through feeding on contaminated foliage, seeds or fruits. When possible, spot treatment of herbicide significantly reduces the exposure level to non-target organisms. The following tables provide information on herbicides most frequently used in the GNDC. They contain information important to evaluate and select herbicides based on efficacy, toxicity, exposure potential and fate in the environment. Any adjuvants used to enhance herbicide efficacy will be put through the same level of scrutiny as the herbicides.

Table 30: Herbicide characteristics.

Herbicide	Active Ingredient	Other Ingredients	Target Species	Mode of Action	Adsorption Potential	Primary Degradation Mech	Average Soil Half-life
Fusilade DX	Fluazifop-P-Butyl	Napthalene (<5%)	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	high	microbial metabolism and hydrolysis	15 days
Poast	Sethoxydim	Napthalene 7.32%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	Microbial metabolism and photolysis	5 Days
Arrow 2EC	Clethodim	Napthalene 2.2%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	microbial metabolism slight photolysis	3 Days
Roundup Pro Conc	Glyphosate	POEA 13%	Most Annual and Perennial Plants	Amino acid synthesis inhibitor	high	slow microbial metabolism	47 Days
Habitat	Imazapyr		Most Annual and Perennial Plants	Amino acid synthesis inhibitor	low	slow microbial metabolism and photolysis (in water)	25-141 Days
Garlon 4 Ultra	Triclopyr		Annual and Woody Broadleaf Weeds	Auxin mimic	Intermediate	microbial metabolism, photolysis and hydrolysis	30 Days
Milestone	Aminopyralid		Broadleaf Plants Particularly in Asteraceae and Fabaceae Familys	Auxin mimic	low (10.8 Koc)	slow microbial metabolism and photolysis (in water)	34.5 Days

Table 31: Herbicide toxicity comparison.

Herbicide	Toxicity			Effects to cryptogamic soils	Human Risk		
	Dermal LD50 (rabbits)	Oral LD50 for rats:	LC50 for bluegill sunfish		Irritating to Skin	Eye Damage	Toxic if Inhaled
Fusilade DX	>2,420 mg/kg	4,096 mg/kg	0.53 mg/L	inhibits growth of fungi at levels higher than recommended rates	X	X	X
Poast	>5,000 mg/kg	>2,676 mg/kg	100 mg/L	little noticeable impact on soil microbe populations	X	X	
Arrow 2EC	>5,000 mg/kg	2,920 mg/kg	33 mg/L	insufficient data	X	X	
Roundup Pro Conc	>5,000 mg/kg	5,600 mg/kg	120 mg/L	Initial impacts to microbial populations, but recover rapidly and thought to pose no long-term threat to microbial activities.		X	
Habitat	>2,000 mg/kg	>5,000 mg/kg	>100 mg/L	insufficient data	X	X	
Garlon (Amine and Ester)	>2,000 mg/kg	713 mg/kg	148 mg/L	Inhibits growth of ectomycorrhizal fungi at concentrations of 1,000 parts per million and higher. Some evidence of inhibition of fungal growth was detected in bioassys with as little as 100 ppm triclopyr.	X	X	
Milestone	Negative for rabbits, >5,000 mg/kg in rats	>5,000 mg/kg	>100 mg/L	insufficient data			
** Caffeine LD50 127 mg/kg							
Table salt LD50 3000 mg/kg							
1 espresso shot has 64mg of caffeine							

Monitoring and Evaluation

There are three types of monitoring applicable to the management of the DPA Network:

- Management Activity Monitoring – This is monitoring that tracks what types of Restoration Methods and Activities are happening where. This is meant to track the management itself and not the effects of management.
- Monitoring to Inform Management – This type of monitoring involves defining threshold values or expected responses, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values indicates whether you should initiate, intensify, or alter management actions. An example would be measuring percent cover of an invasive plant to evaluate management actions designed to reduce the cover to a certain threshold value, say 1-5% cover.
- Baseline Monitoring – Essential to the DPA Network management philosophy is the need to maintain viable landscapes and reverse declining trends. To evaluate this, we identify a type of monitoring that evaluates baseline conditions and tracks changes through time.

Management Activity Monitoring

All management activities will be tracked using AgTerra Technologies GIS data management platform. The AgTerra platform integrates mobile mapping, data collection and reporting solutions. Data is collected in the field each day using smartphones or tablets and then uploaded to a cloud-based server. Data is then easily exported into an ESRI ArcGIS format or GoogleEarth. This occurs at the end of each work day and is considered part of daily management activities.

Monitoring to Inform Management

This monitoring type is specific for each Objective. Objectives are listed below with expected values and descriptions of monitoring protocols.

Objective 1A: **Reduce and maintain European beachgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of *European beachgrass* maintained at a 1-5% cover class value throughout the NWR/CSD DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A)

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 1B: **Reduce and maintain European beachgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core) to improve nesting habitat for Western snowy plover.**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of European beachgrass maintained at a 1-5% cover class value throughout the NWR/CSD DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 1C: **Exclude wild pigs and reduce priority invasive plant cover to 1-5% cover class within a previously fenced buffer around Myrtle Pond.**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of excluding wild pigs and invasive plant cover maintained at a 1-5% cover class value throughout the Myrtle Pond enclosure area.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A). All rare plants documented during this assessment will also be

recorded in the online database Calflora (www.calflora.org).The fence will be assessed using a qualitative assessment checklist annually to document the condition of the fence and evidence of wild pig breaches occurring.

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

***Objective 2A*: Reduce and maintain iceplant cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of iceplant (*Carpobrotus* spp.) maintained at a 1-5% cover class value throughout the NWR/CSD DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A)

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

***Objective 2B:* Reduce and maintain perennial veldtgrass cover to 1-5% cover class within the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur in every 5 years to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the NWRCSD DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A)

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune

Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2C: **Reduce and maintain non-native invasive plant cover to 1-5% cover class within the Core areas of the NWR/CSD DPA to enhance habitat for surf thistle and beach spectaclepod.**

Performance monitoring will occur in every 5 years to document progress towards meeting the objective of invasive plant cover maintained at a 1-5% cover class value throughout the NWRCSD DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2D: **Reduce and maintain the infestation of *purple ragwort* to 1-5% cover class with no range expansion within the NWR/CSD DPA.**

Performance monitoring will occur every 5 years to document progress towards meeting the objective of purple ragwort cover maintained at a 1-5% cover class value throughout the NWR/CSD DPA with no range expansion.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A).

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2E: **Reduce and maintain feral pig populations by 90% annually on the entire GNDNWR. Assess removal interval after year five.**

Performance monitoring will occur during each removal event. The act of flying the GNDNWR will also provide an assessment of the pig population as a snap-shot in time. Every 5 years trends will be looked at to document progress towards meeting the objective of feral pig populations reduced by 90% annually

Protocol: During aerial removal flights, all pig locations and numbers will be documented using GPS/GIS technology. These numbers will be compared to the total number of pigs removed during the culling event.

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Baseline Monitoring

To determine if the Conservation Strategy is achieving its higher-level goals, it is important to set up a monitoring program that will track changes over time. Ecosystems are dynamic, none more so than the coastal dune environment. There will be multiple successional trajectories that are possible but tracking species composition and functional groups as they change through time will help us evaluate if our management actions are indeed keeping the dune ecosystem viable and sustainable through time.

The most efficient way to achieve this is by setting up and monitoring vegetation releves. All releve monitoring will follow California Native Plant Society standardized releve protocols. This monitoring method allows for quick classification over a large area. It relies on ocular estimates of plant cover rather than counts of the “hits” of particular species along a transect line or precise measurements of cover/biomass by planimetric or weighing techniques. Monitoring will take place in years 1 and 3 to assess how native biodiversity is changing throughout management as well as assist in adaptive management.

Adaptive Management

Adaptive management is essentially a process for evaluating how well the methods of a plan are meeting the stated objectives and using these evaluations to refine future methods and

approaches of the plan. In real life, this happens in the field. On a day to day basis, land practitioners are evaluating the tools and techniques they are using and determining ways to increase productivity while meeting the desired goals. Decisions are made quickly and typically by those that are present. Adaptive management essentially happens without having to name it or formalize the process. However, there is also merit in having a formalized way of gathering information to have more formal processes to reflect on the success of a program and if changes in method, strategy or direction are warranted. This allows more time to work with experts to ensure management is based on the best available science and critical thought.

For the DPA Network Conservation Strategy, formal program evaluations will occur every 5 years coinciding with years that monitoring occurs. In those years, monitoring reports will be prepared to evaluate:

- What happened (Management Activity Monitoring),
- are we meeting our stated Objectives (Monitoring to Inform Management),
- and is our Conservation Strategy working (Baseline Monitoring).

Meetings will be held in those years to discuss the monitoring evaluations and refine our management methods and Conservation Strategy based on the findings. Changes will be incorporated into new workplans to guide management in the field.

Point Sal

Site Description

Point Sal Reserve is located at the very southern extent of the GNDC and is home to unique maritime chaparral habitat which provides important habitat to a variety of species. Approximately half of his DPA is privately owned and the other half is shared by publicly owned State Parks and Santa Barbara County Parks. South of this DPA is Vandenberg Air Force Base. Access to this region is difficult as you must pass through private property to reach it. An agreement is currently in place for access to this site with neighboring private land owners. An abandoned road is used by hikers to access the beach by way of a five-mile trek. The terrain is difficult, with some areas over 1000 feet in elevation. The surrounding area has been grazed with cattle for hundreds of years and perennial veldtgrass (*Ehrharta calycina*) has transformed the landscape to a monoculture grassland.

While surrounding areas have been altered, maritime chaparral habitat persists within this DPA. Maritime chaparral is a unique habitat which is only found on fog-ridden ridges of the coast. In general, chaparral tends to be less susceptible to human disturbance than coastal dune scrub because it occurs in more stable soils (*Point Sal Reserve Final Management Plan*, 1991). Point Sal Reserve was selected as a DPA because of this maritime chaparral plant community that cannot be found elsewhere in the GNDC. Rare manzanita species, sand mesa manzanita (*Arctostaphylos rudis*) and La Purisima manzanita (*Arctostaphylos purissma*) have been reported in this DPA but no current botanical surveys have been conducted to confirm their status. This DPA is also located at the confluence of many southern and northern species distributions, offer a unique overlap in species.

Figure 38: Maritime Chaparral within the Point Sal DPA.

Not much is known about the specific faunal species residing in Point Sal Reserve. Surveys were last conducted in 2002 with the revision to the Point Sal Reserve Management Plan. This survey emphasized the importance

of Point Sal Reserve for nesting and breeding bird, especially those using the rocky intertidal. Point Sal Reserve is also an important connectivity corridor from the open expanses of Vandenberg Air Force Base.

Management challenges in this DPA are focused on access and the ability to work in difficult terrain. Access to Point Sal Reserve is available but takes hours of mobilization time. Chaparral is also difficult to work in as the plants have sharp spine-like branches and vegetation is dense. The terrain is also very steep and minimal trails are present. Limited management funds are available in this DPA and not much is known about the current threats and trends in changing vegetation. Perennial veldtgrass is a major threat in coastal dune scrub and sage scrub habitats. Invasive plant species mapping was completed in early fall of 2017.

Management History

Most of the Point Sal Reserve is not actively managed and access is difficult. Two management Plans have been drafted for the area, one in 1991 and again in 2002. The most recent plan, prepared by Condor Environmental Planning Services, Inc., focused on resource protection and public access. This plan provided a list of recommended measures, recommends creating a land manager position, and a budget for day-to-day operations of the Reserve. Surrounding privately owned land is subject to cattle grazing. There is not much fencing infrastructure, so cattle grazing also occurs on public land.

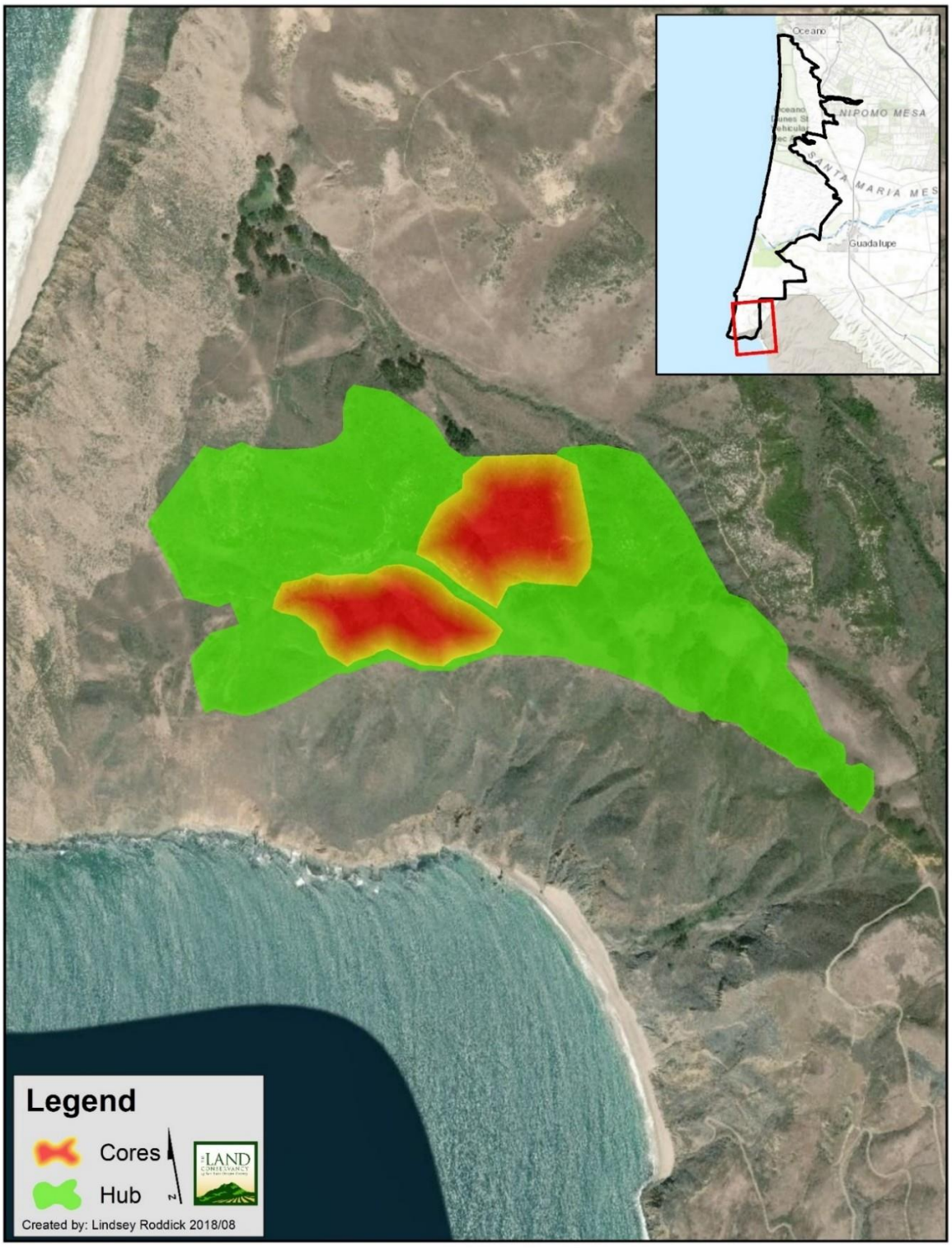


Figure 39: Boundary of the Point Sal Reserve DPA.

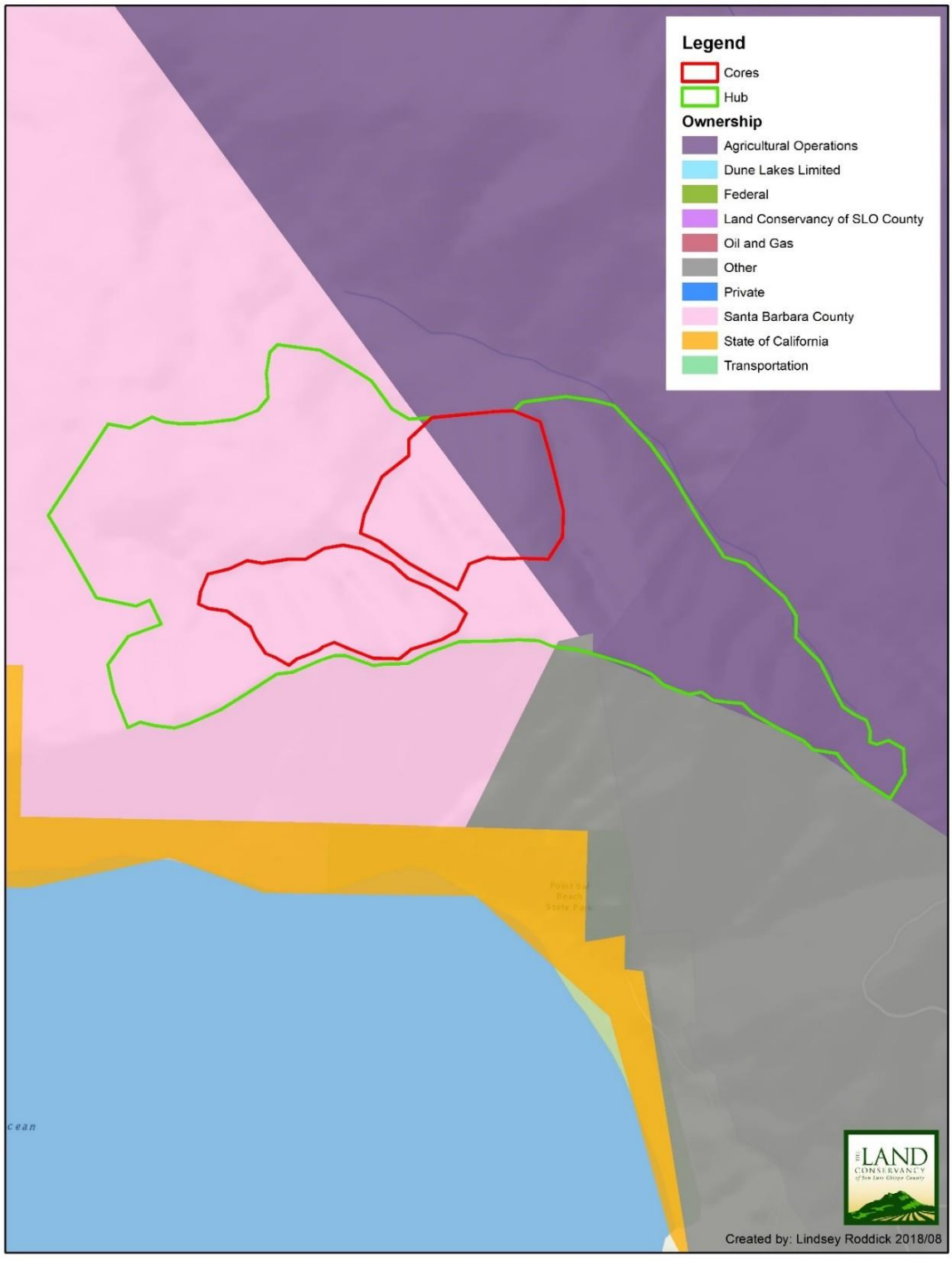


Figure 40: Property Ownership of the Point Sal Reserve DPA.

Site Assessment

The site assessment for the Point Sal Reserve DPA is a snapshot in time representing a baseline of site conditions during the years 2016-2018. This includes a species inventory as well as geospatial data for habitat types, conservation targets, and threats.

Species Inventory

There are no current species inventories of this area. The most recent accounting of species present was in the 1991 Point Sal Reserve Management Plan.

Habitats

Point Sal Reserve and Mussel Rock Dunes Habitat Mapping

The habitat types of the Point Sal Reserve and the Mussel Rock Dunes were digitized from 9,143 high-resolution, geotagged photos from aerial surveys. Habitat types were selected based on the habitat descriptions given in most recent GNDC Conservation Strategy Restoration Plan (The Land Conservancy of San Luis Obispo County, 2018). The Point Sal Reserve DPA (Hubs and Cores) is composed of the following habitat types:

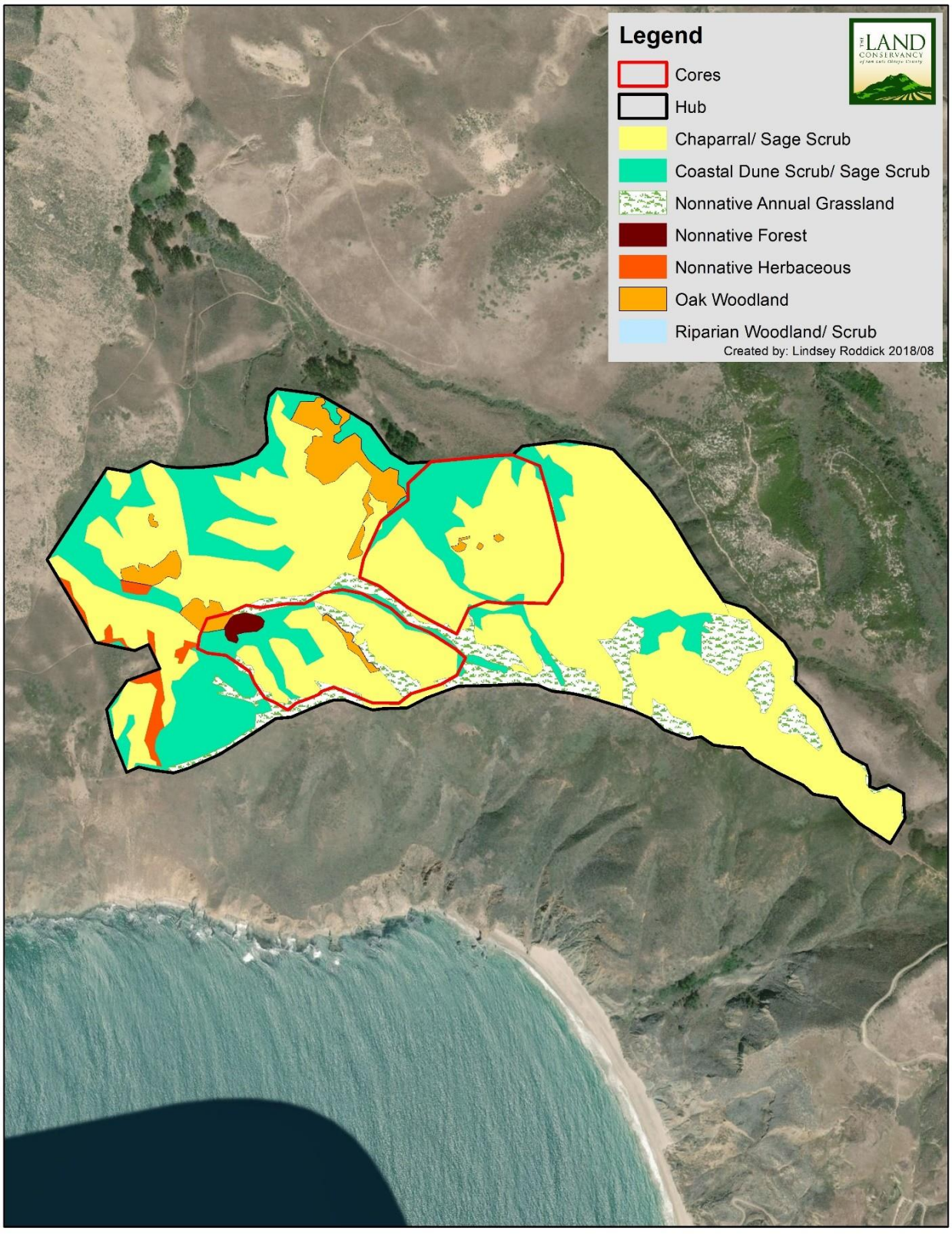
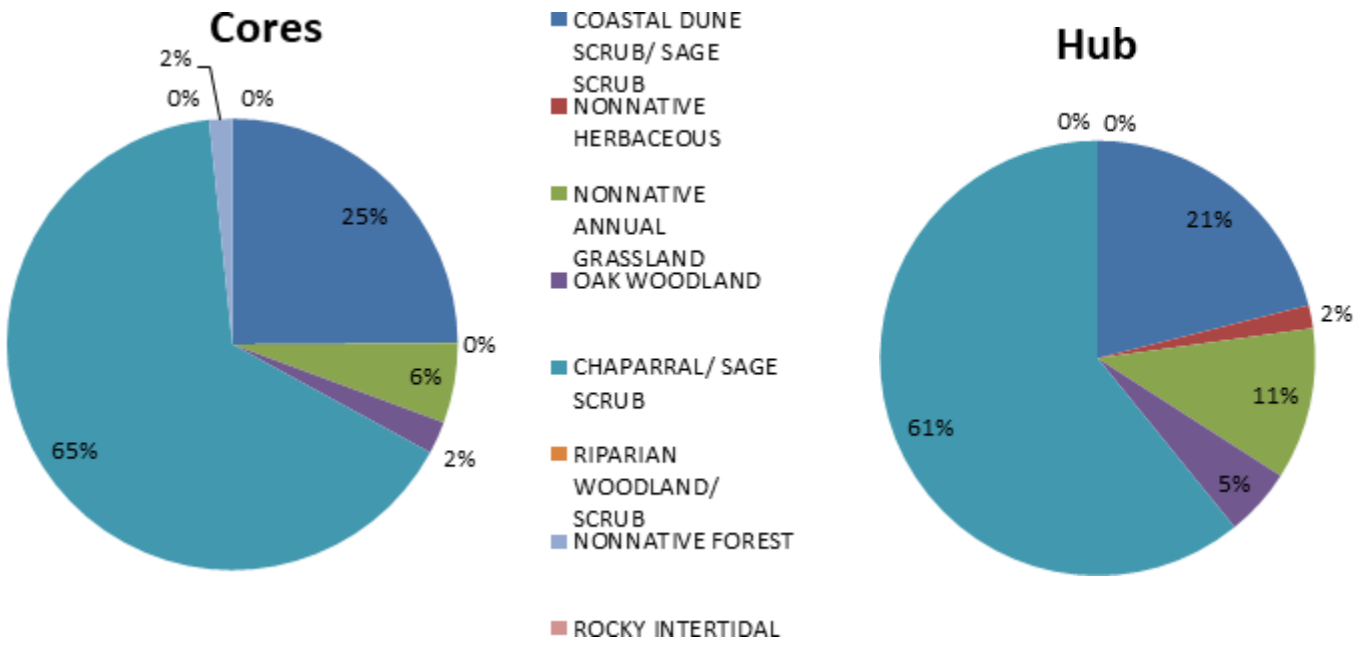


Figure 41: Habitat Types within the Point Sal DPA.



Habitat Type	Core Acres	Core %	Hub Acres	Hub %
COASTAL DUNE SCRUB/ SAGE SCRUB	19.57	24.91%	50.24	15.45%
NONNATIVE HERBACEOUS	0.00	0.00%	4.08	1.42%
NONNATIVE ANNUAL GRASSLAND	4.49	5.72%	26.92	8.27%
OAK WOODLAND	1.82	2.32%	12.07	3.32%
CHAPARRAL/ SAGE SCRUB	51.36	65.40%	144.95	70.29%
RIPARIAN WOODLAND/ SCRUB	0.00	0.00%	0.00	0.00%
NONNATIVE FOREST	1.30	1.65%	0.02	0.01%
TOTAL	**78.54**		**363.17**	

Figure 42: Types and Percent Cover of Habitats within the Point Sal DPA.

Threats

The biggest threats to the resources of the Point Sal Reserve are associated with public access and non-native invasive plants. The impacts associated with public access is documented in the 2002 Point Sal Reserve Management Plan (Santa Barbara County Parks Department, 2002). These include erosion impacts from roads and trails as well as public use activities such as camping, off-road vehicle use and animal poaching. In the 1990s substantial erosion on sections of the Point Sal Road has limited vehicle access and reduced user visitation.

The other major threats to the Point Sal Reserve are impacts from non-native invasive species. Given the large number of non-native species in the Guadalupe Nipomo Dunes Process it is often difficult to know where to start. To help in this process, during a 3-day workshop, a target invasive plant list for surveys was selected by the Dunes Collaborative and was informed by the *Invasive Plant Inventory and Early Detection Prioritization Tool* (Olsen & Hall, 2015). However, invasive plants aren't the only species causing widespread damage in the GNDC. Feral pig localities, numbers observed, and habitat damage was also documented. In addition to invasive species, surveys targeted special status native plants such as Nipomo lupine, La Graciosa thistle, beach spectaclepod, and surf thistle which are known to occur throughout the Guadalupe Nipomo Dunes Complex. A list of species targeted for inventory surveys is found in Table 72.

Table 32: Species list for aerial survey of Point Sal Reserve.

Method	Species	Common Name	Family	Conservation Status	Cal-IPC Ranking
Documented Invasive Plants *Map Using a Grid System (5 Species)*	*Ammophila arenaria*	European beachgrass	Poaceae	*invasive plant*	High
	Carpobrotus chilensis	ice-plant / sea fig	Aizoaceae		Moderate
	Carpobrotus edulis	freeway ice-plant	Aizoaceae		High
	Concosia pugioniformis	slender leaf ice-plant	Aizoaceae		Limited
	Ehrharta calycina	perennial veldt grass	Poaceae		High
Documented Invasive Plants *Map Using Points & Polygons (12 Species)*	*Arundo donax*	giant reed	Poaceae	*invasive plant*	High
	Delairea odorata	cape ivy	Asteraceae		High
	Thinopyrum junceiforme	russian wheatgrass	Poaceae		Red Alert
	Tamarix sp.	tamerisk	Tamaricaceae		High
	Senecio elegans	purple ragwort	Asteraceae		n/a
	Brassica tournefortii	saharan mustard	Brassicaceae		High
	Hedera sp.	algerian/english ivy	Araliaceae		High
	Lepidium draba	hoary cress	Brassicaceae		Moderate
	Vinca major	greater periwinkle	Apocynaceae		Moderate
	Centaurea solstitalis	yellow star thistle	Asteraceae		High
	Cortaderia jubata	pampas grass	Poaceae		High
	Glebionis coronarium	crowndaisy	Asteraceae		Moderate
Dune Protected Areas Only *(Grasses)* *Map Using a Grid System (4 Species)*	*Bromus madritensis ssp rubens*	red brome	Poaceae	*invasive plant*	High
	Bromus tectorum	downy brome	Poaceae		High
	Cynodon dactylon	bermuudagrass	Poaceae		Moderate
	Cenchrus clandestinus	kikuyugrass	Poaceae		Limited
Dune Protected Areas Only *(Non-grasses)* *Map Using a Grid System (4 Species)*	*Cirsium vulgare*	bull thistle	Asteraceae	*invasive plant*	Moderate
	Conium maculatum	poison hemlock	Apiaceae		Moderate
	Myoporum laetum	ngaio tree	Myoporaceae		Moderate
	Foeniculum vulgare	sweet fennel	Apiaceae		High
Early Detection Invasive Plants (Undocumented) *Map Using Grid, Points or Polygons (10 Species)*	*Eichornia crassipes*	common water-hyacinth	Pontederiaceae	*invasive plant*	High
	Alternanthera philoxeriodes	alligator weed	Amaranthaceae		High
	Genista monspessulana	french broom	Fabacae		High
	Lepidium latifolium	perennial pepperweed	Brassicaceae		High
	Limonium sp.	Algerian sea lavender	Plumbaginaceae		Limited
	Salvinia molesta	giant salvinia	Salviniaceae		High- Alert
	Taeniatherumm caput-medusae	medusahead	Poaceae		High
	Hydrilla verticillata	hydrilla	Hydrocharitaceae		High
	Ludwigia sp.	Uruguay waterprimrose	Onagraceae		High
	Emex spinosa	Spiney emex	Polygonaceae		Moderate
Documented Special Status Native Plants *Map Using Grid, Points or Polygons (3 Species)*	*Cirsium rhothophilum*	surf thistle	Asteraceae	CT; 1B.2	*na*
	Cirsium scariosum var. *loncholepis*	La Graciosa thistle	Asteraceae	FE; CT; 1B.1	
	Dithyrea maritima	beach spectaclepod	Brassicaceae	CT; 1B.1	
Undocumented Special Status Native Plants *Map Using Grid, Points or Polygons (4 Species)*	*Lupinus nipomensis*	nipomo Lupine	Fabaceae	FE; CE; 1B.1	*na*
	Nasturtium gambelii	gambel's watercress	Brassicaceae	FE; CE; 1B.1	
	Arenaria paludicola	marsh sandwort	Caryophyllaceae	FE; CE; 1B.1	
	Layia carnosa	beach layia	Asteraceae	FE; CET; 1B.1	
Non-native Vertebrates *Map Using Points & Polygons (1 Species)*	*Sus scrofa*	Feral Pig	Suidae	invasive animal	*na*

Total- 35 Invasive Plants, 7 Special Status Native Plants & 1 Invasive Animal

In doing surveys in the GNDC, data was collected in a standardized format to allow data sharing among members of the Dunes Collaborative. A protocol was developed by Wildlands Conservation Science (WCS) for survey mapping in the GNDC that captures the most important information for management accurately and efficiently (Morgan Ball & Olthof, 2016).

When target species were encountered, their location, distribution and ground cover was recorded using one of three mapping methods herein referred to as point, polygon, or grid. Point and polygon mapping is restricted to plant populations with a discernible boundary extent, these mapping units are herein referred to as populations or stands. An individual population is defined

by a single contiguous infestation or a cluster of infestations separated by no more than 30-meters.

Descriptions of the three mapping methodologies are provided below:

> **Point -** Discrete populations with easily identifiable (circular) boundaries were mapped using a single data point collected at the population centroid. For each population, diameter and percent ground cover and attribute information listed in Table 73 was also collected. Plant populations mapped as points were later buffered by their infestation radius and converted to polygons for the final product. All feral pigs and rare plant occurrences were mapped using discrete point data.
>
> **Polygon** – Populations with a discernible, irregular-shaped boundary are mapped using a polygon drawn atop a high-resolution orthophotograph. Additional population attributes listed in Table 73 were collected.
>
> **Grid -** European beachgrass, perennial veldtgrass, sea-fig iceplant (*Carpobrotus chilensis*), hottentot fig iceplant (*Carpobrotus edulis*) and Narrow-leaved iceplant (*Conicosia pugioniformis*) cannot be mapped using point or polygon methods because there are no discernible population boundaries to be delineated. Therefore, these widespread and/or diffusely occurring species were mapped by estimating ground cover within a 100-meter by 100-meter pre-established grid system. Within each grid cell, additional population attribute information was collected (Table 74).

Wildlands Conservation Science (WCS) was contracted to complete the aerial invasive and rare plant survey of Point Sal Reserve. WCS is uniquely qualified to perform the survey as they successfully completed a similar survey in 2015 on Guadalupe-Nipomo National Wildlife Refuge (M Ball & Olthof, 2017). An aerial survey was selected because of the dense chaparral and steep slopes present in this area. Some species were specified to be surveyed only within DPAs. DPAs had not been selected for this region during the survey so documentation of these species was completed for the entire survey area when possible.

Table 33: Attribute field information associated with polygon data recorded during the Point Sal Reserve aerial survey.

Field Name	Attribute Description
Stand_ID	Individual stand identification code
Date	Date in which the survey was preformed
Com_Name	Common name of the documented population stand
Species	Scientific name of documented population stand
Num_Indv	Estimated number of plants within documented population stand
Pop_Dens	The vegetative cover of the documented invasive species within the mapped population based off the CNPS cover class diagrams. The cover-classes are used to visually estimate cover within the polygon. Value ranges: **0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%**.
Age_Class	The common age of plants within the population stand. Age is divided into **seedling**, **immature**, **mature**, mixed classes with more young plants (**MixedYoung**) and mixed age classes with more old plants than young (**MixedOld**).
ID_Confid	Confidence level (**High**, **Med**, **Low**) that the surveyor was able to identify the documented plant to species.
Photo	A photo taken of the population stand, if necessary
Surveyor	The name of the surveyor recording the data
Comment	Miscellaneous notes regarding the documented population stand
Gross_Acres	Total area (Acres) of the polygons including the interstitial spaces between the documented invasive plants within a populations (post-survey).
Net Acres	Net area (acres) covered by the documented invasive plants within the polygon, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of the pop_Dens x the Gross_Acres value (post-survey).
Rank	Plant ranking for the documented invasive species or rare plant (post-survey).
Point_X	X coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet
Point_Y	Y coordinate of the polygon centroid in NAD_1983_StatePlane_California_V_FIPF_0405_Feet

Table 34: Attribute field information associated with grid data recorded during the Point Sal Reserve aerial survey.

Field Name	Attribute Description
ID	Individual grid cell identification code
Date	Date in which the survey was preformed
AMAR_Cover	The vegetative cover of European beachgrass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
CARP_Cover	The vegetative cover of Hottentot fig iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
COPU_Cover	The vegetative cover of slender-leaved iceplant within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
EHCA_Cover	The vegetative cover of perennial veldt grass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
CAMA_Cover	The vegetative cover of perennial veldt grass within the grid cell based on the CNPS class cover diagrams. Value ranges: **0-1%**, **1-5%**, **5-25%**, **25-50%**, **50-75%**, **75-95%**, **95-100%**.
Gross_Acre	Total area (acres) of each mapped grid cell including the interstitial spaces between documented invasive species within a population (Post-survey).
AMAR_Acres	Net Area (acres) covered by European beachgrass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of AMAR_Cover x the Gross_Acres (Post-survey).
CARP_Acres	Net Area (acres) covered by Hottentot fig iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of CARP_Cover x the Gross_Acres (Post-survey).
COPU_Acres	Net Area (acres) covered by slender-leaved iceplant within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of COPU_Cover x the Gross_Acres (Post-survey).
EHCA_Acres	Net Area (acres) covered by perennial veldt grass within the grid cell, not including the interstitial spaces between plants. Calculated by multiplying the midpoint value of EHCA_Cover x the Gross_Acres (Post-survey).

Results of the assessment are depicted in Figure 67.

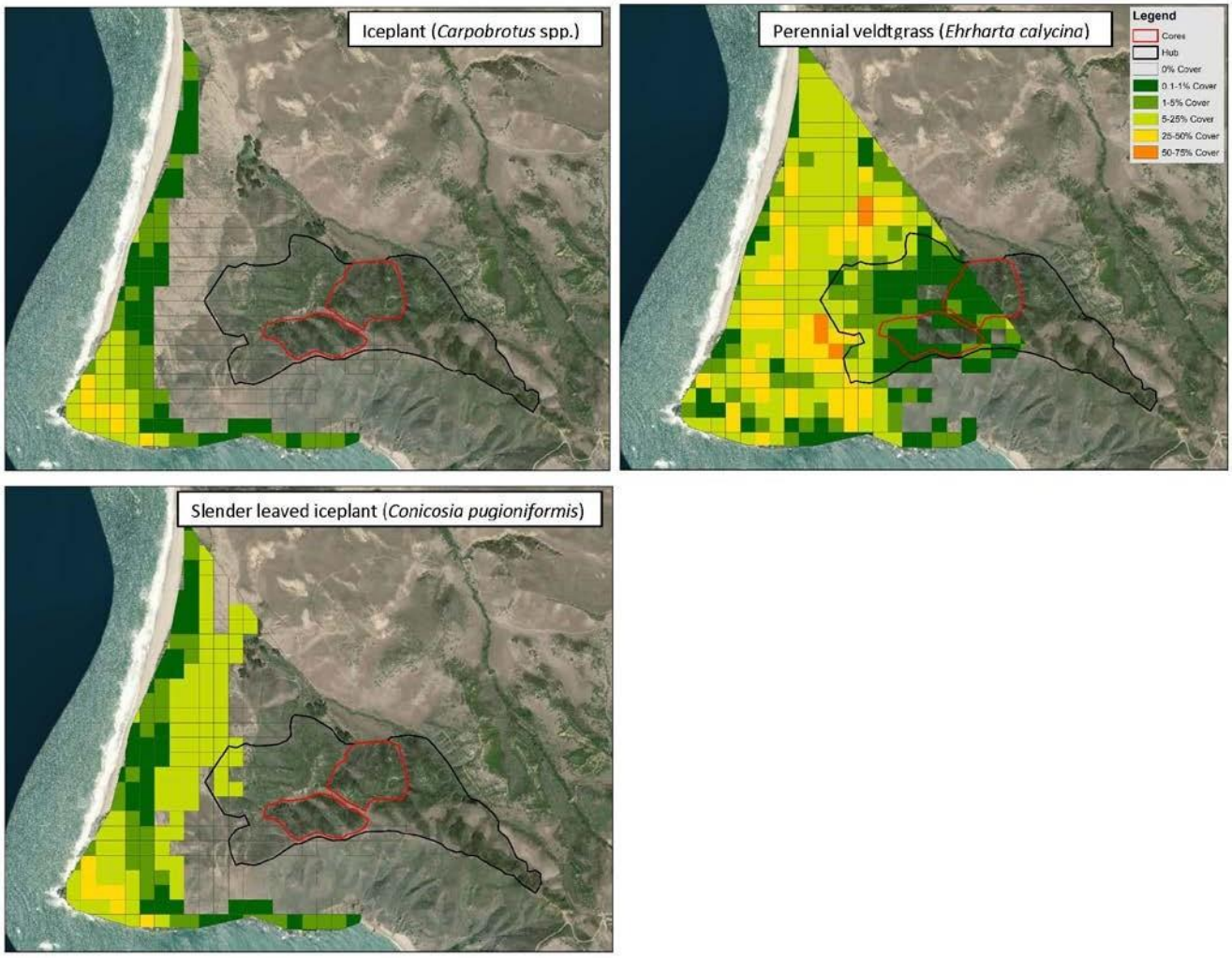


Figure 43: Dominant invasive species in the Point Sal Reserve DPA.

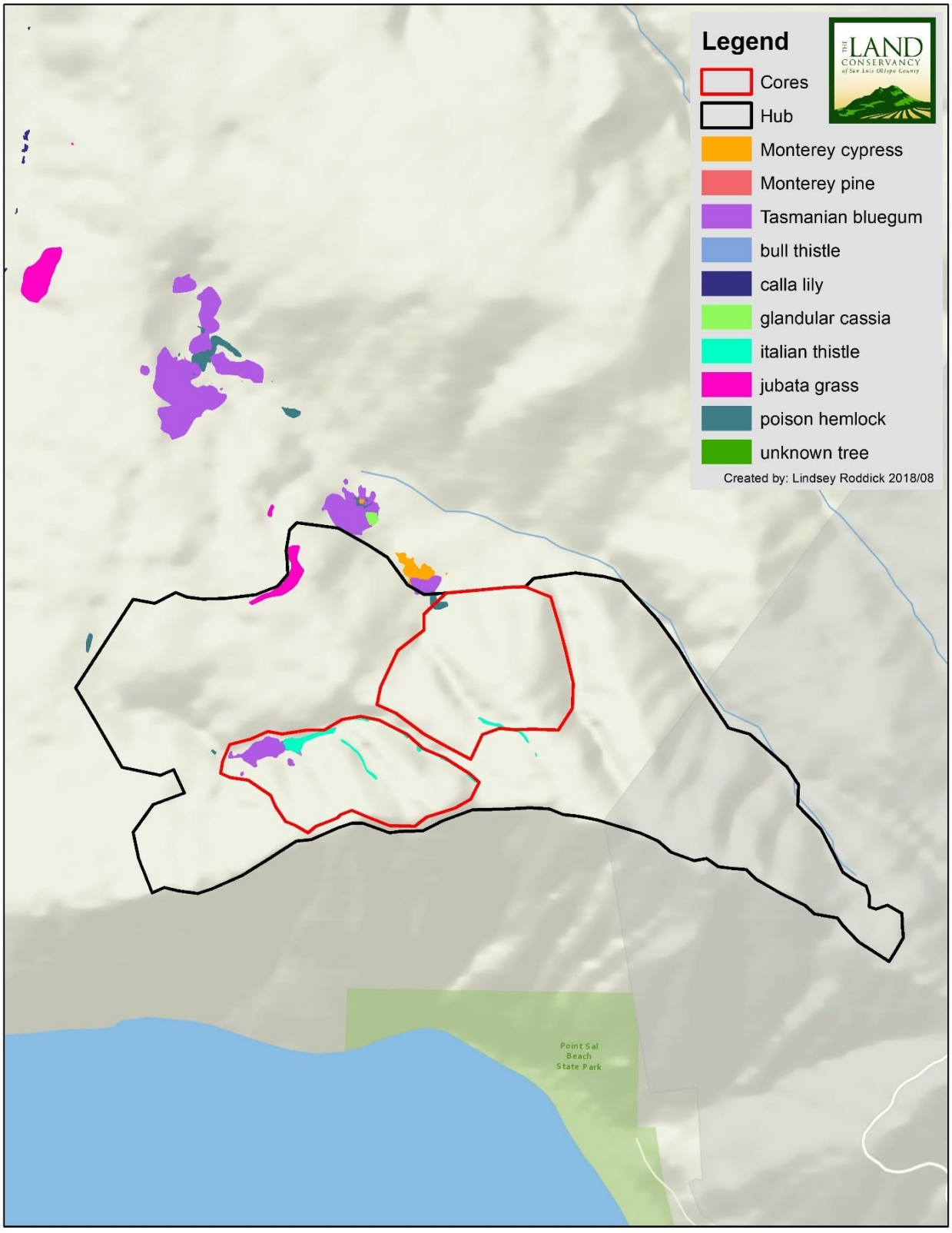


Figure 44: Less common invasive species in the Point Sal Reserve DPA.

Table 35: GRID mapped species acreage in the Point Sal Reserve DPA.

SPECIES NAME	Cores		Hub	
	Net Acres	Gross Acres	Net Acres	Gross Acres
Conicosia pugioniformis	0	0	0.068	12.384
Ehrharta calycina	0.487	44.651	6.529	132.806

Table 36: Polygon mapped species acreage in the Point Sal Reserve DPA.

SPECIES NAME	Cores		Hub	
	Net Acres	Gross Acres	Net Acres	Gross Acres
Carduus pycnocephalus	0.006	0.205	0.006	0.205
Cirsium vulgare	0.002	0.069	0.001	0.040
Conium maculatum	0.048	1.585	0.005	0.168
Cortaderia jubata	0.000	0.000	0.043	1.447
Cupressus macrocarpa	0.000	0.000	0.0003	0.0004
Eucalyptus globulus	0.016	0.019	0.056	0.082

Habitats most affected by the invasive species in the Point Sal/Muscle Rock Dunes Area

The most dominant invasive species detected in this region was perennial veldtgrass. This species covered substantial acres of the region disturbing important native habitats. Perennial veldtgrass is dominant in the eastern portions and has moved into the natural open spaces in the coastal dune scrub habitat. CAL-IPC ranks veldtgrass as a HIGH threat and is a high management concern in other regions of the GNDC. It covers significantly more net acres than any other invasive species surveyed, most of which can be found in the coastal dune scrub habitat. Coastal foredune habitats are invaded by *Carpobrotus* ssp. but none is found in the Point Sal Reserve DPA. Riparian and Freshwater marsh zones of this region are invaded by Pampas grass (*C. jubata*), Salt cedar (*Tamarix sp.)* and Calla Lily *(Z. aethiopica).* This is especially concerning because the riparian and freshwater marsh habitat's role as important wildlife habitat as well as it is not common elsewhere in the GNDC.

Opportunity Prioritization

Based on the assets and threats in the Point Sal Reserve DPA, opportunities for habitat restoration that meet the higher-level management goals were identified. Higher level management goals include:

Because of the preliminary nature of wildlife and botanical surveys in this region, habitat restoration opportunities would be premature at this point. To identify restoration opportunities, we relied heavily on recommendations made in the 2002 Point Sal Reserve Management Plan. For management, these opportunities were categorized into three tiers of Priority Opportunities (Priority 1, Priority 2, Priority 3). The tiers were set based on careful consideration of the opportunity and how it balances contributions to the higher-level goals while considering social, economic and ecological interests.

Priority 1 Opportunities will be those projects that contribute to the high-level goals, are cost efficient to implement and have a certain level of urgency in implementation. These are considered the highest priority restoration opportunities if funding is limited.

Priority 2 Opportunities will be those that contribute to high level goals, have a lower cost/benefit ratio than Priority 1 opportunities, but still achievable within a ten-year time frame.

Priority 3 Opportunities are those that contribute to high level goals, but are difficult to achieve because cost is prohibitive, success is unlikely, or there are political/social reasons that will keep them from being implemented.

Priority 1 Opportunities

Jubata grass (*Cortaderia jubata)* eradication: Jubata grass *is* a large perennial grass that has become highly invasive along the coast of California. One only needs to drive through California's fabled Big Sur coast to witness the invasive potential of this species. Jubata grass is ranked "high" by the California Invasive Plant Council because of its ability to alter plant community composition and structure. It develops mono-specific stands with >75% cover, eliminates lower layers, displaces native species, and creates a new layer in maritime chaparral and other scrub ecosystems. In the 2002 Point Sal Reserve Management Plan eradicating jubata grass wherever it is found was identified as a priority management goal (Santa Barbara County Parks Department, 2002). This was ranked as a Priority 1 Opportunity due to the small size of the infestation in this DPA and relatively short-lived seedbank making the probability of success high.

Stabilize erosion on the Point Sal Reserve Trail System: There are a number of trails bisecting through this DPA. The 2002 Point Sal Reserve Management Plan notes unstable trails creating erosion which affects native plant communities (Santa Barbara County Parks Department, 2002). The trail system going through this DPA should be assessed for erosion potential and usage. The trail system should be designed and adapted to ensure less erosion and a more sustainable long-term design. This was considered a high priority, because the chance of success is high and maintaining a stable infrastructure is critical to the long-term maintenance of this DPA. If this workplan were also considering Visitor Serving Amenities, providing sustainable user access to the spectacular coast of Point Sal would further increase the value of this project.

Priority 2 Opportunities

Perennial veldtgrass (*Ehrharta calycina*) control: Perennial veldtgrass is the largest threat to coastal dune scrub habitat in the Guadalupe Nipomo Dunes Complex. It is ranked "High" by the California Invasive Plant Council for its severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. It has the ability to completely type convert the shrub dominated coastal dune scrub into a grassland. Perennial veldtgrass is a perennial grass which releases hundreds to thousands of seed creating extensive seedbanks. Successful control methods use herbicide to kill the plant before going to flower. It is anticipated that this invader can be brought to manageable levels, however due to the extensive infestations throughout the GNDC, eradication will never be feasible and long-term monitoring and control will be required in perpetuity. Widespread threats such as this were the main drivers to creating the Dune Protected Areas Network. To ensure success, defensible spaces must be created to minimize reintroduction from neighboring propagules. Reducing the population to a manageable level is considered questionable due to the remoteness of the site, difficult terrain and potential high cost. Aerial herbicide applications could reduce the cost, but follow-up spot treatment for long-term control will be difficult. It is a Priority 2 Opportunity because of the urgency of the threat posed

by this plant and the possibility of control with aerial herbicide applications. However, this project is bordering on being a priority 3 because of the persistence of the seedbank.

Priority 3 Opportunities

Land Acquisition: Part of this DPA is in private ownership. Land conservation through either conservation easements or in fee acquisitions would enhance the ability to preserve resources in this DPA. The possibility of future land acquisitions should continue to be investigated and pursued with willing landowners.

Non-native tree removal: Within this DPA are stands of Monterey cypress (*Cupressus macrocarpa)* and blue gum eucalyptus (*Eucalyptus globulus*). As noted in the 2002 Point Sal Reserve Management Plan, these trees have impacts to the pristine nature of the area, however they provide habitat for several bird species (Santa Barbara County Parks Department, 2002). They also have historic and aesthetic value that could argue in favor of preservation. Management for these non-native tree stands involve gradually replacing the eucalyptus with a species native to the site that provides similar ecological and cultural functions. No management recommendations are suggested for the Monterey cypress.

Management Objectives, Actions, Method, Timeline and Budgets

Priority 1 Opportunities

Opportunity 1A: Jubata grass eradication:
Objective 1A: Eradicate jubata grass within the Point Sal Reserve DPA.

Action 1A.1: Survey- Do baseline survey of jubata grass distribution and abundance throughout the Point Sal Reserve DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Complete survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

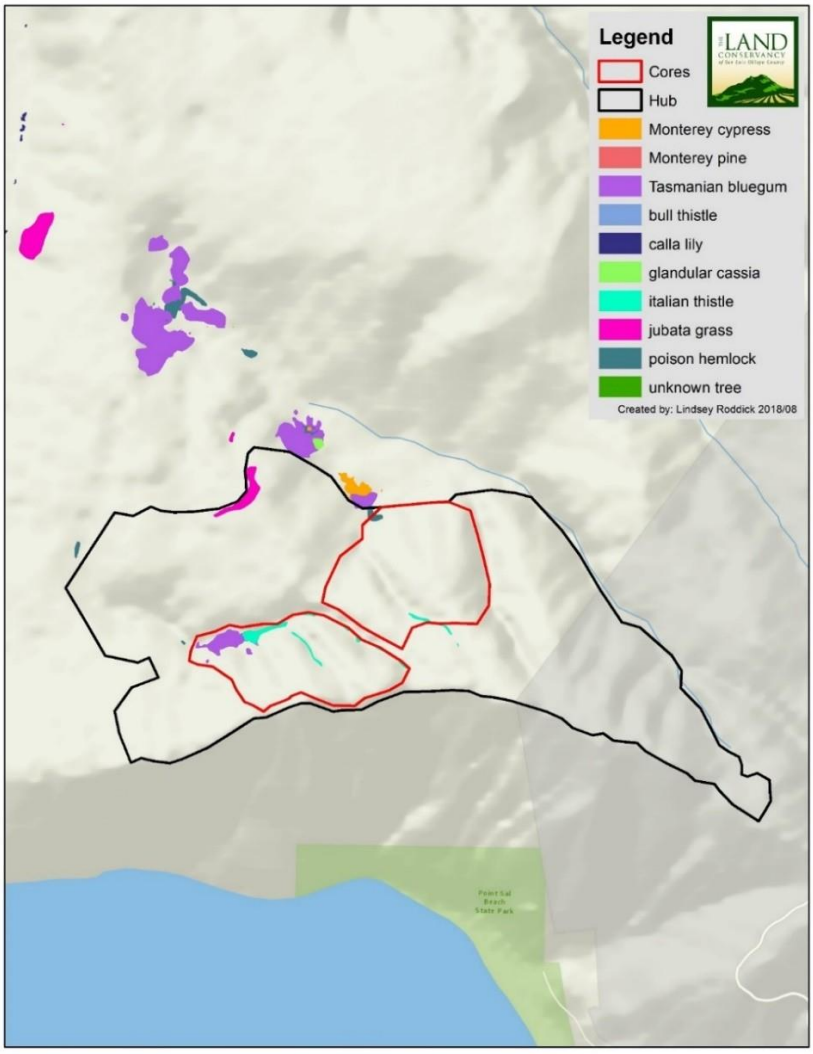


Figure 45: Baseline survey of jubata grass cover in the Point Sal Reserve DPA.

Action 1A.2: Control jubata grass within the Point Sal Reserve DPA (1.45 acres gross, 0.05 acres net)

Methods:
Jubata grass is a large perennial grass with a C3 photosynthetic pathway. It spreads by wind dispersed seed. Seed set in the plant is shown to be 100%. The grass requires about 1 year to reach flowering size. The grass can also reproduce vegetatively by stolons, but this seems to be infrequent. The seeds have no dormancy, making the seedbank short-lived. Experiments done by Researches at UC Davis on Vandenberg Airforce Base have shown that the best success was achieved by wiper applications of glyphosate. Due to the short-lived seedbank, eradication can be achieved in three years. However, some populations considered eradicated in San Luis Obispo County had emergence from the seed bank occur 7 years after control, indicating that maybe a few seeds do in fact lay dormant in the seedbank (Jon Hall, Pers. Obs). Although control techniques are fairly simple, jubata grass typically grows on steep inaccessible slopes, making actual control logistics difficult.

Treatment Schedule:
This will constitute an annual herbicide treatment in the fall with follow-up work to assess the success of control and remove new seedlings in the spring.

Table 37: Seasonal treatment strategies for jubata grass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL			
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
PERENNIALS & BIENNIALS																
Jubata grass (*Cortaderia jubata*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit			
	Manual	seedlings	3+ Years				Hand-pull seedlings									
	Chemical	after flowering	3+ Years										8% Roundup Pro Conc- Low-volume foliar spray			

Opportunity 1B: Stabilize erosion on the Point Sal Reserve Trail System:
Objective 1B: Create a sustainable self-sustaining trail system in the Point Sal Reserve DPA by year three.

Action 1B.1: Trails Assessment – Perform a three-day preliminary trails assessment to evaluate the overall trail design, identify and prioritize problem areas for erosion and usability, and recommend prescriptive actions and develop cost estimates for implementation.

Methods:
Perform a visual and GPS analysis of trail alignment and corridor. Use Slope and grade assessments to formulate recommendations for stabilization and/or reroutes of problematic area to meet sustainable trail criteria. Compile a prioritization of problematic trail segments to determine most practical and effective projects to complete.

Schedule:
This Activity is expected to be complete in Year one of implementation.

Action 1B.2: Trail improvements – This will be based on the Trails Assessment completed in Action 1B.1.

Methods: TBD

Treatment Schedule: Based on findings of Action 1B.1

Opportunity 1B Cost Estimates:
Pending Results of Trails Assessment. Based on similar trail construction projects a generic costs estimate is given based on an assumption of 32 total days of trail work by a CCC crew with oversight and direction from LCSLO.

Table 38: Cost estimate for trail assessment and repairs within the Point Sal Reserve DPA.

Opportunity 1B: Stabilize erosion on the Point Sal Reserve Trail System		
Task 1: Yr 1 Trail Assessment	$	4,089.45
Task 2: Yr 2 Trail Stabilization Implementation (Example of CCC/ACE crew costs - TBD after assessment)	$	40,275.20
Task 3: Yr 3 Trail Stabilization Implementation (Example of CCC/ACE crew costs - TBD after assessment)	$	40,275.20
Task 4: Reporting	$	4,650.00
Contingency 20% (inflation, unanticipated cost increases)	$	8,872.93
Project Total:	**$**	**98,162.78**

Priority 2 Opportunities

Opportunity 2A Perennial veldtgrass control:
Objective 2A: Reduce and maintain perennial veldtgrass cover to 1-5% cover class within the Point Sal Reserve DPA (Hub & Core).

Action 2A.1: Do baseline survey of perennial veldtgrass cover classes throughout the Point Sal Reserve DPA to estimate level of work required to meet the objective and as a reference to track progress.

Method: Do ground survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Completed at least every 5 years

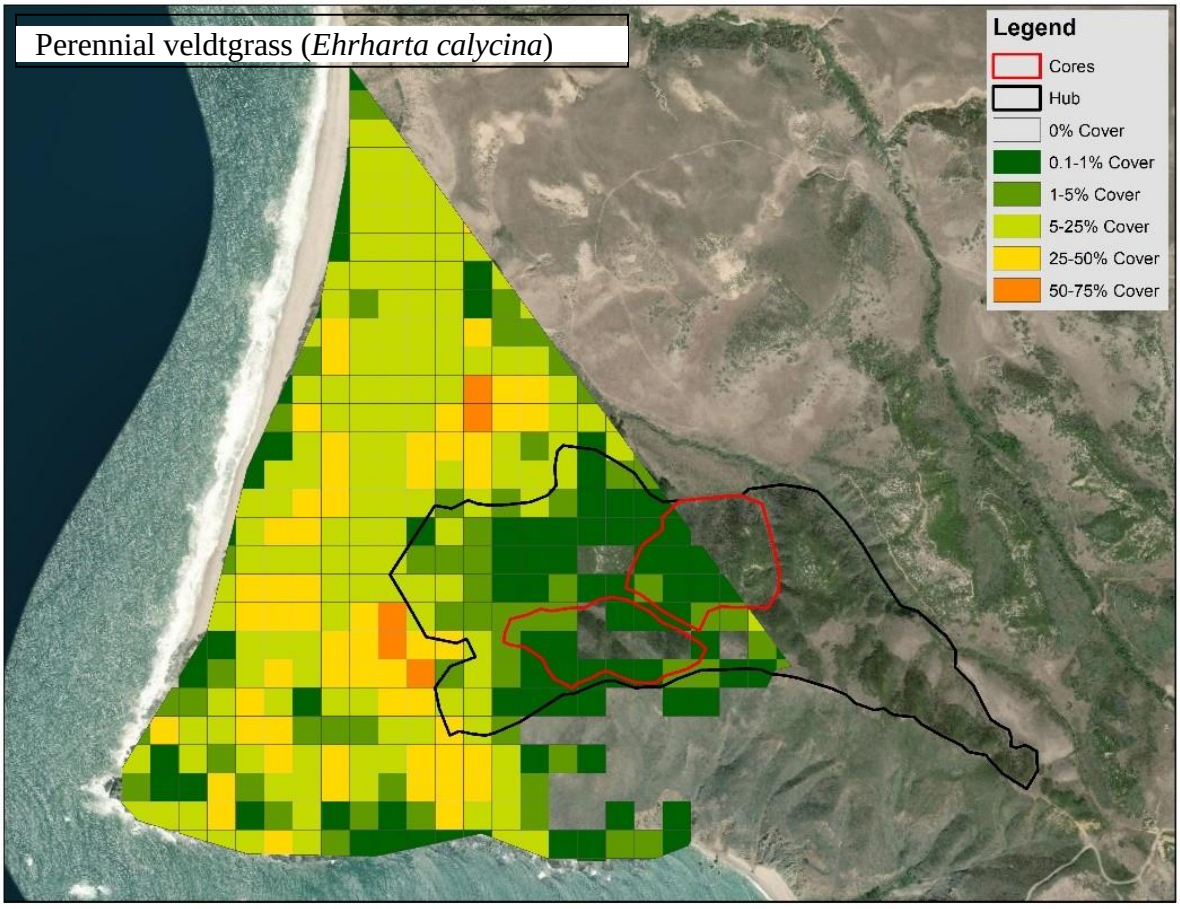


Figure 46: Baseline survey of perennial veldtgrass on the Point Sal Reserve DPA.

Action 1C.2: Control perennial veldtgrass within the Point Sal Reserve DPA (Cores and Hub) (177.46 acres gross: 7.02 Acres Net) while creating defensible spaces to minimize reintroduction from plant propagules.

Methods:
Perennial veldtgrass is a cool season perennial grass with a C3 photosynthetic pathway. Reproduction is by seed and short rhizome. Dispersal mechanisms include wind, water, birds and mammals. It develops large, but relatively short-lived seedbanks. The seedbank can be significantly reduced within 5 years. The rhizomes are used as a strategy to survive periods of drought and can be a source of re-sprouting after herbicide treatments. New plants can flower and set seed within 1 year and there can be multiple seeding events throughout the year.
For small infestations, manually remove the plants ensuring crown removal. Dense infestations should be treated with a broadcast application of a grass specific herbicide such as fluazifop-p-butyl (ex. Fusilade DX) to minimize off-target damage to natives. Once the population is reduced to spot treatments, herbicides can be switched to a non-selective herbicide such as glyphosate (ex. Roundup Pro Conc). Treatments typically occur in two large spraying events with follow-up spot treatments or hand removal to eliminate any plants that escaped the initial treatments. Of the three grass herbicides available for use on veldtgrass, clethodim (ex. Arrow 2EC) shows the most promise for control. Unfortunately, it is currently not labeled for use in wildland areas so is not an option on the Point Sal Reserve DPA. It is also important to note that herbicide resistance to clethodim by an *Ehrharta* species has been documented in Australia after 7-years of use. This is a good reminder to switch up the herbicide mode of action periodically to ensure herbicide resistance does not develop in the Guadalupe-Nipomo Dunes Complex.

Grass herbicide treatment timing typically occurs in the wetter winter season. These herbicides are most effective on actively growing plants before the "boot stage" when flower heads begin to form in the grass. After this time, glyphosate becomes much more effective than the grass herbicides.

After three years of control, areas not successfully recolonizing through the native seedbank should be augmented with additional native seed applications. Seeding rates will vary based on the species being broadcast.

Treatment Schedule:
Herbicide Treatments will involve two broadcast treatment events per year. Years 1-3 will be considered the "knock down" phase and will constitute the bulk of the effort. During this time, there should be a significant drop in the percent cover. Yr. 4-10 will involve follow-up monitoring and spot treatments of any reintroductions. Although the seedbank is short-lived, the chance for re-introduction is high. Treatment of veldtgrass anywhere in the Guadalupe Nipomo

Dunes Complex should be considered a long-term endeavor requiring diligent follow-up. The table below highlights the expected timing of treatment strategies.

Table 39: Seasonal treatment strategies for perennial veldtgrass.

Treatment Strategies for Invasive Plants in Guadalupe Nipomo Dunes Complex																	
Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Perennial Veldtgrass (*Ehrharta calycina*)	Perennial Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
	Manual	before seeding	5+ Years		Hand remove plants including root before fruiting. Plants left on-site may re-root										
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Poast 1.5 pt product/acre - foliar spray			Poast 1.5 pt product/acre - foliar spray								
	Chemical	not water stressed	5+ Years		Roundup Pro Conc 1.5% v/v foliar spray			Roundup Pro Conc 1.5% v/v foliar spray							
	Chemical	not water stressed, applied to early growth stage of plant	5+ Years	Fusilade DX 1-1.5 pt product/acre - foliar spray			Fusilade DX 1-1.5 pt product/acre - foliar spray								

Preventing or Mitigating Effects to Non-Target Resources

While implementing habitat restoration activities it is important to make sure that important natural resources you are trying to protect are not negatively affected in the process. Every method of restoration has its benefits and costs that should be carefully weighed before doing any work.

During any activities or monitoring at the site, people involved will be trained in identifying and avoiding wildlife and sensitive resources. Buffers will be placed and clearly identified around known sensitive areas where care must be taken.
One of the management tools that has the potential for non-target damage is chemical control through herbicides. When herbicides are used, a recommendation from a state-licensed Pest Control Advisor should be used and in most cases is required. An herbicide's potential risk to aquatic and terrestrial wildlife is assessed by the EPA before the product is registered for use in wildlands. Therefore, it is extremely important to closely follow the label for handling and using pesticides.

In most cases though, just following the label isn't enough. The land manager and PCA must carefully weigh the toxicity of the herbicide and the likelihood of exposure to non-target organisms. Only then can the Land Manager decide if an herbicide can be used without undue risk and develop mitigation measures to reduce that risk. Specific mitigation measures will be identified in the written PCA recommendation.

Exposure to non-target organisms increases with broadcast applications of herbicide. Broadcast applications increase exposure through direct herbicide contact and feeding on contaminated plants. Organisms that are browsers are most at risk from increased exposure through feeding on contaminated foliage, seeds or fruits. When possible, spot treatment of herbicide significantly reduces the exposure level to non-target organisms. The following tables provide information on herbicides most frequently used in the GNDC. They contain information important to evaluate and select herbicides based on efficacy, toxicity, exposure potential and fate in the environment. Any adjuvants used to enhance herbicide efficacy will be put through the same level of scrutiny as the herbicides.

Table 40: Herbicide characteristics.

Herbicide	Active Ingredient	Other Ingredients	Target Species	Mode of Action	Adsorption Potential	Primary Degradation Mech	Average Soil Half-life
Fusilade DX	Fluazifop-P-Butyl	Napthalene (<5%)	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	high	microbial metabolism and hydrolysis	15 days
Poast	Sethoxydim	Napthalene 7.32%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	Microbial metabolism and photolysis	5 Days
Arrow 2EC	Clethodim	Napthalene 2.2%	Annual and Perennial Grasses	Lipid Synthesis Inhibitor	low	microbial metabolism slight photolysis	3 Days
Roundup Pro Conc	Glyphosate	POEA 13%	Most Annual and Perennial Plants	Amino acid synthesis inhibitor	high	slow microbial metabolism	47 Days
Habitat	Imazapyr		Most Annual and Perennial Plants	Amino acid synthesis inhibitor	low	slow microbial metabolism and photolysis (in water)	25-141 Days
Garlon 4 Ultra	Triclopyr		Annual and Woody Broadleaf Weeds	Auxin mimic	Intermediate	microbial metabolism, photolysis and hydrolysis	30 Days
Milestone	Aminopyralid		Broadleaf Plants Particularly in Asteraceae and Fabaceae Familys	Auxin mimic	low (10.8 Koc)	slow microbial metabolism and photolysis (in water)	34.5 Days

Table 41: Herbicide toxicity comparison.

Herbicide	Toxicity			Effects to cryptogamic soils	Human Risk		
	Dermal LD50 (rabbits)	Oral LD50 for rats:	LC50 for bluegill sunfish		Irritating to Skin	Eye Damage	Toxic if Inhaled
Fusilade DX	>2,420 mg/kg	4,096 mg/kg	0.53 mg/L	inhibits growth of fungi at levels higher than recommended rates	X	X	X
Poast	>5,000 mg/kg	>2,676 mg/kg	100 mg/L	little noticeable impact on soil microbe populations	X	X	
Arrow 2EC	>5,000 mg/kg	2,920 mg/kg	33 mg/L	insufficient data	X	X	
Roundup Pro Conc	>5,000 mg/kg	5,600 mg/kg	120 mg/L	Initial impacts to microbial populations, but recover rapidly and thought to pose no long-term threat to microbial activities.		X	
Habitat	>2,000 mg/kg	>5,000 mg/kg	>100 mg/L	insufficient data	X	X	
Garlon (Amine and Ester)	>2,000 mg/kg	713 mg/kg	148 mg/L	Inhibits growth of ectomycorrhizal fungi at concentrations of 1,000 parts per million and higher. Some evidence of inhibition of fungal growth was detected in bioassys with as little as 100 ppm triclopyr.	X	X	
Milestone	Negative for rabbits, >5,000 mg/kg in rats	>5,000 mg/kg	>100 mg/L	insufficient data			
** Caffeine LD50 127 mg/kg							
Table salt LD50 3000 mg/kg							
1 espresso shot has 64mg of caffeine							

Monitoring and Evaluation

There are three types of monitoring applicable to the management of the DPA Network:

- Management Activity Monitoring – This is monitoring that tracks what types of Restoration Methods and Activities are happening where. This is meant to track the management itself and not the effects of management.
- Monitoring to Inform Management – This type of monitoring involves defining threshold values or expected responses, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values indicates whether you should initiate, intensify, or alter management actions. An example would be measuring percent cover of an invasive plant to evaluate management actions designed to reduce the cover to a certain threshold value, say 1-5% cover.
- Baseline Monitoring – Essential to the DPA Network management philosophy is the need to maintain viable landscapes and reverse declining trends. To evaluate this, we identify a type of monitoring that evaluates baseline conditions and tracks changes through time.

Management Activity Monitoring

All management activities will be tracked using AgTerra Technologies GIS data management platform. The AgTerra platform integrates mobile mapping, data collection and reporting solutions. Data is collected in the field each day using smartphones or tablets and then uploaded to a cloud-based server. Data is then easily exported into an ESRI ArcGIS format or GoogleEarth. This occurs at the end of each work day and is considered part of daily management activities.

Monitoring to Inform Management

This monitoring type is specific for each Objective. Objectives are listed below with expected values and descriptions of monitoring protocols.

Objective 1A: Eradicate jubata grass within the Point Sal Reserve DPA.
Performance monitoring will occur every 5 years to document progress towards meeting the objective of jubata grass eradicated throughout the Point Sal Reserve DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A)

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Objective 2A: Reduce and maintain perennial veldtgrass cover to 1-5% cover class within the Point Sal Reserve DPA (Hub & Core).
Performance monitoring will occur in every 5 years to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the Point Sal Reserve DPA.

Protocol: Monitoring will follow the invasive plant mapping protocol used in the baseline Assessment (Appendix A)

Actions if Objective is not met: If monitoring shows that the Objective is not being met, the methods being used will be re-evaluated by a group of technical advisors (The Dune Collaborative Restoration Task Force or RTF) to determine why they are not working and if a change in methods is required. If the methods are found to be sound, then the RTF will determine if the Objective is a realistic target and if not, revise the Objective or terminate activities.

Baseline Monitoring

To determine if the Conservation Strategy is achieving its higher-level goals, it is important to set up a monitoring program that will track changes over time. Ecosystems are dynamic, none more so than the coastal dune environment. There will be multiple successional trajectories that are possible but tracking species composition and functional groups as they change through time will help us evaluate if our management actions are indeed keeping the dune ecosystem viable and sustainable through time.

The most efficient way to achieve this is by setting up and monitoring vegetation releves. All releve monitoring will follow California Native Plant Society standardized releve protocols. This monitoring method allows for quick classification over a large area. It relies on ocular estimates of plant cover rather than counts of the “hits” of particular species along a transect line or precise measurements of cover/biomass by planimetric or weighing techniques. Monitoring will take place in years 1 and 3 to assess how native biodiversity is changing throughout management as well as assist in adaptive management.

Adaptive Management

Adaptive management is essentially a process for evaluating how well the methods of a plan are meeting the stated objectives and using these evaluations to refine future methods and approaches of the plan. In real life, this happens in the field. On a day to day basis, land practitioners are evaluating the tools and techniques they are using and determining ways to increase productivity while meeting the desired goals. Decisions are made quickly and typically by those that are present. Adaptive management essentially happens without having to name it or formalize the process. However, there is also merit in having a formalized way of gathering information to have more formal processes to reflect on the success of a program and if changes in method, strategy or direction are warranted. This allows more time to work with experts to ensure management is based on the best available science and critical thought.

For the DPA Network Conservation Strategy, formal program evaluations will occur in year 1 and 3 coinciding with years that monitoring occurs. In those years, monitoring reports will be prepared to evaluate:

- What happened (Management Activity Monitoring),
- are we meeting our stated Objectives (Monitoring to Inform Management),
- and is our Conservation Strategy working (Baseline Monitoring).

Meetings will be held in those years to discuss the monitoring evaluations and refine our management methods and Conservation Strategy based on the findings. Changes will be incorporated into new workplans to guide management in the field. After Year three, the program will move into a long-term maintenance mode and these monitoring and evaluation events will occur on five-year intervals in perpetuity.

Appendices

References

Ball, M. (2017). Personal Comm.

Ball, M., & Olthof, K. (2016). *Aerial Invasive Plant Survey and Treatment Prioritization Analysis*. Guadalupe Nipomo Dune Wildlife Refuge.

Ball, M., & Olthof, K. (2017). *Aerial Invasive Plant Survey - Guadalupe-Nipomo Dunes National Wildlife Refuge*. *Unpublished Report*. Lompoc, CA.

Benedict, M. A., Edward, T., & McMahon, J. D. (2002). Green Infrastructure: Smart Conservation for the 21st Century.

Berry, A. (2017). Pers. comm.

Browning, C. A. (2008). *A preliminary examination of the effects of feral pigs (Sus scrofa) on water quality and soil loss within a Hawaiian watershed. Master's Thesis submitted to the University of Hawaii Manoa, May 2008. 128 pp.* University of Hawaii Manoa.

Cooper, W. S. (1967). *Coastal Dunes of California*. Blouder: The Geological Society of America, Inc.

Crooks, J. A. (2017). Characterizing Ecosystem-Level Consequences of Biological Invasions : The Role of Ecosystem Engineers. *Nordic Society Oikos*, *97*(2), 153–166.

DiTomaso, J. M., Kyser G.B., Oneto, S. R., Wilson, R. G., Orloff, S. B., Anderson, L. W., … Mann, J. J. (2013). *Weed Control in Natural Areas in the Western United States*. Weed Reserch and Infromation Center, University of California.

Dunning, J. B., Danielson, B. J., & Pulliam, H. R. (1992). Ecological Processes That Affect Populations in Complex Landscapes. *Oikos*, *65*(1), 169–175.

Groves, C. R. (2003). *Drafting a Conservation Blueprint: A Practitioner's Guide to Planning for Biodiversity*. Island Press.

Hall, J., Whitaker, L., Stienmaus, S., & Berry, A. (2016). *Aerial Herbicide Application Pilot Experiment on the Guadalupe-Nipomo Dunes Wildlife Refuge*. *Unpublished Report*. San Luis Obispo, CA.

Hensley, G. R. (1995). *Easement Documentation Report for Dunes Lakes, Ltd.* San Luis Obispo, CA.

Hodgson, J. A., Thomas, C. D., Wintle, B. A., & Moilanen, A. (2009). Climate change, connectivity and conservation decision making: Back to basics. *Journal of Applied Ecology*, *46*(5), 964–969. https://doi.org/10.1111/j.1365-2664.2009.01695.x

Hoover, R. F. (1970). *The Vascular Plants of San Luis Obispo County*. University of California Press.

Interactive Planning and Management. (2001). *Final Guadalupe-Nipomo Dunes Restoration Plan for Natural Resources Impacted by the Guadalupe Oil Field Diluent Release*. Santa Barbara, CA.

Madsen, S. (2017). Personal Comm.

McRae, B. H., & Kavanagh, D. M. (2011). Linkage Mapper Connectivity Analysis Software. Seattle WA: The Nature Conservancy. Retrieved from http://www.circuitscape.org/linkagemapper

Mobley, L. (2017). *Promoting connectivity between dune protected areas in the guadalupe nipomo dunes complex.*

Olsen, H., & Hall, J. (2015). *Invasive Plant Species and Area Prioritization Report: Guadalupe Nipomo Dunes Complex*.

Parkes, J. P., Ramsey, D. S. L., Macdonald, N., & Morrison, S. A. (2010). Rapid eradication of feral pigs (Sus scrofa) from Santa Cruz Island, California. *Biological Conservation*, *143*(3), 634–641.

Point Sal Reserve Final Management Plan. (1991). Santa Barbara, CA.

Santa Barbara County Parks Department. (2002). Point Sal Reserve Revised Management Plan.

Santa Maria River Estuary Enhancement and Management Plan. (2004). Retrieved from https://mapcarta.com/29762006

Skinner, M. (2017). Pers. comm.

Skinner, M., Cleveland, C., Holmes, P., Stewart, A., & Watts, J. (2003). *A Review of the Land Conservancy of San Luis Obispo County Guadalupe-Nipomo Dunes Exotic Weed Eradication Program from 1999 to 2003*. San Luis Obispo, CA.

The Land Conservancy of San Luis Obispo County. (2018). *Dune Protected Areas Network: Creating a Blueprint for Restoration in the Nipomo Dunes Complex Restoration Plan*. San Luis Obispo, CA.

U.S. Fish and Wildlife Service. (1993). Endangered and threatened wildlife and plants; determination of threatened status for the Pacific coast population of the western snowy plover; final rule. *Federal Register*, *58*(42), 12864–12874.

U.S. Fish and Wildlife Service. (2007). *Recovery Plan for the Pacific Coast Population Western Snowy Plover (Charadrius alexandrinus nivosus* (Vol. In 2 volum). Sacramento, California.

U.S. Fish and Wildlife Service. (2016). Guadalupe-Nipomo Dunes National Wildlife Refuge: Final Comprehensive Conservation Plan and Environmental Assessment, (August).