Dune Protected Areas Network 1.0

Creating a Blueprint for Restoration in the Guadalupe Nipomo Dunes Complex

2018

Work Plan

Prepared by: The Land Conservancy of San Luis Obispo County

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Chapter 1: Introduction

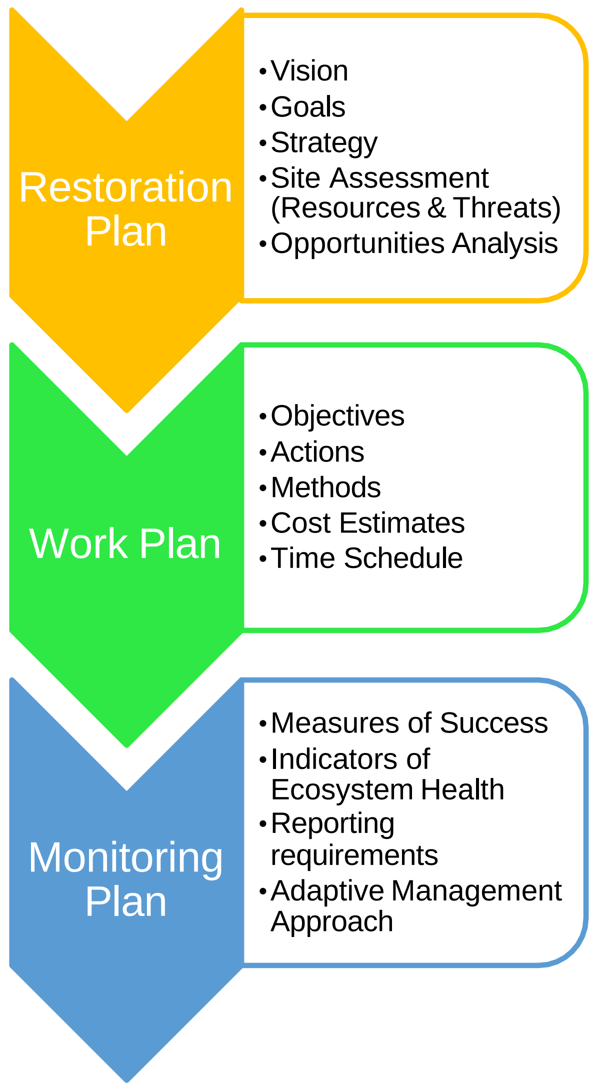
Conservation Strategy Overview

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 and what will it cost? 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*.

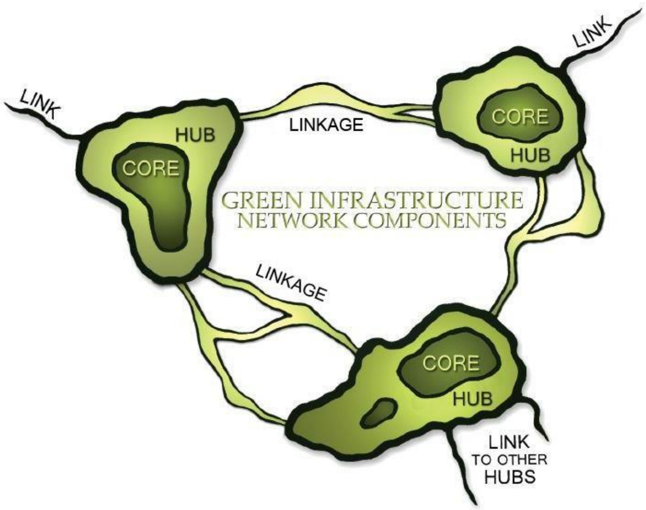


Figure 1: Green Infrastructure Network. The Dune Protected Network is roughly based on the Green Infrastructure Network used to create wildlife pathways through urban areas.

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.

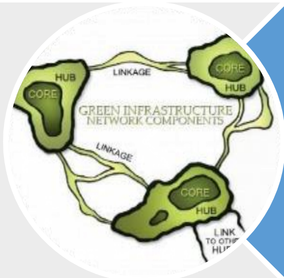
Management Strategy

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 support major restoration projects that will provide a defensible space for long-term management.

Phase 2: Long-term Endowment ($2 million)
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.

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.

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 Management Plan, 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: DPA Prioritization

The following ranking system was developed to prioritize Dune Protected Areas (DPAs) for inclusion in the work plan. The DPAs ranked in this prioritization were already selected as the most important areas for protection and management in the GNDC. There is limited funding through the Guadalupe Restoration fund, and thus a more specific prioritization was needed to select areas for management. DPAs receiving a low score in this prioritization are still very important to the protection of native species and coastal habitats. A prioritization-scoring matrix was developed that first looks at the DPAs contribution towards Conservation Goals and then filters the DPAs by factors affecting management and cost (Figure 2). In this prioritization system, highest priority goes to the combination of areas important to accomplishing the DPA Conservation Goals, occur on properties with long term commitments to conservation, and require minimal resources for management. This ensures that the greatest benefit is achieved for the least amount of resources.

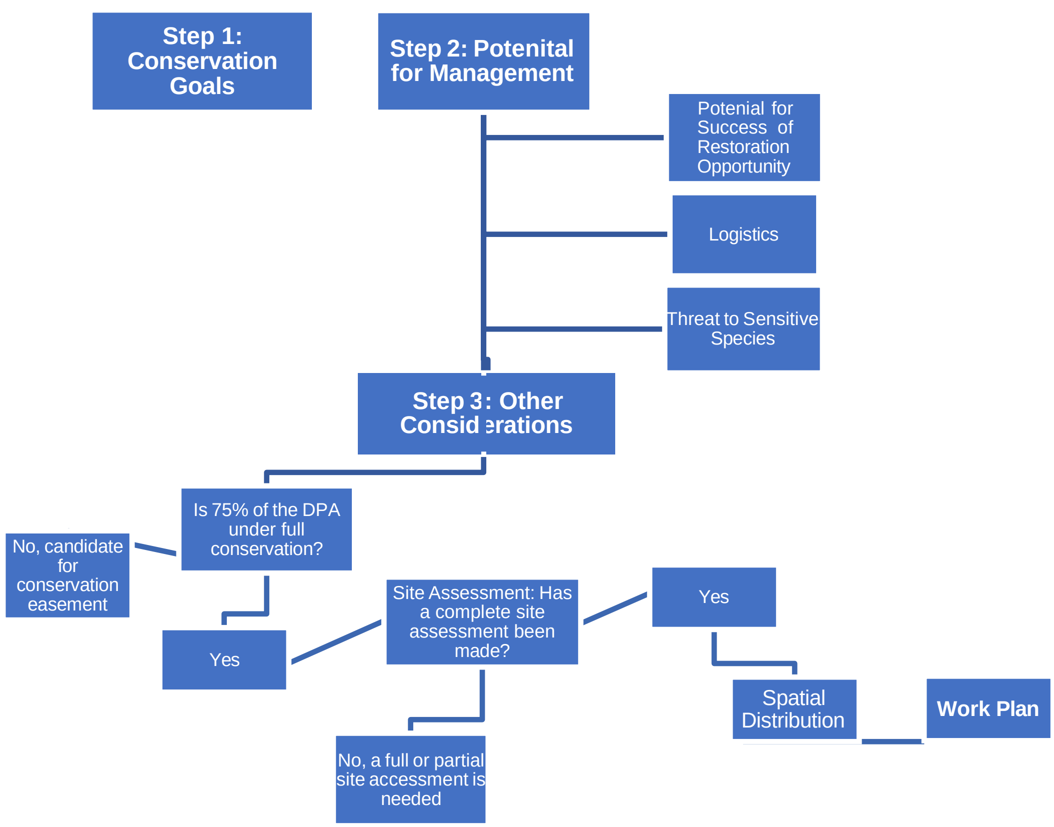


Figure 2: DPA Prioritization diagram.

Prioritization by Conservation Goals

The first step in prioritizing DPA's for management is to rank the DPAs based on their contribution to the Conservation Goals. Conservation Goals for Dune Protected Areas are:

- Preserve and promote native biodiversity
- Maximize resiliency to a changing climate
- Maintain ecological processes that promote the dynamic nature of the dunes
- Preserve and promote wetland and upland habitat quality and connectivity

Although the DPA network was designed to build resiliency to a changing climate, metrics to evaluate climate change are not well established and those that are established, require a high level of spatial data. Research suggests the best way to protect future climate conditions is to mitigate known threats (Groves, 2003). "Increasing protected area, maintaining and in some cases increasing environmental heterogeneity, concentrating efforts in centers of endemism and reducing other pressures are likely to be beneficial and robust with or without climate change (Hodgson, Thomas, Wintle, & Moilanen, 2009)." Therefore, only three categories were selected to represent the DPAs contribution to conservation goals: biodiversity, ecological processes and habitat connectivity. Within each of the three categories, elements were ranked from 1-3 based on their importance to that element. A score of 3 denotes a DPA that is most advantageous to the element and a 1 is least advantageous. Rankings were subsequently combined to give an overall High-Med-Low ranking for the DPA.

<u>Biodiversity</u>

Biodiversity of native species is important for all ecological processes and can be an excellent measure of a successful natural ecosystem. These metrics capture the importance of a diversity of taxonomic groups. Determinations made in this evaluation where based on available data. It is important to keep in mind that rankings for biodiversity become biased towards DPAs with more complete datasets. Ranking categories were based on one standard deviation from the average. Table 4 shows the calculation for the birds' element.

Table 4: Bird Element Calculation.

Average	32.22
Standard Deviation	11.07
Low Category (1 Point)	32-11 = 21 and below
Medium Category (2 Points)	22-42
High Category (3 Points)	32+11 = 43 and above

Biodiversity	
Element	**Categories and Associated Points**
Birds	22 or less bird conservation targets present = 1 23-42 bird conservation targets present = 2 43 or more bird conservation targets present = 3
Mammals	20 or less mammal conservation targets present = 1 21-25 mammal conservation targets present = 2 26 or more mammal conservation targets present = 3
Rare Plants	15 or less rare plant conservation targets present = 1 16-20 rare plant conservation targets present = 2 21 or more rare plant conservation targets present = 3
Reptiles and Amphibians	1 or less reptile or amphibian conservation target present = 1 2 reptile and amphibian conservation targets present = 2 3 or more reptile and amphibian conservation targets present = 3
Lichens	19 or less lichen and soil crust conservation targets present = 1 20-38 lichen and soil crust conservation targets present =2 39 or more lichen and soil crust conservation targets present = 3

*Each element calculation was based on standard deviations +/- the average.

Ecological Processes

This ranking captures DPAs which include successful natural ecological processes. Strong candidates for protection can be selected by choosing areas with a high diversity of habitat types with large patches of intact native habitat types (Dunning, Danielson, & Pulliam, 1992). Species depend on native habitats for foraging and breeding. Movement between and throughout habitat patches allows for more foraging and breeding habitat and natural community interactions, providing a more dynamic ecosystem.

Ecological Processes	
Element	**Categories and Associated Points**
Habitat Diversity	Five habitat types or less present =1 Six and seven habitat types present = 2 Eight or more habitat types present = 3
Habitat Patch Size	Small and disjointed native habitat patches (Average patches less than 1.14 acres) = 1 Examples of both small and medium habitat patches (Average patches between 1.15 acres and 4.97 acres) = 2 Large patches of undisturbed native habitats (Average patches more than 4.97 acres) = 3

*Each element calculation was based on standard deviations +/- the average.

Habitat Connectivity

Connectivity throughout the GNDC is important for migratory pathways, facilitating gene flow and strengthening adaptability to rapid and severe changes in climate (Mobley, 2017). In order to evaluate the strength of connectivity for each DPA, we ranked the proximity to other DPAs;

ecosystem waterway connectivity; and Riparian and Swale Habitat. DPAs located near each other offer an easier route between protected habitats and are more likely to be used by native wildlife. Connectivity between DPAs also offers smooth genetic flow of both plant and animals. Waterways and the movement of freshwater is also very important to the health of the overall ecosystem. Waterways offer natural connectivity for wildlife and the breeding and foraging habitat they depend on for survival. Riparian and swale habitat are especially important for movement of faunal specie, such as the California red-legged frog which can has limited ability to move between wetland sites.

Habitat Connectivity	
Element	**Categories and Associated Points**
Proximity to Other DPAs	.5-mile buffer reaches no other DPAs or one other DPA = 1 .5-mile buffer reaches two other DPAs = 2 .5-mile buffer reaches three or more other DPAs = 3
Ecosystem Water Connectivity	Does not include a natural waterway with neither inlet and outlet to the system = 1 Includes a seasonal water flows through an inlet or outlet but not both = 2 Includes a natural waterway with an inlet and outlet to the system = 3
Riparian and Swale Habitat	Riparian, swale, freshwater marsh habitats occupy 8.77% or more of area within .5 miles buffer of DPA (not including appropriate habitat within DPA) = 1 Riparian, swale, freshwater marsh habitats occupies between 2.96-8.76% of area within .5 miles buffer of DPA (not including appropriate habitat within DPA) = 2 Riparian, swale, freshwater marsh habitats occupies 2.95% or less of area within .5 miles buffer of DPA (not including appropriate habitat within DPA) = 3

*Each element calculation was based on standard deviations +/- the average.

Table 5: Prioritization by Conservation Goals.

Dune Protected Area	Biodiversity					Ecological Processes		Habitat Connectivity			Raw Score	**Final Score**
	Rare Plants	Mammals	Birds	Amphibians & Reptiles	Lichens & Soil Crusts	Habitat Diversity	Habitat Patch Size	Proximity to Other DPAs	Ecosystem Waterway Connectivity	Riparian and Swale Habitat		
Oso Flaco Lake Natural Area	3	2	3	2	3	3	2	3	3	2	26	**79%**
Oceano Dunes Natural Preserve	2	1	2	1	2	3	2	2	3	2	20	**61%**
Santa Maria River Estuary and Associated Floodplains	1	3	3	1	2	3	3	1	3	1	21	**64%**
Chevron Restoration Site	3	3	2	1	2	2	3	2	1	2	21	**64%**
Dune Lakes	2	0	3	0	2	2	3	3	2	2	19	**58%**
Nipomo Lupine	3	1	2	2	2	2	2	2	1	2	19	**58%**
Black Lake Ecological Area	1	2	2	2	3	1	2	1	2	2	18	**55%**
National Wildlife Refuge/ Chevron Successional Dune	1	3	1	1	2	2	2	3	1	2	18	**55%**
Dune Islands	1	1	1	1	2	3	1	3	1	2	16	**48%**
Big Coreopsis Hill	2	0	0	0	2	2	2	2	1	3	14	**42%**
Surprise Lake	3	0	0	0	2	1	2	1	1	1	11	**33%**

Rank	Dune Protected Area	Final Score
High	Oso Flaco Lake Natural Area	79%
Medium	Oceano Dunes Natural Preserve	61%
	Santa Maria River Estuary and Associated Floodplains	64%
	Chevron Restoration Site	64%
	Dune Lakes	58%
	Nipomo Lupine	58%
	Black Lake Ecological Area	55%
	National Wildlife Refuge/ Chevron Successional Dune	55%
	Dune Islands	52%
Low	Big Coreopsis Hill	42%
	Surprise Lake	33%

*Categories for High, Medium, and Low were selected by one standard deviation +/- the average

Rank	Final Score
High	68% or more
Medium	45% -67%
Low	44% or less

Elements were added together and then evaluated against each other. Each of the elements were weighted equally and then added together to calculate the raw score. The DPAs were compared the total points score out the total points possible (Table 5).

Prioritization by Management Potential

The DPAs which best met the Conservation Goals (receiving a high or medium score) were then evaluated by a second filter: management potential. More simply stated, when management resources are limited, management costs and potential for success should be considered to ensure a wise use of resources and a good return on investment. To evaluate management potential, DPAs were ranked based on the following elements: potential for success, logistics and threat to sensitive species (Figure 3).

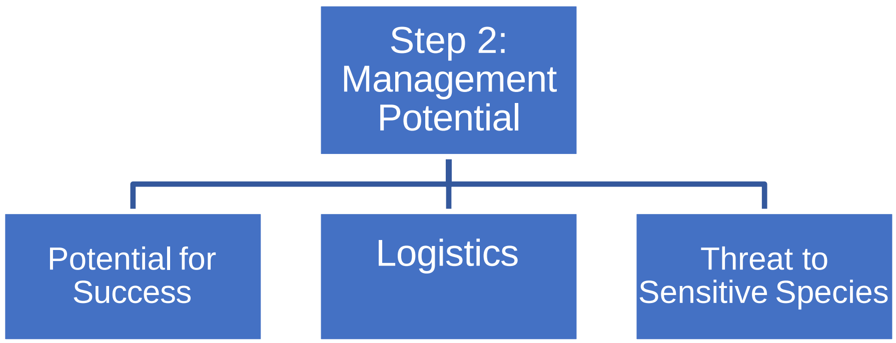


Figure 3: Management Potential Elements of the Prioritization.

DPAs within the Mussel Rock dunes region of the GNDC were delayed in inclusion in the conservation planning process, as additional data was necessary. Some of the necessary site assessments of rare and invasive plant species were completed, and conservation plans were created (The Land Conservancy of San Luis Obispo County, 2018). Two major DPAs are confirmed in the region: Rancho Guadalupe and Point Sal. Additional DPAs are outlined in the Restoration Plan but are on private property and little known about the resources within them. Selected DPAs from the Mussel Rock dunes region are included in Step 2&3 of this prioritization process. The following DPAs were considered in Step 2 of the prioritization:

- Black Lake Ecological Area
- Chevron Restoration Site
- Dune Islands
- Dune Lakes
- National Wildlife Refuge/ Chevron Successional Dune
- Nipomo Lupine
- Oceano Dunes Natural Preserve
- Oso Flaco Lake Natural Area
- **Point Sal**
- **Rancho Guadalupe**
- Santa Maria River Estuary and Associated Floodplains

Potential for Success

The main driver determining whether a DPAs ecosystem will remain viable is the threat of invasion by non-native species. "Potential for success" evaluates the DPAs potential for controlling, and in some cases eradicating, major invasive species threats. This is represented as a numerical value from 1 to 3. A DPA where control is considered to have a high potential for success is given a 3. If the DPA has an incredibly long-lived seed bank present and threats are hard to detect, it would receive a lower rating of 1. Factors considered when evaluating the potential for success include:

- Current Population size and Distribution
- Seed Bank (Plant Species)
- Detectability
- Likelihood of Reinvasion

Rank and Associated Points	Dune Protected Area
3	Chevron Restoration Site
	Dune Islands
	Oso Flaco Lake Natural Area
	Rancho Guadalupe
2	Black Lake Ecological Area
	Nipomo Lupine
	National Wildlife Refuge/ Chevron Successional Dune
	Point Sal
1	Dune Lakes
	Oceano Dunes Natural Preserve
	Santa Maria River Estuary and Associated Floodplains

Logistics

A numerical value from 1 to 3. This category evaluates how difficult it is to access and control major invasive species threats. A value of 3 is given to a DPA easy to access and adequate control techniques exist for major invasive species targets. A value of 1 is given to DPAs with difficult access and harbors invasive species that require time intensive control techniques. Factors considered for this rating are:

- Distance from base of operations
- Steep slopes
- Accessibility
- Poison oak
- Complexity of control techniques

Rank and Associated Points	Dune Protected Area
3	Black Lake Ecological Area
	Chevron Restoration Site
	Dune Lakes
	Nipomo Lupine
	Oceano Dunes Natural Preserve
	Rancho Guadalupe
2	Dune Islands
	Oso Flaco Lake Natural Area
1	National Wildlife Refuge/ Chevron Successional Dune
	Point Sal
	Santa Maria River Estuary and Associated Floodplains

Threat to Sensitive Resources

A numerical value from 1 to 3. This category evaluates the current status of the DPAs sensitive species. A value of 3 is given to a DPA containing sensitive species in eminent danger of extinction and has a high threat from invasive species. Species considered rank 3 include Nipomo lupine (*Lupinus nipomensis*), marsh sandwort (*Arenaria paludicola*) and Gambel's watercress (*Nasturtium gambelii*), all of which are federally endangered, and the only populations are found in the GNDC. A value of 1 is given to a DPA containing sensitive species considered to be within a stable population with low risk from invasive species. Factors considered for this rating are:

- Current status of sensitive species
- Population stability
- Invasive species threat

Rank and Associated Points	Dune Protected Area
3	Black Lake Ecological Area
	National Wildlife Refuge/ Chevron Successional Dune
	Nipomo Lupine
	Oso Flaco Lake Natural Area
2	Chevron Restoration Site
	Dune Islands
	Dune Lakes
	Oceano Dunes Natural Preserve
	Point Sal
	Rancho Guadalupe
	Santa Maria River Estuary and Associated Floodplains

Table 6: DPA Ranking after Management Potential Prioritization.

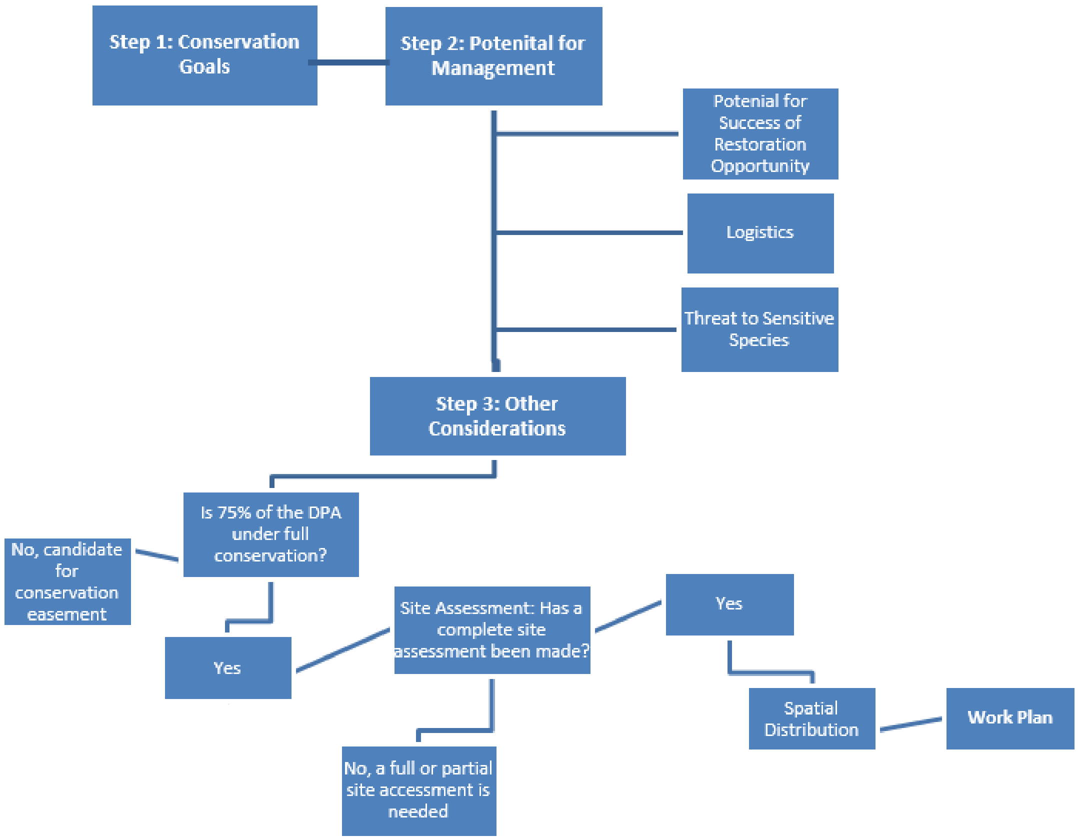
Dune Protected Area	Potential for Success	Logistics	Threats to Sensitive Species	Raw Score	**Final Score**
Black Lake Ecological Area	2	3	3	8	**89%**
Chevron Restoration Site	3	3	2	8	**89%**
Nipomo Lupine	2	3	3	8	**89%**
Oso Flaco Lake Natural Area	3	2	3	8	**89%**
Rancho Guadalupe	3	3	2	8	**89%**
Dune Islands	3	2	2	7	**78%**
Dune Lakes	1	3	2	6	**67%**
Oceano Dunes Natural Preserve	1	3	2	6	**67%**
National Wildlife Refuge/ Chevron Successional Dune	2	1	3	6	**67%**
Point Sal	2	1	2	5	**56%**
Santa Maria River Estuary and Associated Floodplains	1	1	2	4	**44%**

Rank	Dune Protected Area	Final Score
High	Black Lake Ecological Area	**89%**
	Chevron Restoration Site	**89%**
	Nipomo Lupine	**89%**
	Oso Flaco Lake Natural Area	**89%**
	Rancho Guadalupe	**89%**
Medium	Dune Islands	**78%**
	Dune Lakes	**67%**
	Oceano Dunes Natural Preserve	**67%**
	National Wildlife Refuge/ Chevron Successional Dune	**67%**
Low	Point Sal	**56%**
	Santa Maria River Estuary and Associated Floodplains	**44%**

Rank	Final Score
High	89% or more
Medium	58% -88%
Low	57% or less

Elements were added together and then evaluated against each other. Each of the elements were weighted equally and then added together to calculate the Raw score. The DPAs were compared the total points score out the total points possible.

Other Important Considerations



Ownership: Is 75% of the DPA under full conservation?

The management objectives of the property/properties within the DPA must correlated with those of the GNDC Conservation Strategy and have long-term habitat protection in place. Landowners must be able to promise a long-term commitment to the preservation of the habitats preserved and restored. It also must have ownership which restoration efforts can be controlled and conserved. If the DPA does not meet this standard, it should be considered for protection under a conservation easement or land purchase.

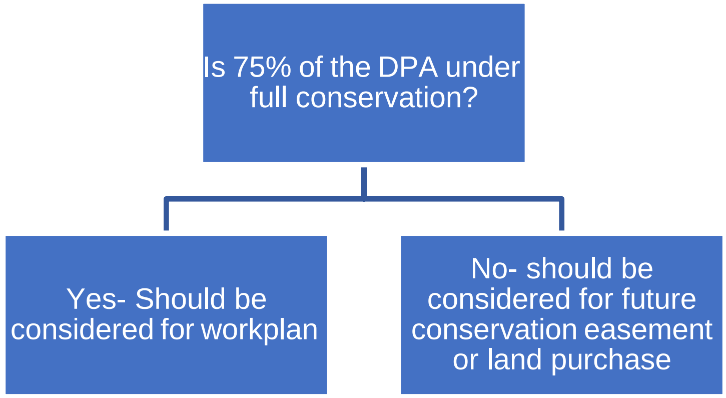


Figure 4: Property Ownership.

Percent in long term commitment to conservation	Dune Protected Area	Percent
75% or above	Oceano Dunes Natural Preserve	100%
	Chevron Restoration Site	100%
	Dune Lakes	100%
	National Wildlife Refuge/ Chevron Successional Dune	100%
	Dune Islands	100%
	Point Sal	100%
	Rancho Guadalupe	100%
	Oso Flaco Lake Natural Area	93.5%
	Nipomo Lupine**	83.19%
	Black Lake Ecological Area	82.76%
Below 75%	Santa Maria River Estuary and Associated Floodplains	53.42%

** Phillips 66 owned- ODSVRA leased portion of the Nipomo Lupine DPA (68.72 % of this DPA) is under a five-year, automatically renewed lease. ODSVRA will continue to manage/operate the lease as part of the park in perpetuity.

Site Assessment: Has a complete site assessment been made?

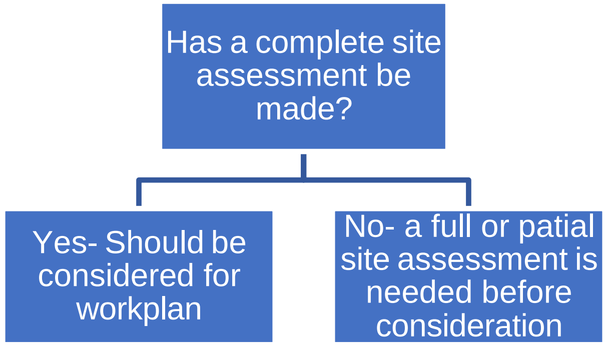


Figure 5: Site Assessment.

Site Assessment Complete?	Dune Protected Area
Yes	Black Lake Ecological Area
	Chevron Restoration Site
	National Wildlife Refuge/ Chevron Successional Dune
	Point Sal
	Nipomo Lupine
	Rancho Guadalupe
No	Dune Lakes
	Dune Islands
	Oso Flaco Lake Natural Area
	Oceano Dunes Natural Preserve

DPAs Already Removed from Prioritization

Site Assessment Complete?	Dune Protected Area
Partial	Santa Maria River Estuary and Associated Floodplains
No	*Big Coreopsis Hill*
	Surprise Lake

*DPAs that are *italicized* were given a low score in the Conservation Goals Prioritization (Step 1).

Spatial Distribution

To ensure management is adequately represented throughout the GNDC, management resources should be divided among the three DPA regions (Callendar dunes, Guadalupe dunes, Mussel Rock dunes) (Figure 6). This does not need a separate ranking but should be considered when finalizing which DPAs should receive management. DPAs should also consider distribution of resources between successional communities. Resources should be equally distributed between habitat types in order to protect all habitats within the coastal dune ecosystem.

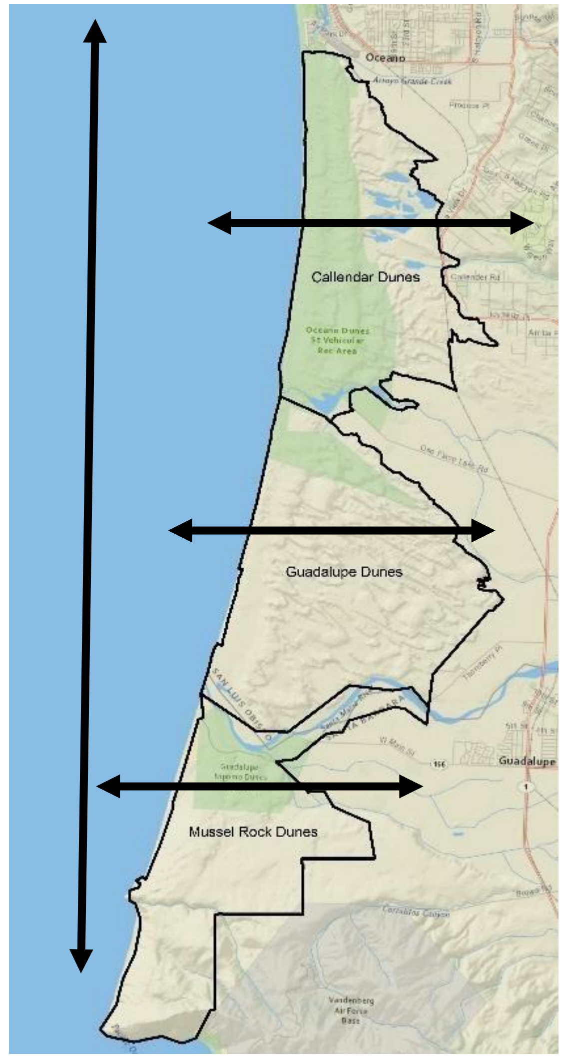


Figure 6: Spatial Distribution throughout the GNDC.

Chapter 3: Selected Dune Protected Area Work Plans

With limited restoration funds, six DPAs were selected for the creation of work plans. The prioritization in Chapter 2 was created to guide the selection of the DPA for work plans and subsequent implementation of restoration projects. Ultimately, the final selection of DPAs was guided by the RTF and land managers.

The selected DPAs for work plans are:

Black Lake Ecological Area

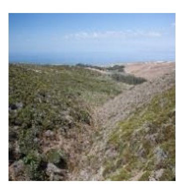
Nipomo Lupine

National Wildlife Refuge/ Chevron Successional Dune

Big Coreopsis Hill

Rancho Guadalupe

Point Sal



Within Chapter 3 are the work plans for each of the selected DPAs. All potential restorations projects are prioritized, and budget estimates have been 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.

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

Figure 8: 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 9: 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 10: 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.

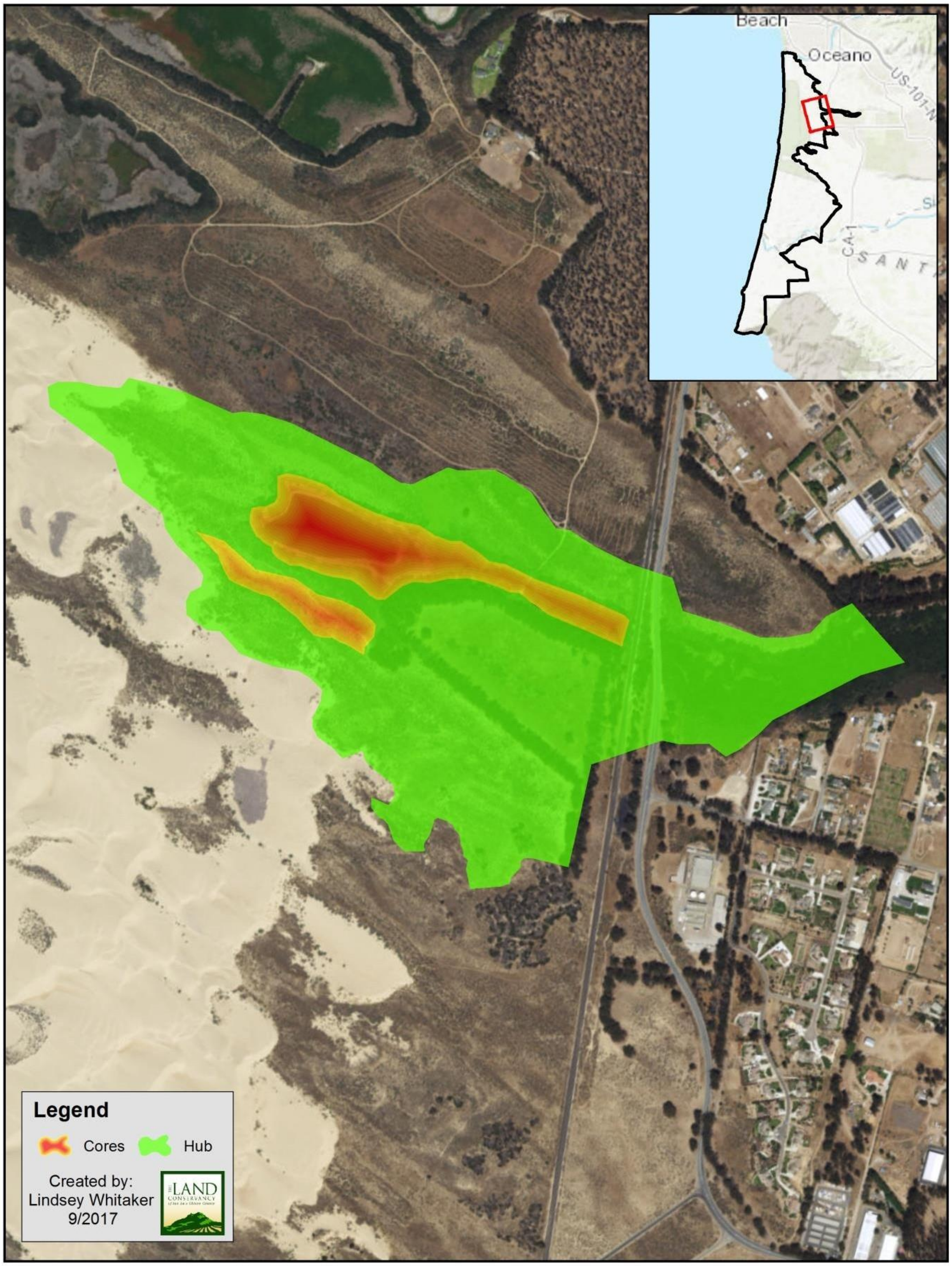


Figure 11: Boundary of the Black Lake Ecological Area DPA.

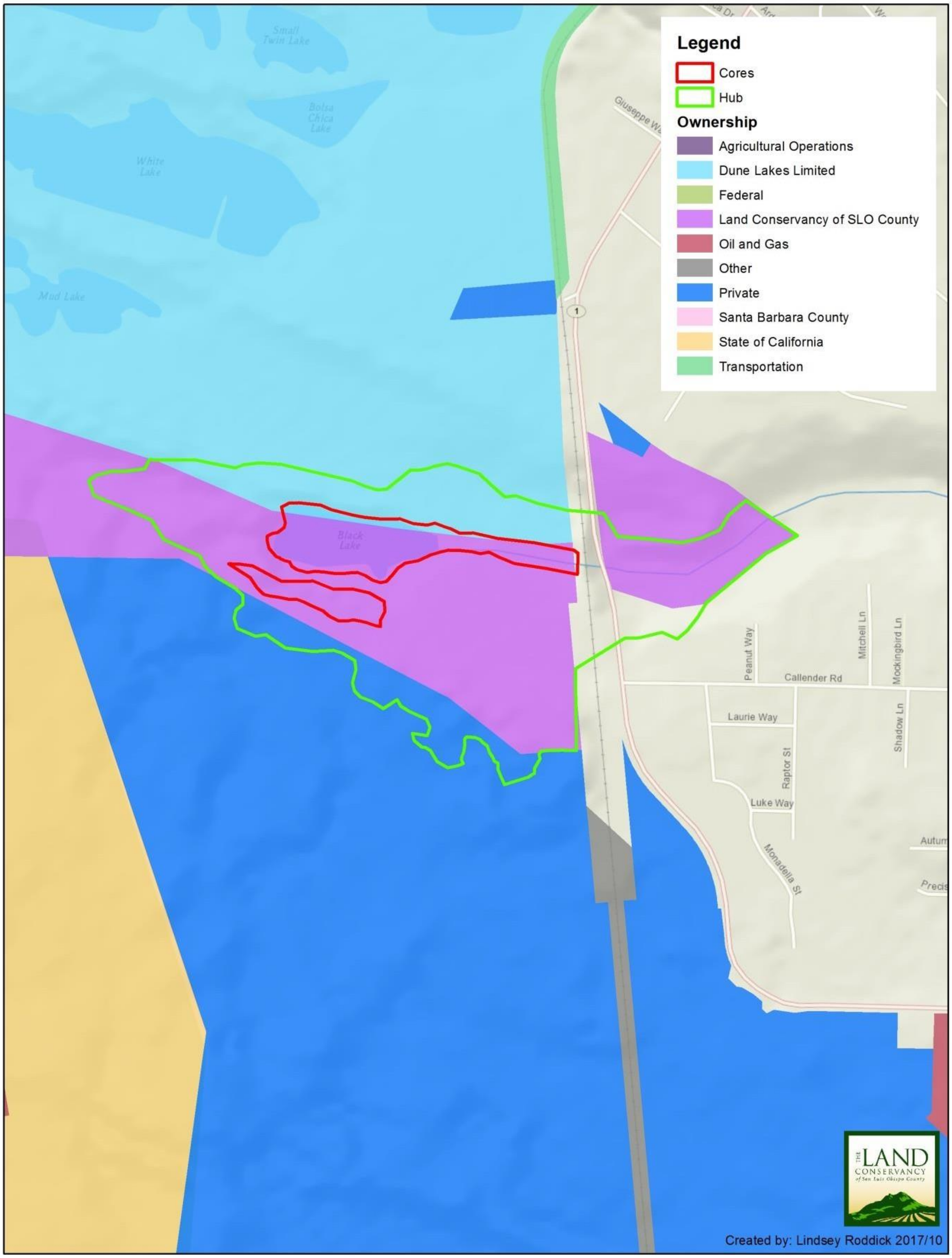


Figure 12: Property Ownership of the Black Lake Ecological Area DPA.

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

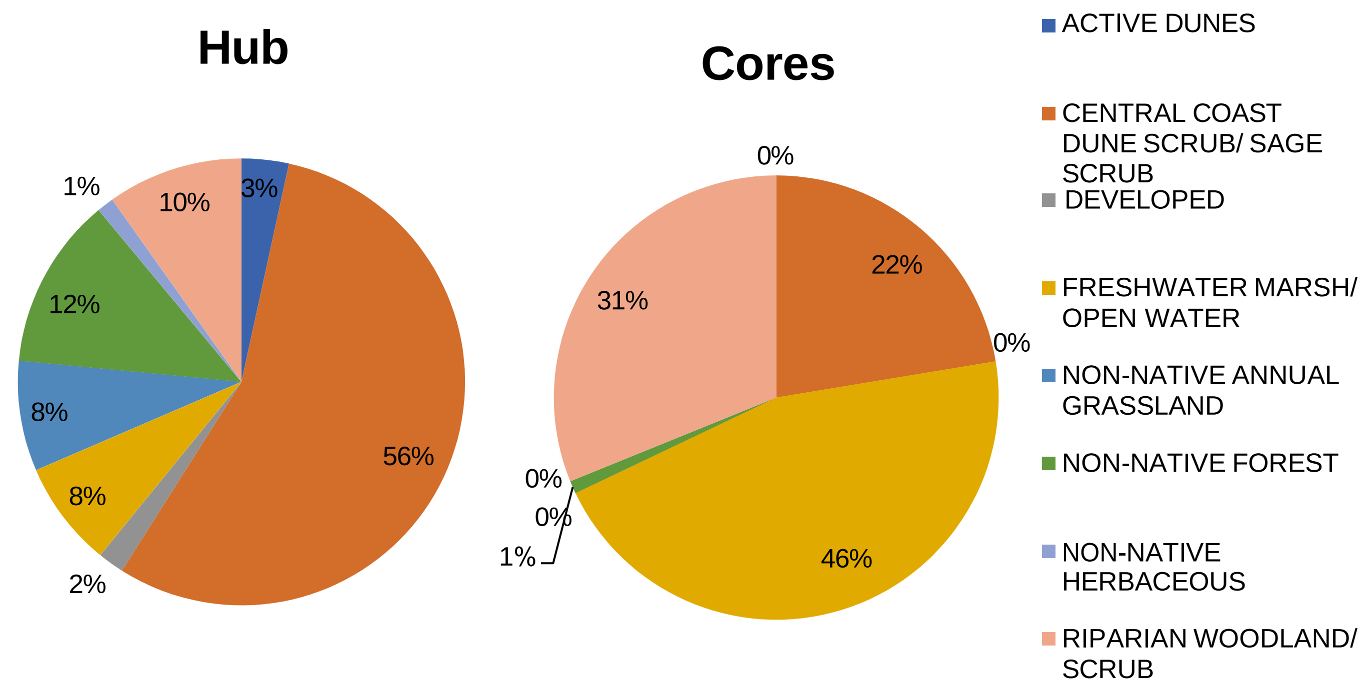
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the Black Lake Ecological Area DPA. Those species are included in the table below.

Table 7: 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 california* (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)
Rare Invertebrate 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)

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

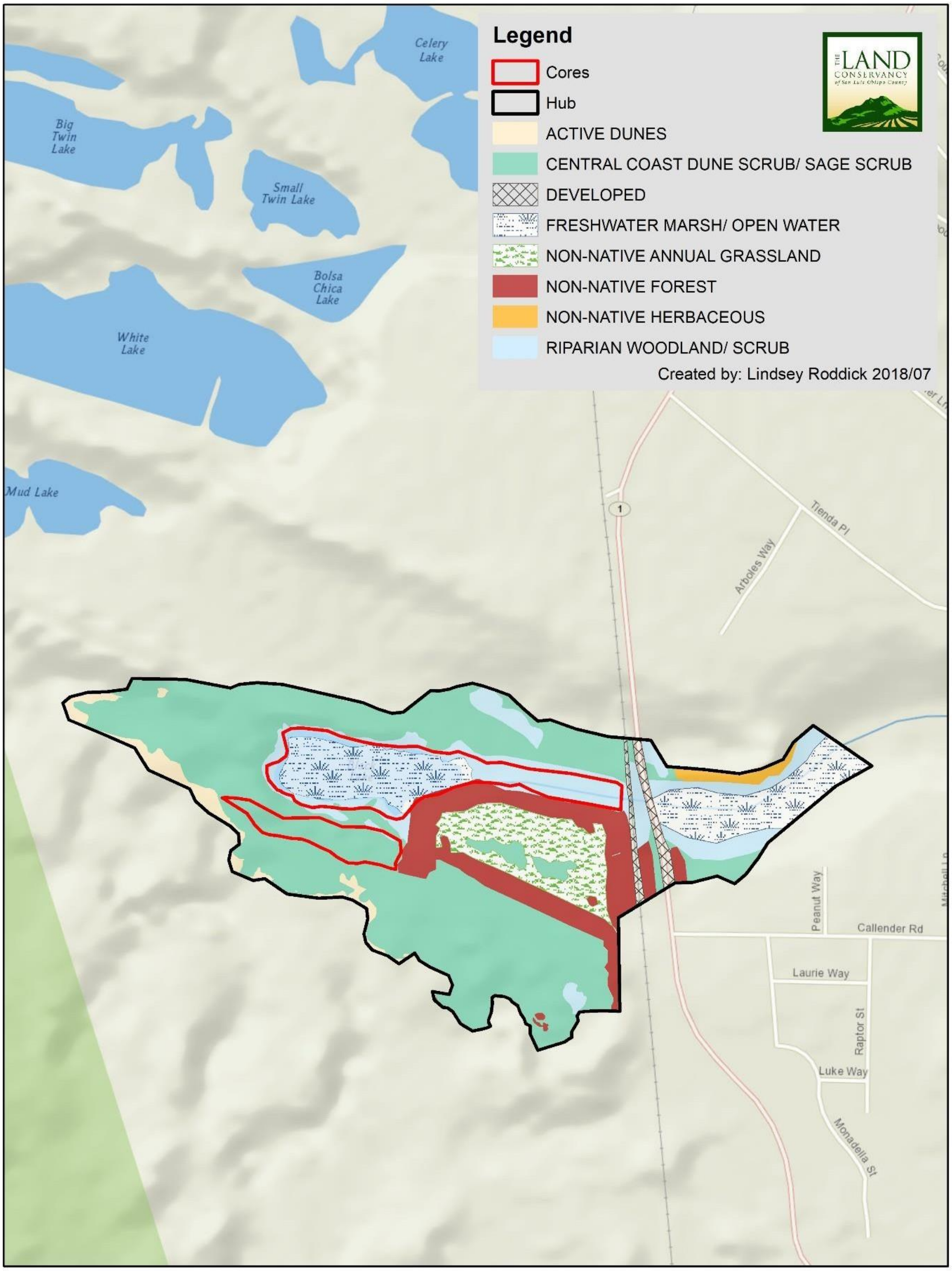


Figure 14: Habitat Types of the Black Lake Ecological Area DPA.

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 8: 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 9: 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 10: 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.

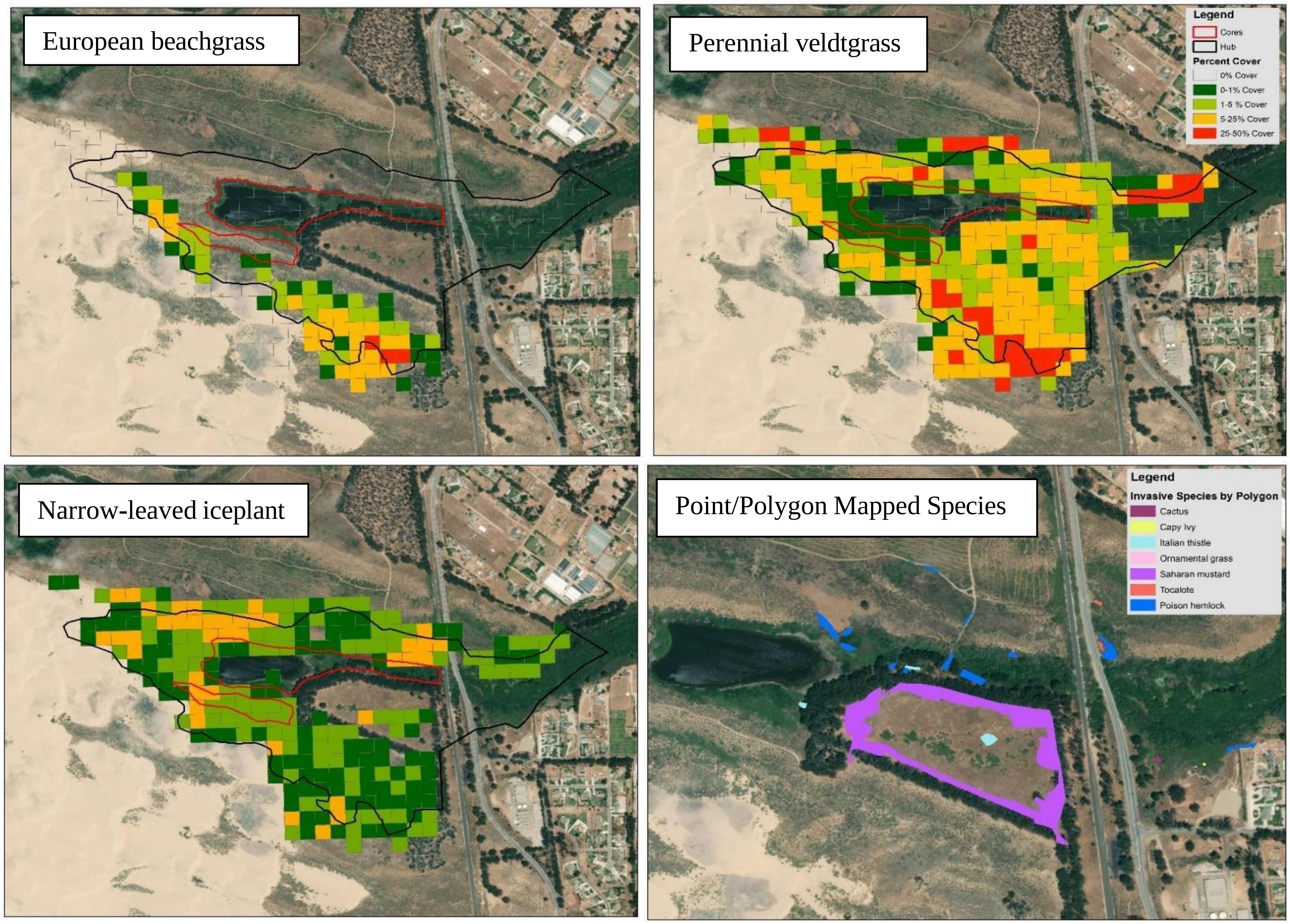


Figure 15: Invasive Species maps for Black Lake Ecological Area DPA.

Table 11: 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.

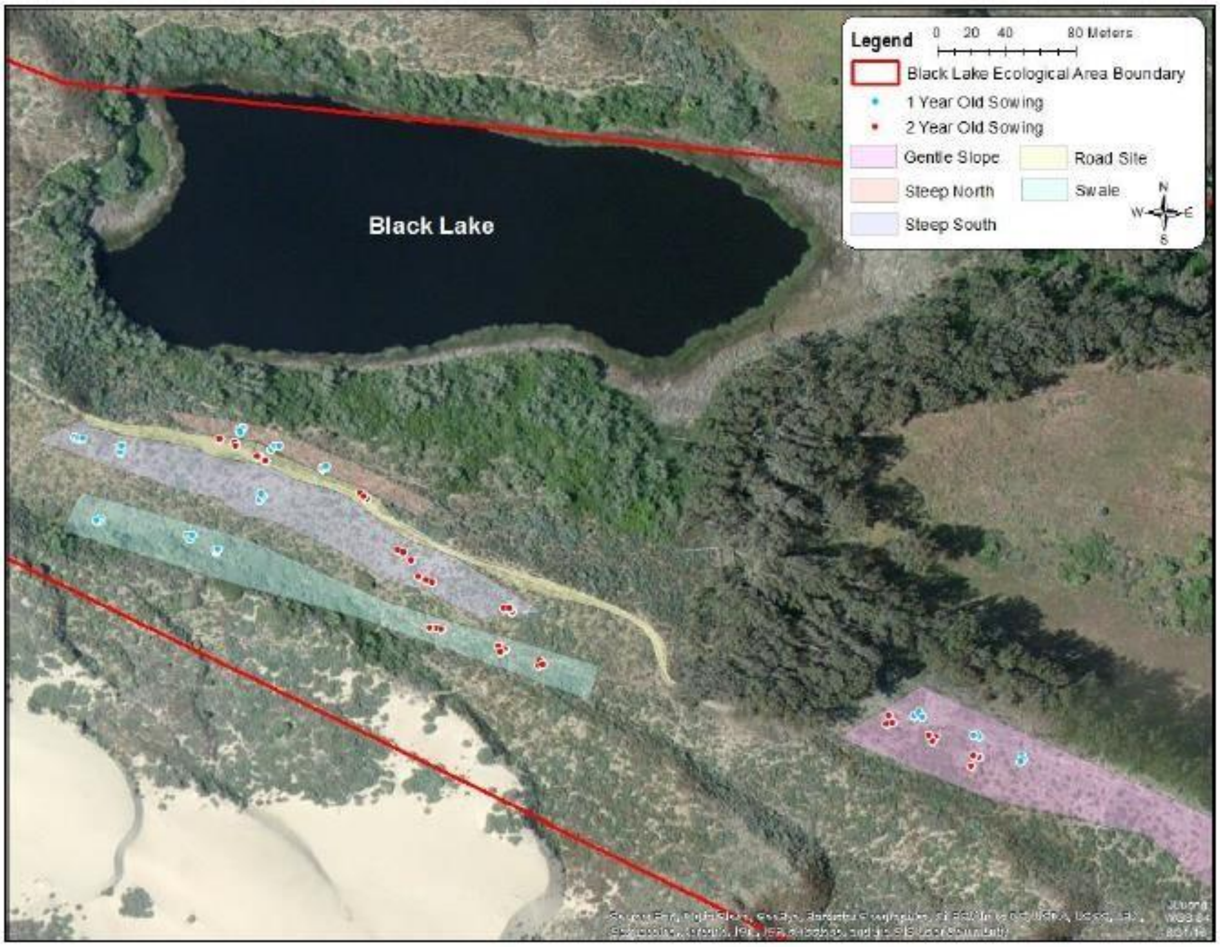


Figure 16: Nipomo lupine out-planting locations at the Black Lake Ecological Area.

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 perennial veldtgrass cover to 1-5% cover class by year 3 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: Complete

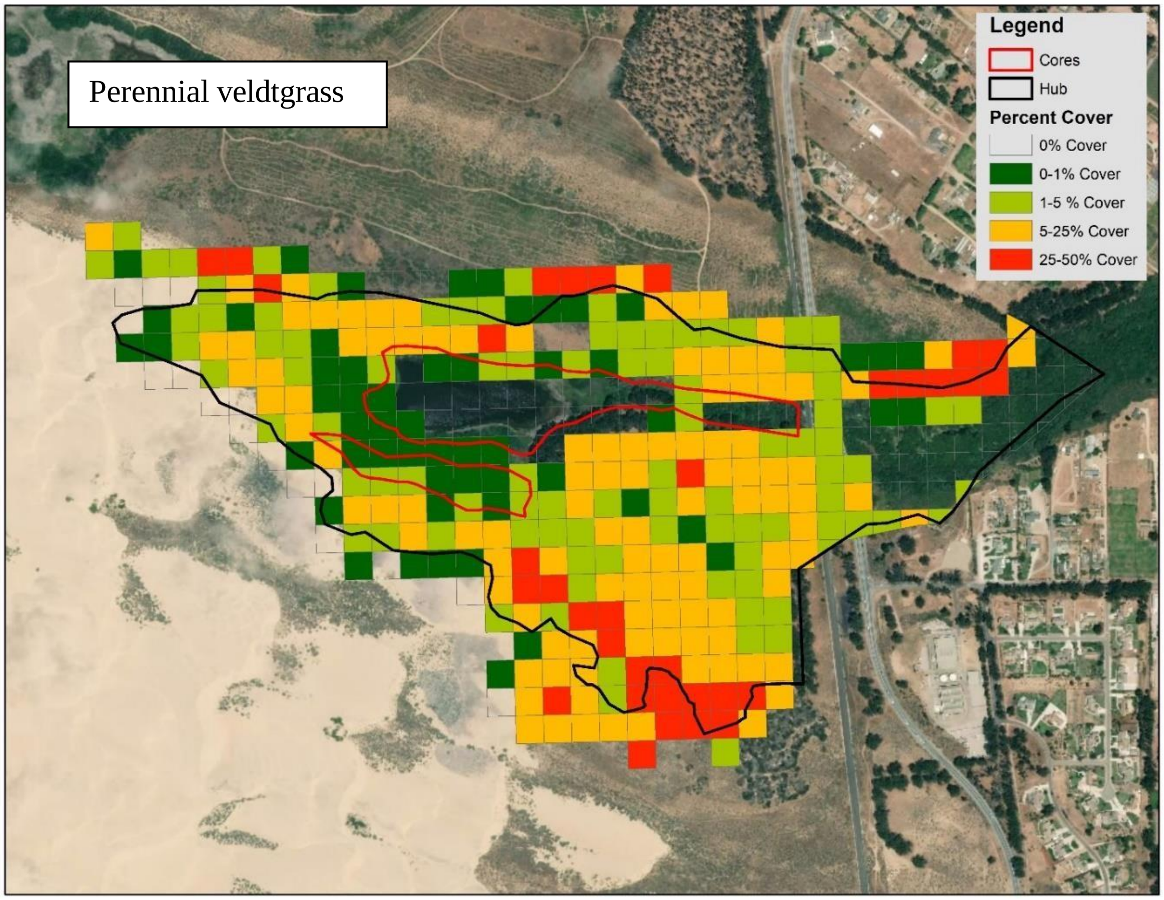


Figure 17: 50-meter grid baseline survey of perennial veldtgrass cover in the BLEA DPA.

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 12: 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 Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
Perennial Veldtgrass (*Ehrharta calycina*)	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 1A Cost Estimates:

Table 13: Cost Estimates for ground/aerial.

Opportunity 1A: Perennial veldtgrass (Ehrharta calycina) control	
Task 1: Yr 1 Herbicide Applications (2)	$ 92,704.50
Task 2: Yr 2 Herbicide Application (2)	$ 92,329.00
Task 3: Yr 3 Herbicide Applications (2)	$ 60,129.50
Task 4: Reporting & Permitting	$ 15,400.00
Contingency 20% (inflation, unanticipated cost increases)	$ 52,112.60
Phase 1 Total	**$312,675.60**
Task 5: Yr 4 Herbicide Applications (2)	*$ 48,064.00*
Task 6: Yr 4 Seeding	*$ 10,229.50*
Task 7: Yr 5 Herbicide Application (2)	*$ 36,185.50*
Phase 2 Total:	***$ 94,479.00***

Opportunity 1B: Nipomo lupine reintroduction

Objective 1B: Reduce invasive plant cover to 1-5% within a 25-foot buffer of Nipomo lupine populations by year 3. Maintain that infestation level during the maintenance phase in Yrs. 3-10.

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: Complete

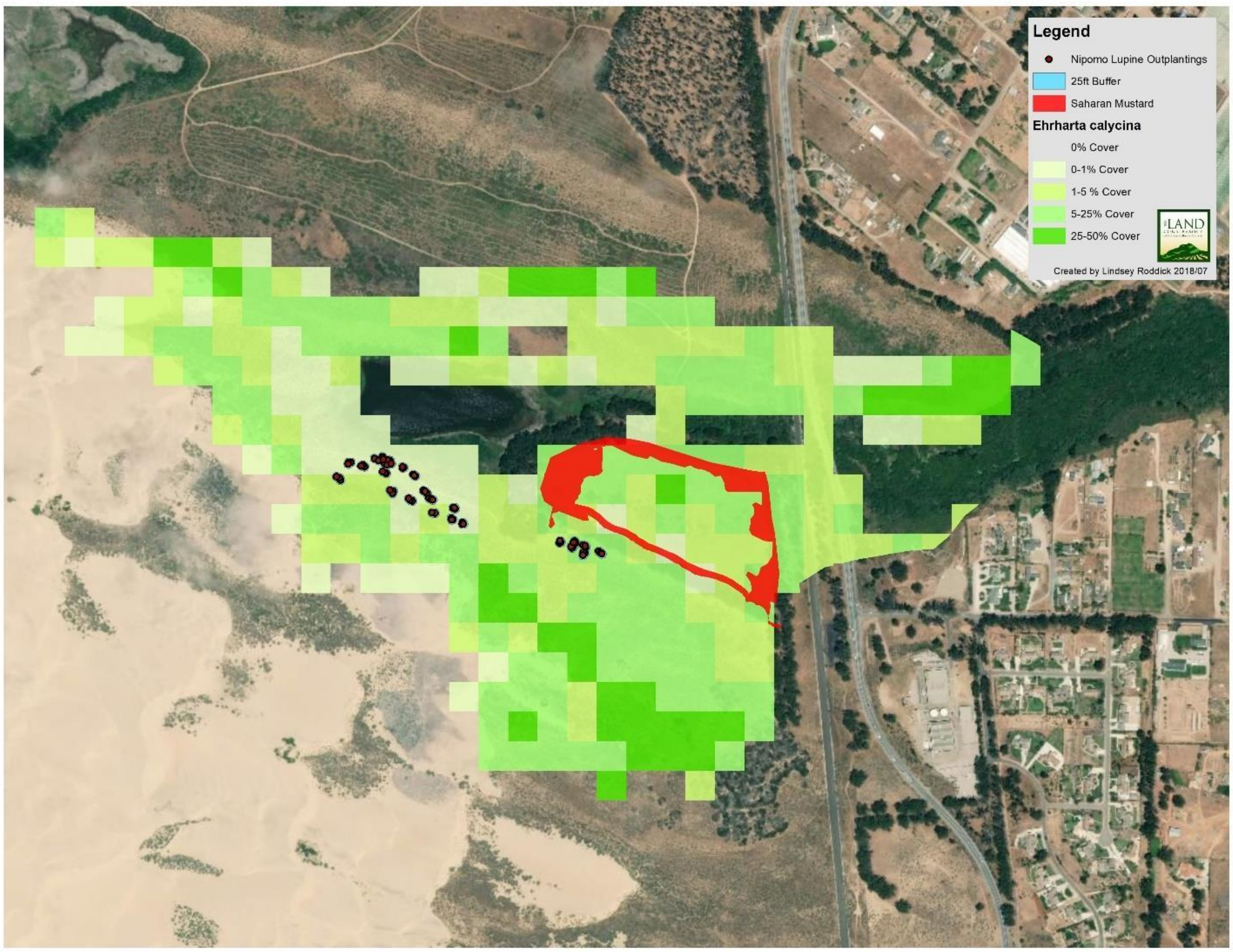


Figure 18: Baseline survey of priority invasive species threats to Nipomo lupine populations.

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 14: 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										

Opportunity 1B Cost Estimates:

Table 15: Cost Estimates for invasive plant control in Nipomo lupine buffers (5yrs).

Opportunity 1B: Nipomo lupine (Lupinus nipomensis) reintroduction	
Task 1: Yr 1 Mechanical Removal (3)	$ 7,839.05
Task 2: Yr 2 Mechanical Removal (3)	$ 7,554.50
Task 3: Yr 3 Mechanical Removal (2) and Monitoring	$ 5,304.50
Task 4: Reporting & Permitting	$ 6,920.00
Contingency 20% (inflation, unanticipated cost increases)	$ 5,523.61
Phase 1 Total	**$ 33,141.66**
Task 5: Yr 4 Mechanical Removal (2) and Monitoring	*$ 5,399.50*
Task 6: Yr 5 Mechanical Removal (1) and Monitoring	*$ 3,423.00*
Phase 2 Total	***$ 8,822.50***

Priority 2 Opportunities

Opportunity 2A: European beachgrass control

Objective 2A: Reduce European beachgrass cover to 1-5% cover class by year 3 in 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: Complete

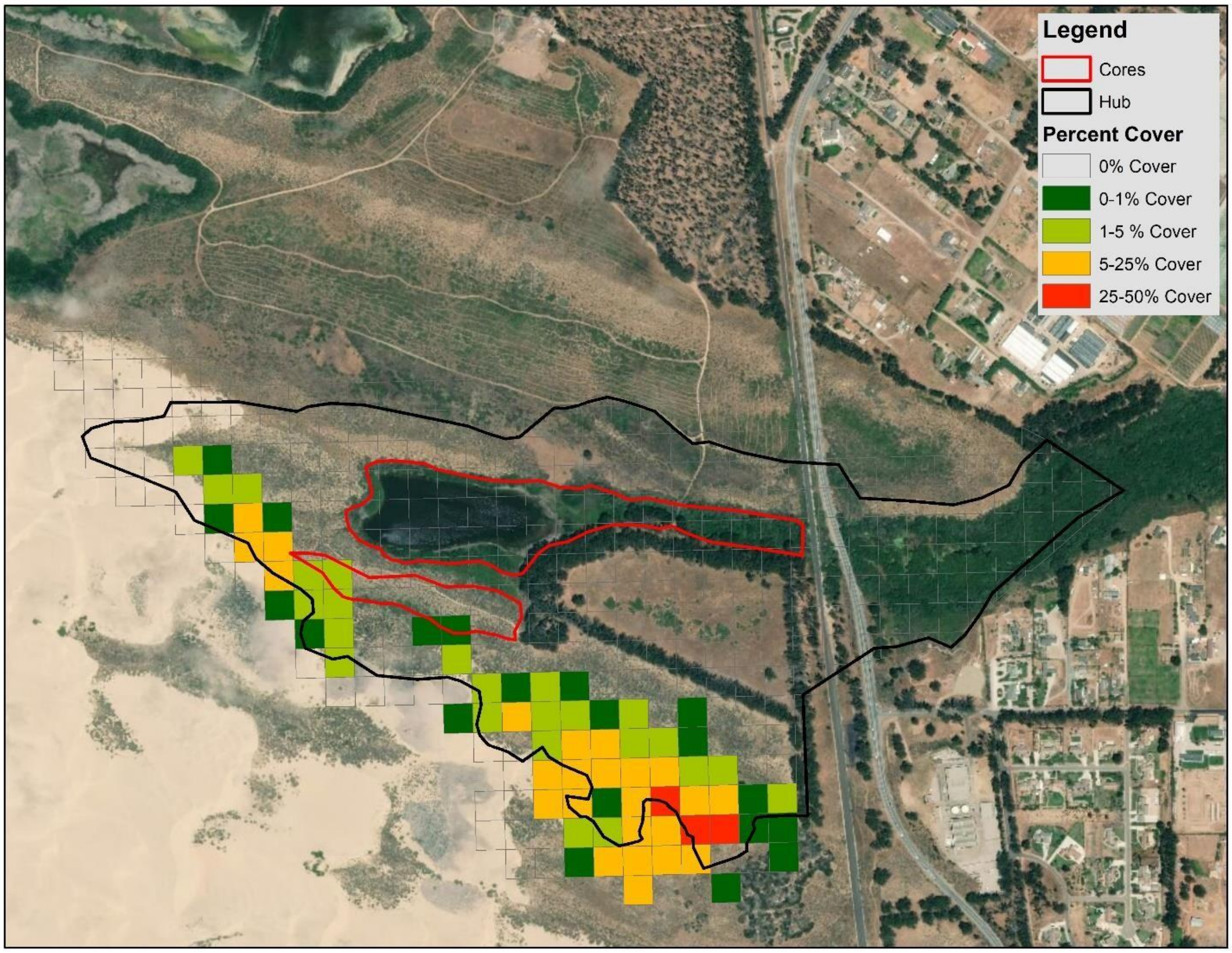


Figure 19: Baseline survey of European beachgrass in the BLEA DPA.

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 16: 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								

Opportunity 2A Cost Estimates:

Table 17: Cost Estimates for European beachgrass control (3yrs).

Opportunitiy 1A: European beachgrass (Amophila arenaria) control	
Task 1: Yr 1 Herbicide Application	$ 19,133.20
Task 2: Yr 2 Herbicide Application	$ 9,002.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 6,519.00
Task 4: Reporting & Permitting	$ 7,700.00
Contingency 20% (inflation, unanticipated cost increases)	$ 8,470.84
Phase 1 Total	**$ 50,825.04**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 6,259.00*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 4,479.00*
Phase 2 Total:	***$ 10,738.00***

Opportunity 2B: Saharan mustard containment and control

Objective 2B: Contain the 2018 infestation of Saharan mustard to its current location and reduce the infestation level to 0-1% cover by year 3 in 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: Complete

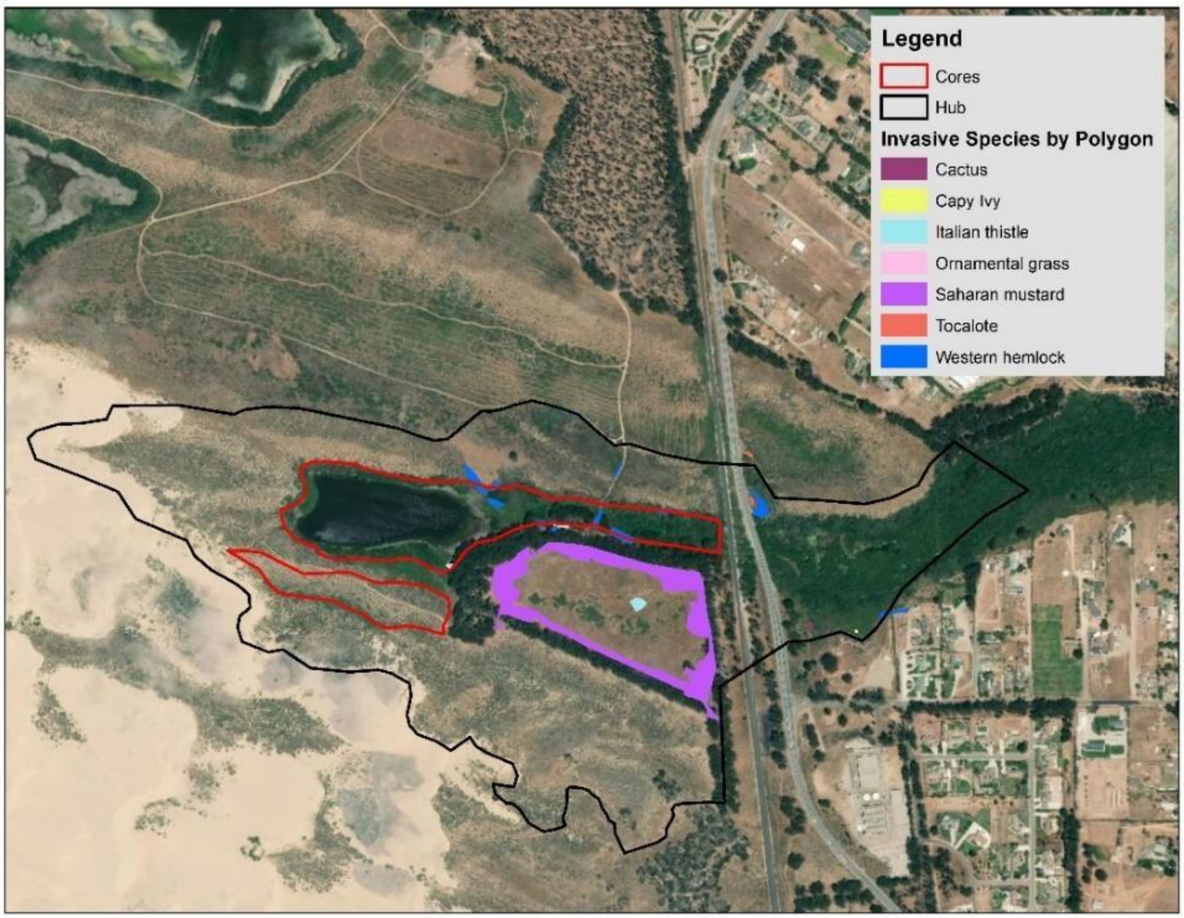


Figure 20: Baseline survey of Saharan mustard in the BLEA DPA.

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 18: 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 2B Cost Estimates:

Table 19: Cost Estimates for Saharan mustard control (3yrs).

Opportunity 2B: Saharan mustard (Brassica tournefortii) control	
Task 1: Yr 1 Herbicide Applications (2) and Mechanical Removal (1).	$ 17,574.80
Task 2: Yr 2 Herbicide Applications (2) and Mechanical Removal (1)	$ 11,871.00
Task 3: Yr 3 Herbicide Application (1), Mechanical Removal (1), and Monitoring	$ 8,762.00
Task 4: Reporting	$ 6,725.00
Contingency 20% (inflation, unanticipated cost increases)	$ 7,641.56
Phase 1 Total	**$ 52,574.36**
Task 5: Yr 4 Herbicide Application (1), Mechanical Removal (1), and Monitoring	*$ 5,974.00*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 4,167.50*
Phase 2 Total	***$ 10,141.50***

Opportunity 2C: Narrow leaved iceplant control:

Objective 2C: Reduce narrow leaved iceplant cover to 1-5% cover class by year 3 in 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: Complete

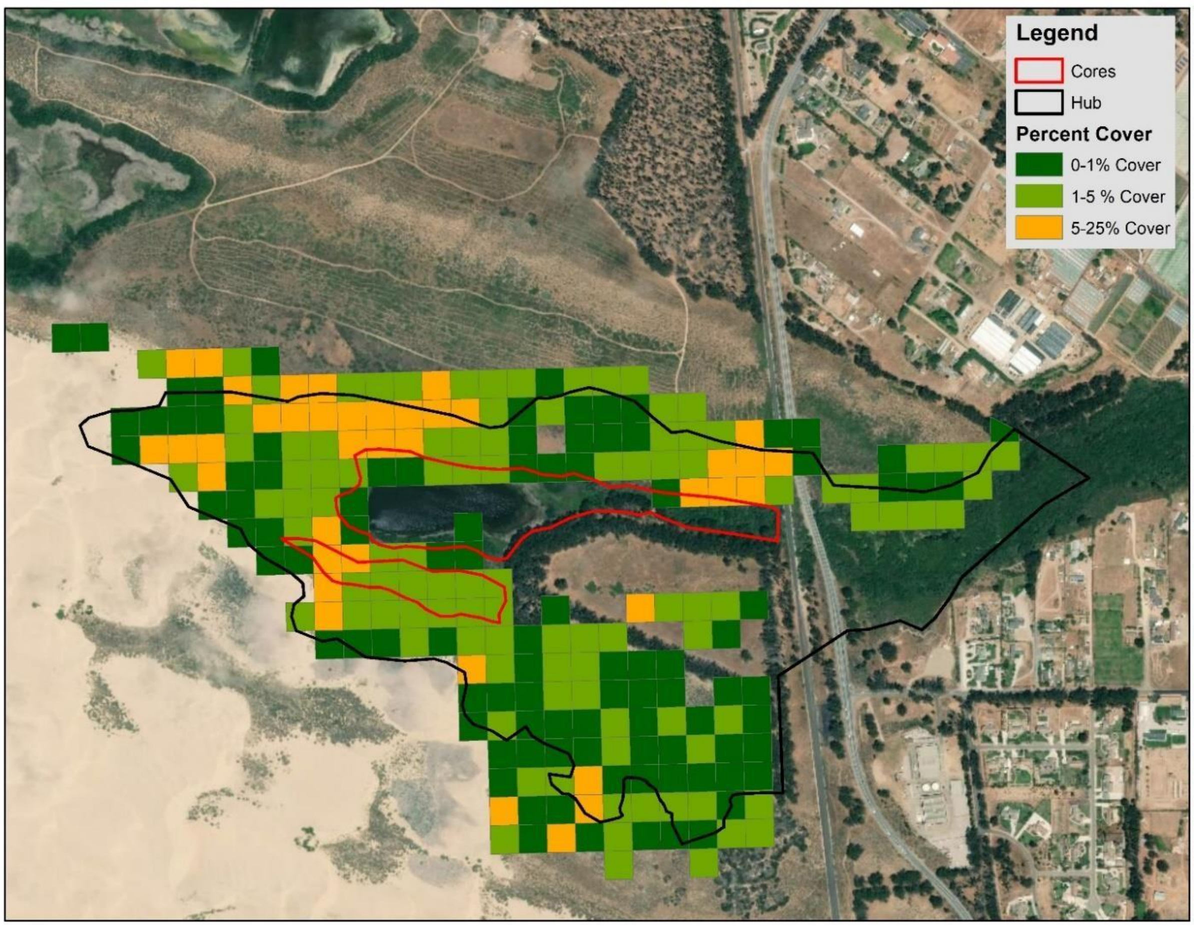


Figure 21: Baseline survey of narrow leaved iceplant in the BLEA DPA.

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. Years 4-10 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 20: 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 2C Cost Estimates:

Cost estimates are based on additional work to spray narrow leaved iceplant while treating perennial veldtgrass in the DPA.

Table 21: Cost Estimates for narrow leaved iceplant control (3 yrs).

Opportunitiy 2C: Narrow leaved iceplant (Conicosia pugioniformis) control; Addition to Opportunity 1A	
Task 1: Yr 1 Herbicide Application	$ 9,934.75
Task 2: Yr 2 Herbicide Application	$ 9,549.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 7,711.00
Task 4: Reporting	$ 1,410.00
Contingency 20% (inflation, unanticipated cost increases)	$ 5,720.95
Phase 1 Total	**$ 34,325.70**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 5,669.50*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 4,514.50*
Project Total:	***$ 10,184.00***

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

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

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 as part of the habitat mapping. Eucalyptus trees are denoted as non-native forest.

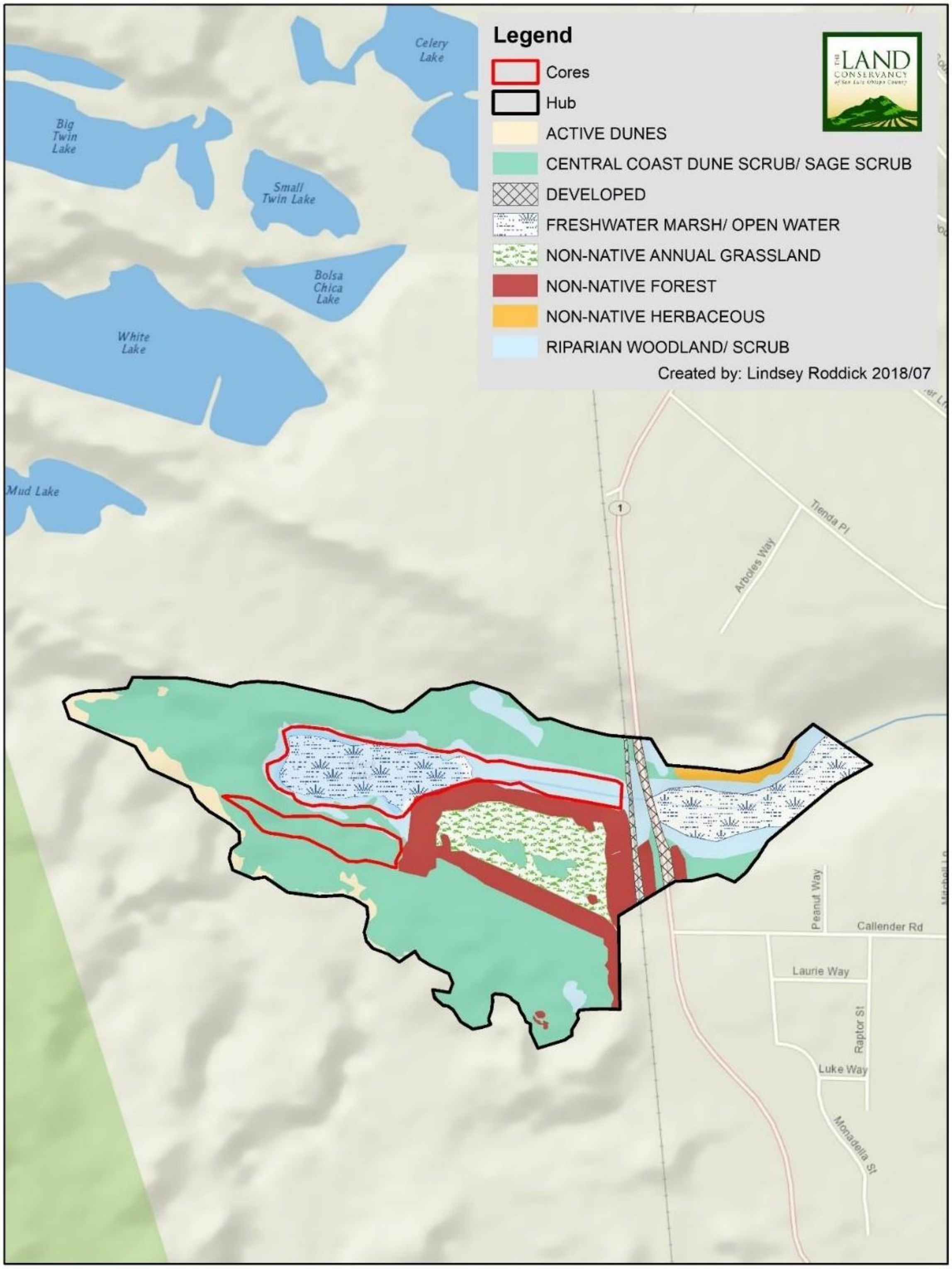


Figure 22: Baseline survey of eucalyptus trees (non-native forest) in the BLEA DPA.

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 2D Cost Estimates:

Table 22: Cost Estimates for eucalyptus tree removal and containment (3yrs).

Opportunitiy 2D: Blum gum (Eucalyptus globulus) containment and removal	
Task 1: Yr 1 Mechanical Removal	$ 4,016.35
Task 2: Yr 2 Mechanical Removal	$ 3,196.35
Task 3: Yr 3 Mechanical Removal and Monitoring	$ 2,903.85
Task 4: Reporting & Permitting	$ 1,410.00
Contingency 20% (inflation, unanticipated cost increases)	$ 2,305.31
Phase 1 Total	**$ 13,831.86**
Task 5: Yr 4 Mechanical Removal and Monitoring	*$ 2,903.85*
Task 6: Yr 5 Mechanical Removal and Monitoring	*$ 2,903.85*
Phase 2 Total	***$ 5,807.70***

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

Figure 24: Eucalyptus Ring Targeted for Removal (View from the North)

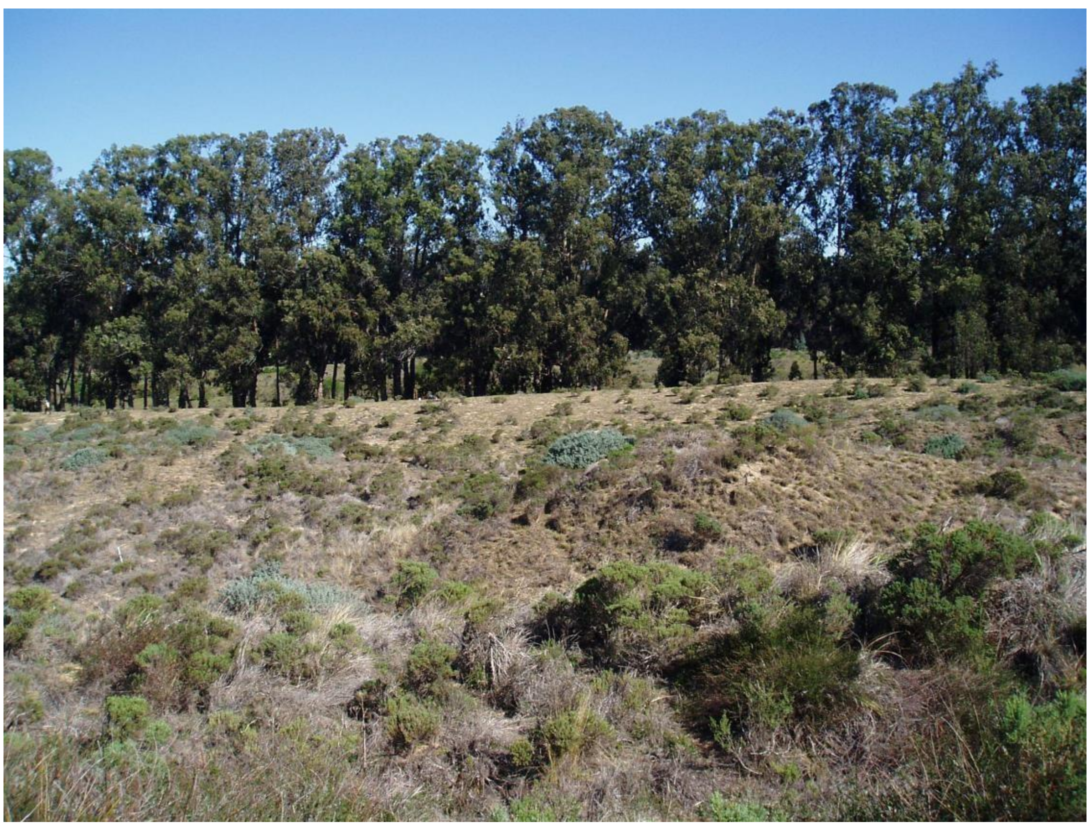


Figure 25: Eucalyptus Ring Targeted for Removal (View from the South)

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 2E Cost Estimates:

Table 23: Cost Estimates for eucalyptus tree selective removal (3 years).

Opportunitiy 2E: Blum gum (Eucalyptus globulus) selective removal	
Task 1: Yr 1 Mechanical Removal and Herbicide Application	$ 80,760.40
Task 2: Yr 2 Herbicide Application	$ 1,821.35
Task 3: Yr 3 Herbicide Application	$ 1,821.35
Task 3: Reporting & Permitting	$ 6,786.00
Contingency 20% (inflation, unanticipated cost increases)	$ 18,237.82
Project Total:	**$109,426.92**

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 26: Black Lake shoreline being encroached on by bulrushes.

Figure 27: 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 24: 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 2F Cost Estimates:

Table 25: Cost estimates for pond lily restoration (3 years).

Opportunitiy 2F: Pond Lily (Nuphar polysepala) restoration	
Task 1: Yr 1 Permitting	$ 8,713.00
Task 2: Yr 2 Mechanical Removal, Seed Collection and Planting	$ 14,325.40
Task 3: Yr 3 Mechanical Removal, and Monitoring	$ 3,771.50
Task 4: Reporting and Monitoring	$ 6,786.00
Contingency 20% (inflation, unanticipated cost increases)	$ 4,976.58
Phase 1 Total	**$ 38,572.48**
Task 5: Yr 4 Mechanical Removal and Monitoring	*$ 3,621.50*
Phase 2 Total:	***$ 3,621.50***

Opportunity 2G: Freshwater habitats enhancement:

Objective 2G: Reduce poison hemlock cover to 1-5% cover class by year 3 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: Complete

Figure 28: 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 26: 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															
Poison Hemlock (*Conium maculatum*)			Biennial Herb -- Life cycle:	Active growth				Flower			Fruit	Reduced growth			
	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											

Opportunity 2G Cost Estimates:

Table 27: Cost estimates for poison hemlock control (3 years).

Opportunitiy 2G: Freshwater habitats Enhancement	
Task 1: Yr 1 Mechanical Removal and Herbicide Application	$ 5,748.20
Task 2: Yr 2 Mechanical Removal and Herbicide Application	$ 4,508.50
Task 3: Yr 3 Mechanical Removal, Herbicide Application and Monitoring	$ 3,383.50
Task 4: Reporting	$ 4,360.00
Contingency 20% (inflation, unanticipated cost increases)	$ 3,600.04
Phase 1 Total	**$ 21,600.24**
Task 5: Yr 4 Mechanical Removal, Herbicide Application and Monitoring	*$ 2,978.70*
Task 6: Yr 5 Mechanical Removal, Herbicide Application and Monitoring	*$ 2,648.70*
Project Total:	***$ 5,627.40***

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 28: 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 29: Herbicide toxicity comparison.

	Toxicity				Human Risk		
Herbicide	Dermal LD50 (rabbits)	Oral LD50 for rats:	LC50 for bluegill sunfish	Effects to cryptogamic soils	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 perennial veldtgrass cover to 1-5% cover class by year 3 in the BLEA DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the BLEA DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 invasive plant cover to 1-5% within a 25-foot buffer of Nipomo lupine populations by year 3. Maintain that infestation level during the maintenance phase in Yrs. 4-10.**

Performance monitoring will occur in Years 1 and 3 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 by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long-term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 European beachgrass cover to 1-5% cover class by year 3 in the BLEA DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of European beachgrass maintained at a 1-5% cover class value throughout the BLEA DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 the infestation level to 0-1% cover by year 3 in the BLEA DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of Saharan mustard maintained at a 0-1% cover class value throughout the BLEA DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 0-1% cover class values are being maintained.

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 narrow leaved iceplant cover to 1-5% cover class by year 3 in the BLEA DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of narrow leaved iceplant maintained at a 1-5% cover class value throughout the BLEA DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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) through year ten.**

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 in the next three years (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 years 1 and 3.

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 poison hemlock cover to 1-5% cover class by year 3 in the BLEA DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of poison hemlock maintained at a 1-5% cover class value throughout the BLEA DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 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.

Monitoring Cost Estimates:
Monitoring cost estimates are based on performance monitoring for Priority 1 Opportunities, releve monitoring, and reporting.

Table 30: Monitoring cost estimates for the BLEA DPA.

Black Lake Ecological Area DPA Monitoring	
Task 1: Yr 1 Grid Monitoring	$ 3,691.75
Task 2: Yr 1 Releve Monitoring	$ 4,179.05
Task 3: Yr 3 Grid Monitoring	$ 4,228.10
Task 4: Yr 3 Releve Monitoring	$ 4,179.05
Task 5: Final Reporting	$ 5,670.00
Contingency 20% (inflation, unanticipated cost increases)	$ 4,389.59
Phase 1 Total	**$ 26,337.54**
Task 6: Yr 5 Grid Monitoring	*$ 3,691.75*
Task 7: Yr 5 Releve Monitoring	*$ 4,179.05*
Phase 2 Total	***$ 7,870.80***

Nipomo Lupine

Site Description

The Nipomo Lupine DPA is located on California State Parks and privately- owned property to the south (Phillips 66 oil refinery and agriculture lands) and is bisected by the Union Pacific Railway. This DPA is the location of the only known natural population of federally endangered Nipomo lupine. Phillips 66 land managers have set aside coastal dune habitat surrounding the refinery to benefit native dune wildlife. The portion of the DPA west of the railway is under a long-term lease to California State Parks and is actively managed to sustain, restore, and enhance the integrity of natural resources on the property. West of the leased land are portions of the Oceano Dunes State Vehicular Recreation Area (ODSVRA). The DPA consists of Central Coast Dune Scrub, invasive non-native herbaceous plants, two freshwater marshes and active dunes. There are also stands of Sydney golden wattle (*Acacia longifolia*) on the site.

Figure 29: Seaside amsinckia (Amsinckia spectabilis)

This DPA was selected by the conservation planning software (both Marxan and Zonation) and local experts because of its unique assemblage of plant species. It is home to a large population of Dune almond (*Prunus fasciculata* var. *punctata*, CNPS Rare Plant Rank 4.3) and the only natural population of the federally endangered Nipomo lupine. This DPA is where excellent spring annual wildflowers appear because of relatively old stabilized dune scrub. Species such as dune larkspur (Delphinium parryi ssp. blochmaniae), seaside fiddleneck (*Amsinckia spectabilis*), purple owl's clover (*Castilleja exserta*) and phacelia (*Phacelia douglasii*) are found regularly in the spring.


Figure 30: Nipomo lupine (Lupinus nipomensis)

Other unique species found within this DPA include a diversity of lichens and vertebrates. It's resident plant species, Dune almond is an important substrate for at least thirteen lichen species (Knudsen, 2015). A north facing slope with intact biological soil crust provides another order of biological diversity to this region. The DPA includes open dune scrub habitat as well as a series of small wetlands/riparian areas predominantly occupied by Arroyo willow and the occasional large nonnative tree acacias (*Acacia longifolia*) and pines (*Pinus contorta* and *P. radiata*)) which offer important faunal breeding and feeding habitat for bird species such great horned owl (*Bubo virginianus*).

The western portion of this DPA (west of the railroad tracks) serves as an open space buffer for the Santa Maria refinery facility of Phillips 66. A service road running through the property allows refinery personnel and equipment access for the maintenance of a brine pipeline running from the refinery through the ODSVRA to an oceanic outfall. ODSVRA uses the service road for emergency access to the vehicular area, access to treatment of invasive species and access for ecological surveys. The LCSLO has used the service road for access to monitor the Nipomo lupine. This portion of the DPA is under lease to California State Parks as part of ODSVRA.

Since the 1980's, State Parks has managed this property to support long term viability of the natural resource features present within the DPA. Restoration efforts in this DPA are focused on management of invasive plant species; this DPA is plagued by dense perennial veldtgrass (*Ehrharta calycina*)- the largest threat to the federally endangered Nipomo lupine. In the past, this region has been a high priority for restoration funds through the Dunes Collaborative Restoration Task Force (RTF) for the removal of perennial veldtgrass for preservation of the Nipomo lupine. Management of the invasive species has focused on removal of perennial veldtgrass by the use of herbicide from the fall through spring (on State Parks-leased property, west of the railroad tracks) and grazed by cattle in the summer (east of the railroad tracks). It is important to note is that management opportunities recommended in this Work Plan do not encompass activities east of the railroad tracks; this portion of the DPA is not managed by State Parks.


Figure 31: Site of native population of Nipomo lupine. Blue Flag indicate individuals.

The RTF has discussed the importance of satellite populations of Nipomo lupine on publicly owned land. One satellite population currently exists at Black Lake Ecological Area.

Future recovery of Nipomo lupine may be constrained by loss of habitat and the lack of additional habitat for species to move into. The natural population within this DPA is located on ancient sand dunes from the pre-Flandrian era (Cooper, 1967) which offers the open landscape preferred by Nipomo lupine. Successional movement of newer sand with denser coastal scrub habitat is slowly moving into the Nipomo lupine current populations. Movement east is impossible due to CA Highway 1 and urban development of Nipomo, CA.

The Nipomo Lupine DPA work plan was written by the ODSVRA and the Coastal San Luis Resource Conservation District. **The work plan is provided in Appendix B.**

Big Coreopsis Hill

Site Description

Big Coreopsis Hill DPA contains land owned by State Parks and privately- owned agricultural properties just south of Oso Flaco Lake and is near the Guadalupe-Nipomo Dunes National Wildlife Refuge. The site is bordered by active agricultural operations to the north. The private landowners are supportive of preserving the site in perpetuity, but no conservation easement is yet held on the property.

GNDC advocate, Kathleen Goddard Jones was particularly fond of this site because of its beautiful blooms. During the spring, the north-facing slope of the valley is covered with dune larkspur (*Delphinium parryi* ssp. *Blochmaniae)*, carnival poppy (*Hesperomecon linearis*) and the beloved giant coreopsis (*Leptosyne gigantea*). The valley appears to be somewhat resistant to invasion by perennial veldtgrass (*Ehrharta calycina*), probably because of the colder and wetter conditions found at the bottom of the valley.

Big Coreopsis Hill DPA is currently experiencing natural successional change as a large active dune is moving eastward through the stabilized coastal dune scrub bordering this DPA. The blowout of active sand is encouraging new plant species such as dune mints (*Monardella* spp.) and nonnative European sea rocket (*Cakile maritima*) to establish. Successional changes offer a diversity of species but also bring new invasive species to which management must adapt.

There are many information gaps that limit our understanding of this DPA. Big Coreopsis Hill is visited each year by botanists of CNPS to record species presence and population numbers. This region was extensively surveyed in 1995

Figure 32: Coreopsis Hill looking north at Oso Flaco Lake and neighboring agricultural lands.

for vegetation types and floral species by Arthur Hazebrook (Hazebrook, 1995). Occurrence data for natural resources within this DPA is incomplete.

Major management challenges in this DPA include the threat of invasive species from areas outside of the DPA. Perennial veldtgrass is dense in the areas to the east of the DPA and has potential to invade the DPA if not managed. No invasive species management is currently being done within this DPA but the neighboring ODSVRA has actively managed for European beachgrass and perennial veldtgrass. The agricultural operation to the north presents a potential source of nonnative seed and agricultural invasive species, specifically that of annual grasses. Surrounding private ownership presents an opportunity to build relationships and expand management of this DPA by exploring opportunities to control invasive species from outside of the DPA.

Figure 33: Big Coreopsis Hill looking toward the ocean.

The Big Coreopsis Hill DPA work plan was written by the ODSVRA and the Coastal San Luis Resource Conservation District. **The work plan is provided in Appendix C.**

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 34: 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.

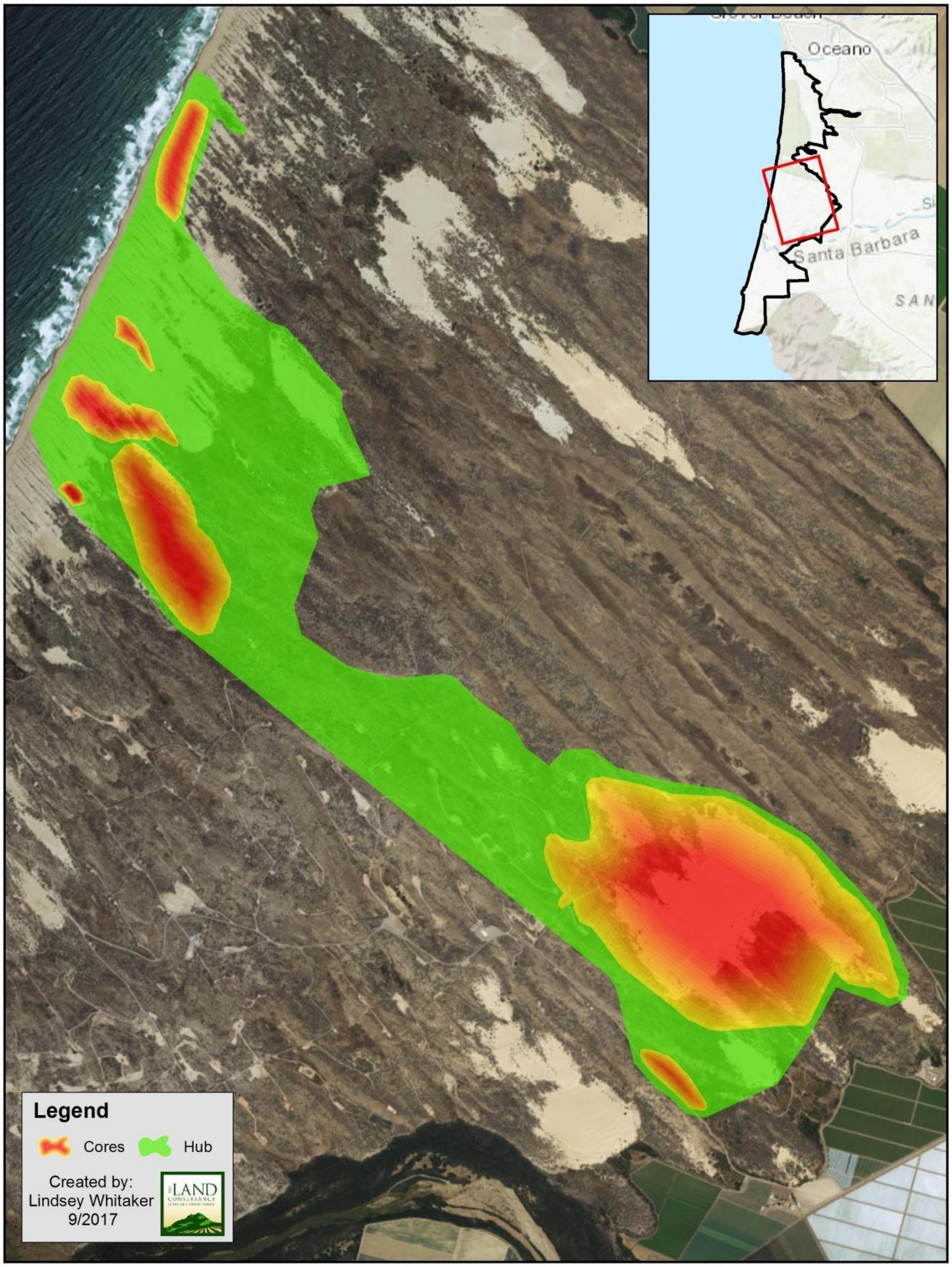


Figure 35: Boundary of the National Wildlife Refuge/ Chevron Successional Dune DPA.

Figure 36: 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

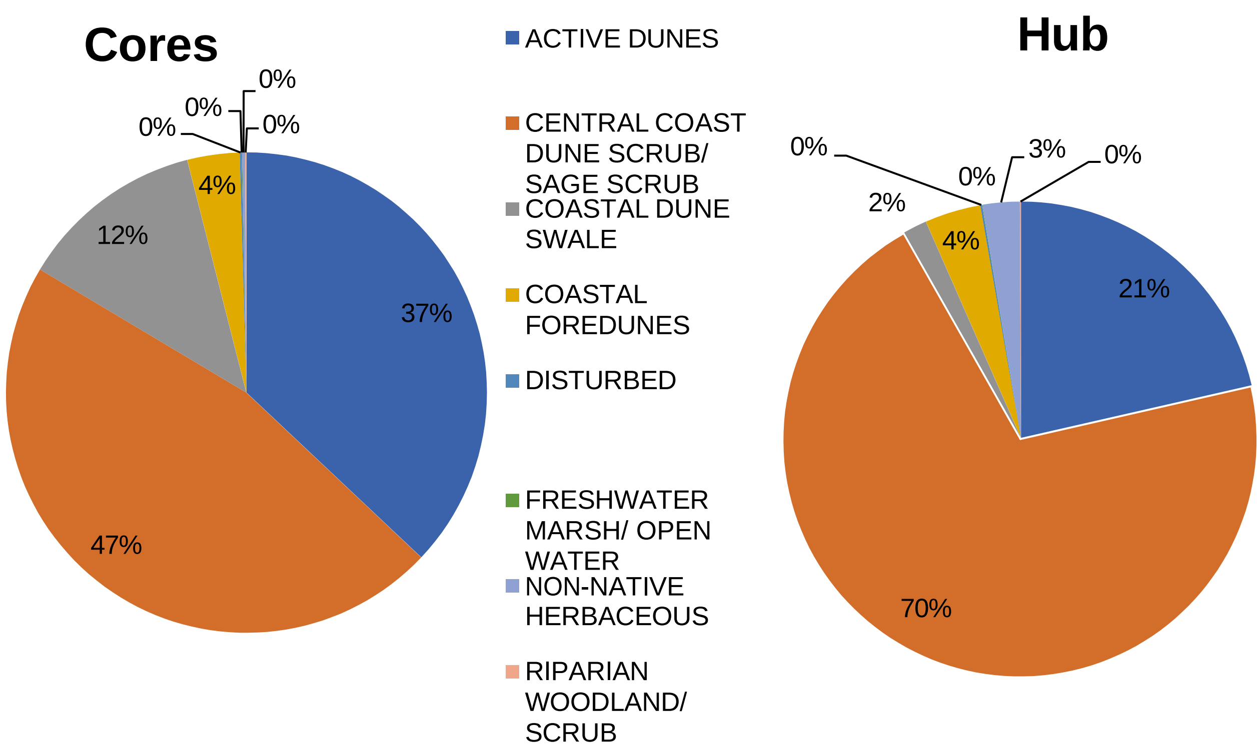
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the National Wildlife Refuge/Chevron Successional Dune DPA. Those species are included in the table below.

Table 31: 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 californica* (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 37: Types and Percent Cover of Habitats within the National Wildlife Refuge/ Chevron Successional Dune DPA.

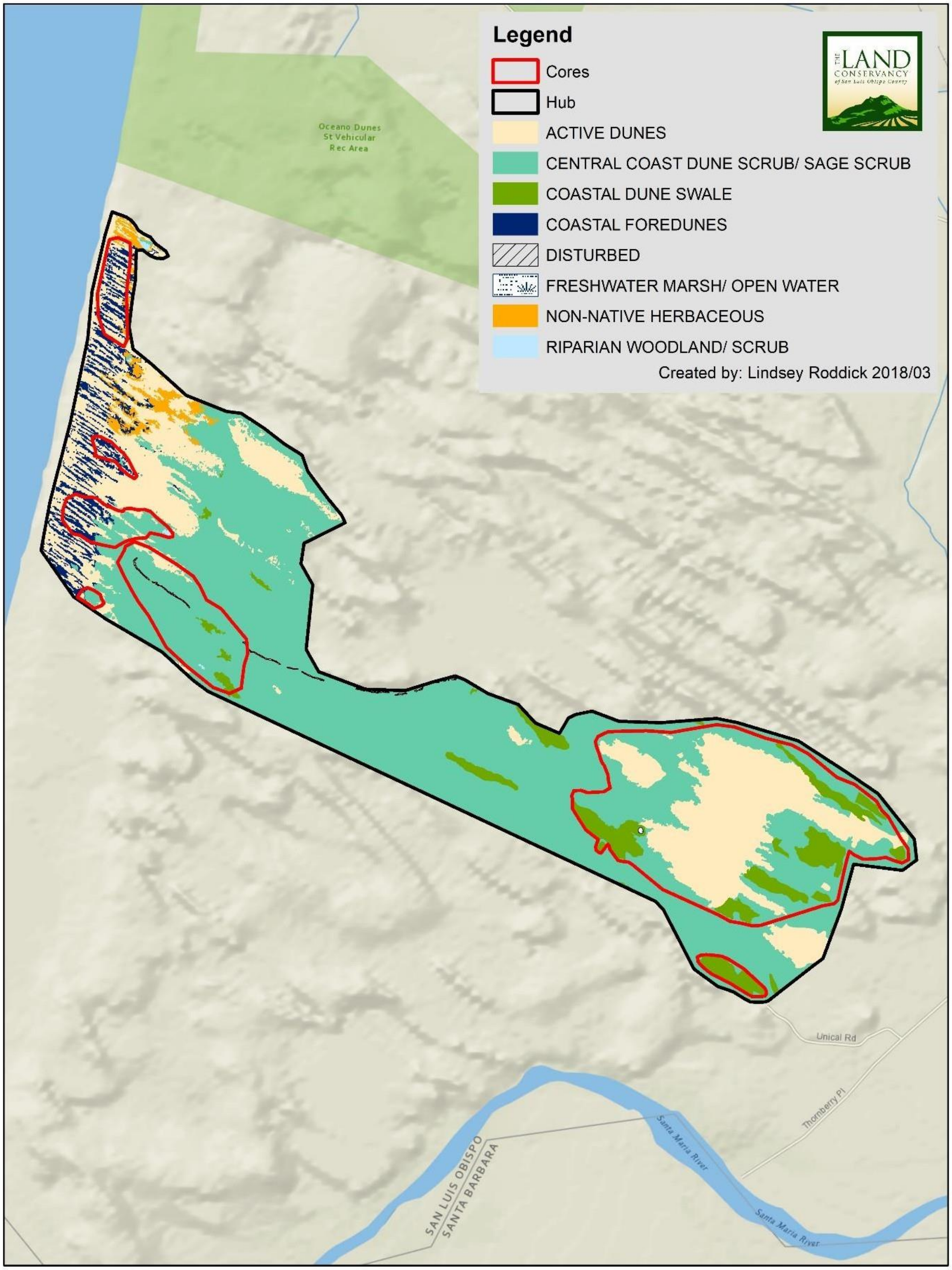


Figure 38: Habitat Types within the National Wildlife Refuge/ Chevron Successional Dune DPA.

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 32: 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 33: 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 34: 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 35: 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

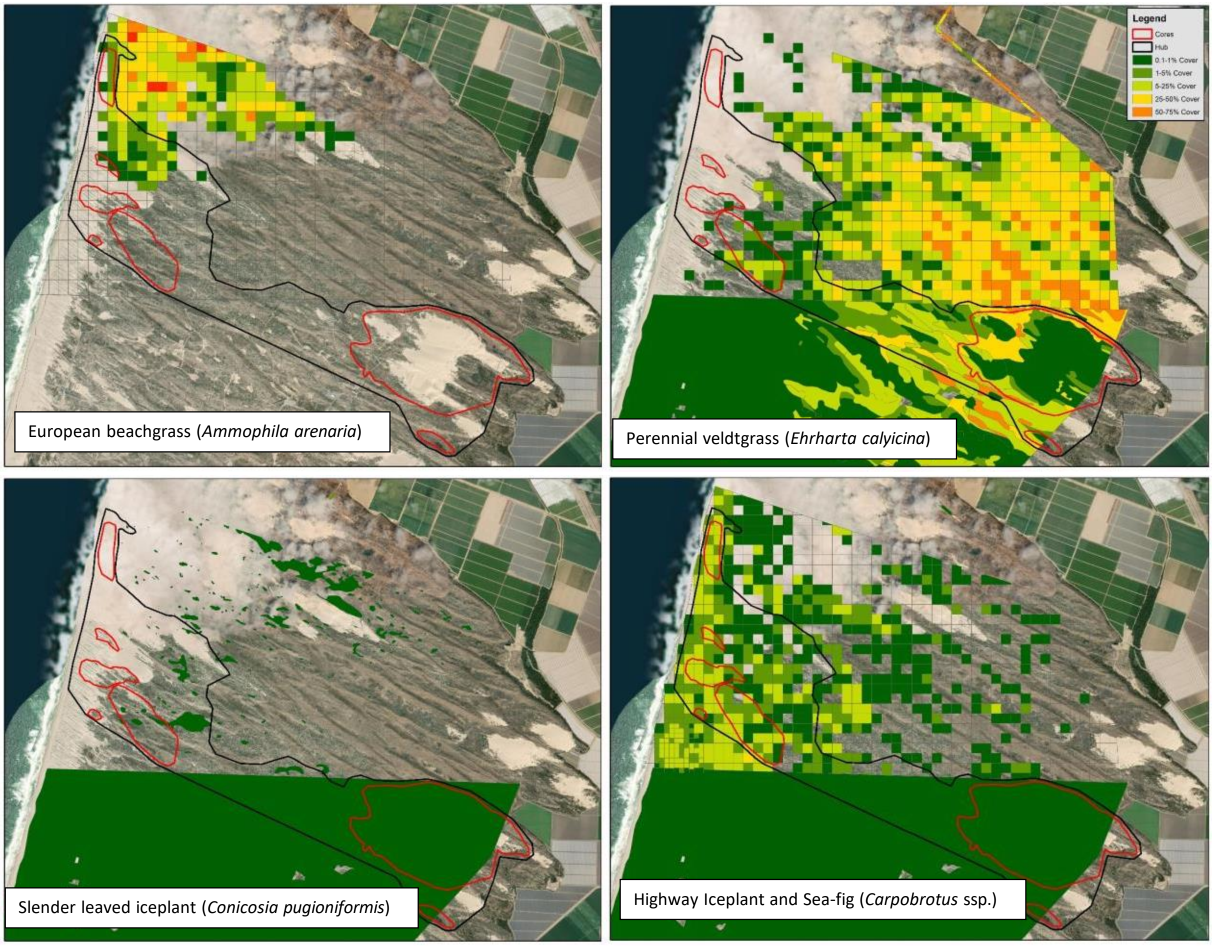


Figure 39: Distribution and abundance maps of dominant invasive species in the NWR/CSD DPA.

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.

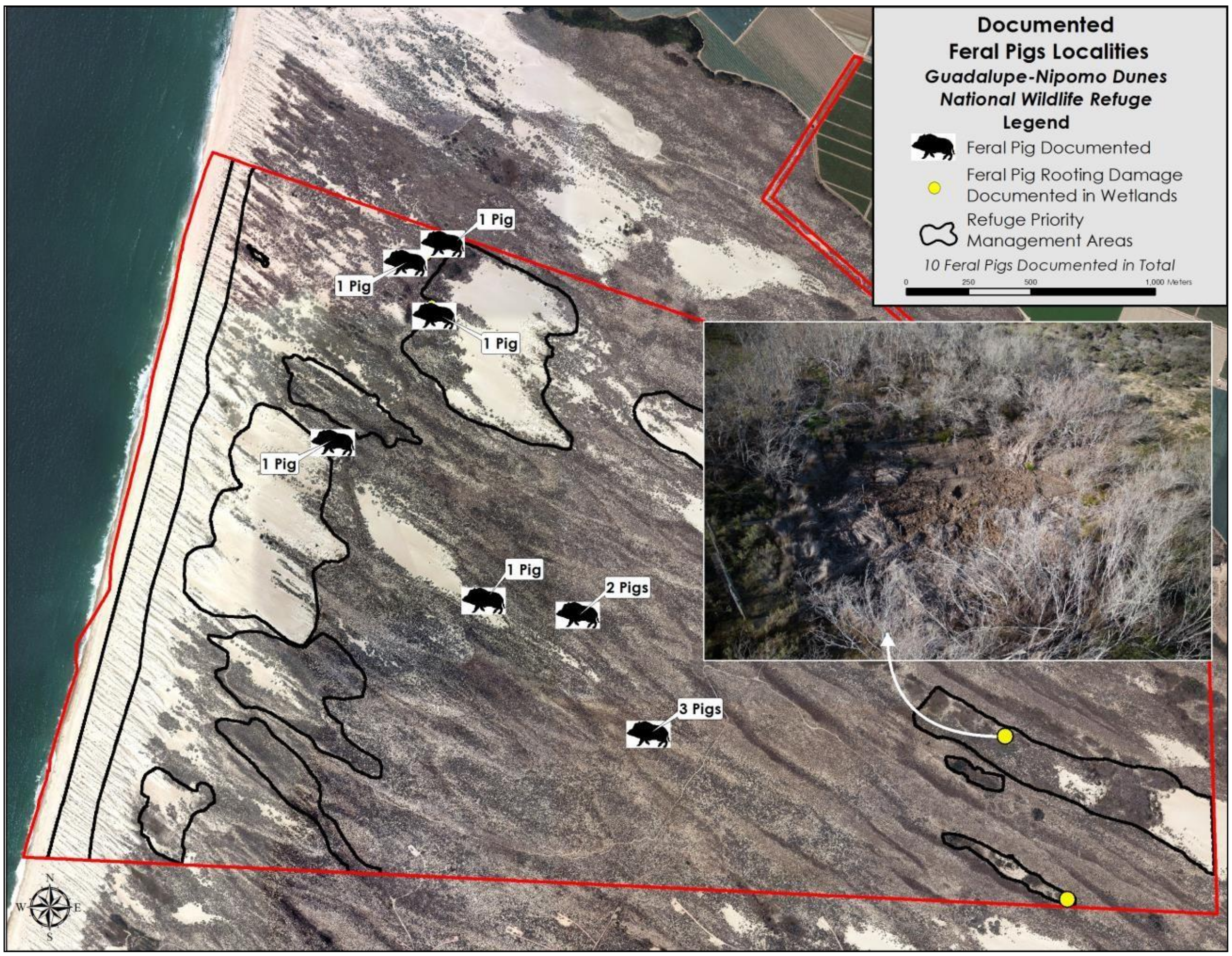


Figure 40: Map of documented feral pigs and rooting damage to wetland habitats on the GNDNWR.

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 European beachgrass cover to 1-5% cover class by year 3 in 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: Complete

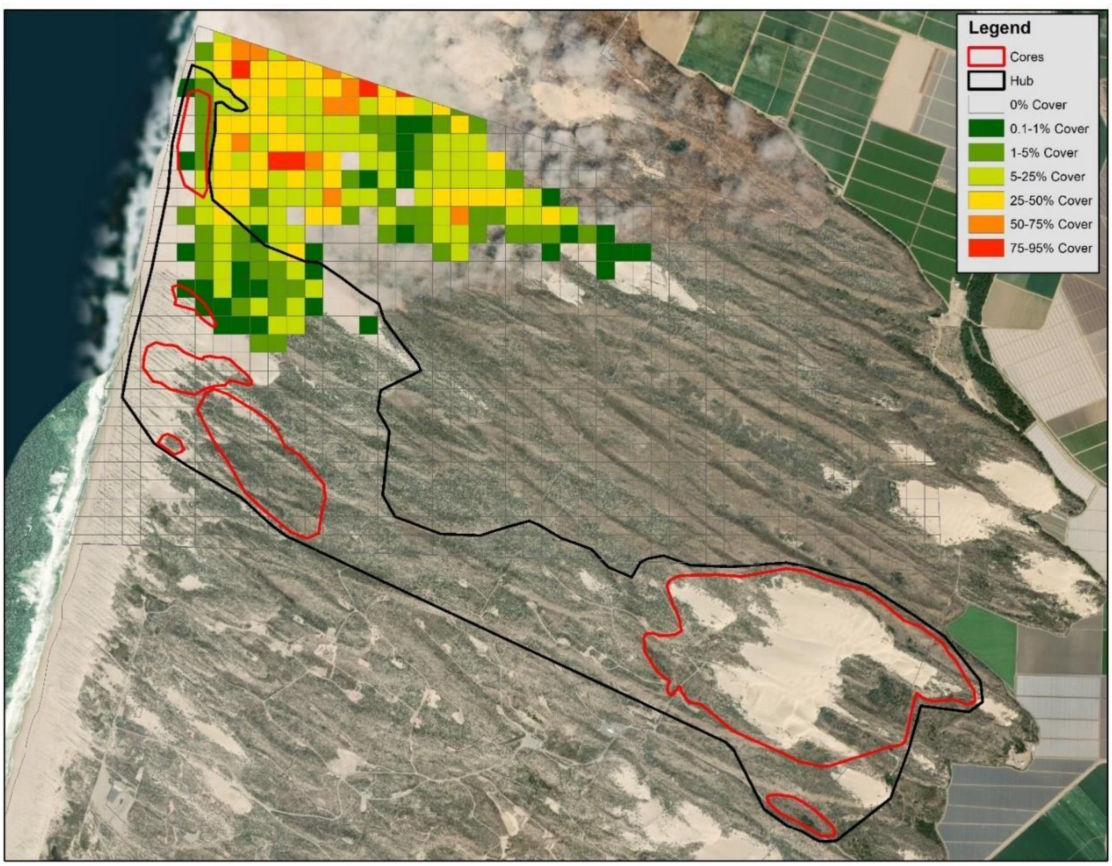


Figure 41: 100-meter grid baseline survey of European beachgrass.

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 36: 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 at the end of Year 3 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 1A Cost Estimates:

Table 37: Cost Estimates for European beachgrass control and removal.

Opportunitiy 1A: European beachgrass (Amophila arenaria) control	
Task 1: Yr 1 Herbicide Application	$ 57,196.20
Task 2: Yr 2 Herbicide Application	$ 42,593.40
Task 3: Yr 3 Herbicide Application and Monitoring	$ 20,593.70
Task 4: Yr 3 Dune Succession Planning and Monitoring	$ 4,167.96
Task 5: Reporting & Permitting	$ 7,700.00
Contingency 20% (inflation, unanticipated cost increases)	$ 26,450.25
Phase 1 Total	**$ 158,701.51**
Task 6: Yr 4 Herbicide Application and Monitoring	*$ 17,465.80*
Task 7: Yr 5 Herbicide Application, and Monitoring	*$ 17,323.76*
Phase 2 Total	***$ 34,789.56***

Opportunity 1B: Western snowy plover nesting habitat enhancement

Objective 1B: Reduce European beachgrass cover to 1-5% cover class by year 3 in the NWR/CSD DPA (Hub & Core) to improve nesting habitat for Western snowy plover.
*Note: This is essentially the same Objective as Opportunity 1A. Cost for the opportunity are the same with the addition of plover monitoring to track improvements in nesting and rearing habitat. This can be considered an expansion of 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 in the years 2019, 2020 and 2021.

Opportunity 1B Cost Estimates:
$20,000/year for three years, or **$60,000 Total. *Note: Already funded through a TORCH Grant.**

Opportunity 1C: Myrtle pond wetland enhancement

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

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

Figure 42: 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: Complete

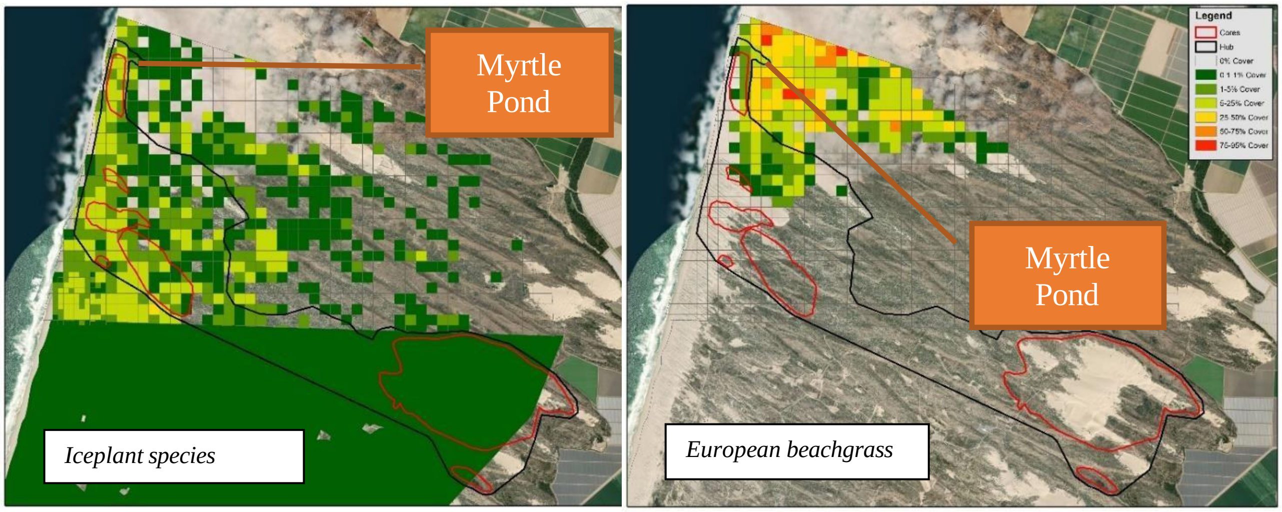


Figure 43: Baseline invasive plant surveys around Myrtle pond.

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 38: 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											

Opportunity 1C Cost Estimates:

Table 39: Cost Estimates for Myrtle pond enhancement activities.

Opportuntiy 1C: Myrtle Pond Enhancement	
Task 1: Yr 1 Fence Construction and Survey	$ 26,894.80
Task 2: Yr 1 Permitting	$ 4,740.00
Task 3: Yr 2 Herbicide Application	$ 17,928.80
Task 4: Yr 3 Herbicide Application and Monitoring	$ 13,074.84
Task 5: Yr 3 Fence Maintenance	$ 6,465.92
Task 6: Reporting & Permitting	$ 6,920.00
Contingency 20% (inflation, unanticipated cost increases)	$ 15,204.87
Phase 1 Total	**$ 91,229.23**
Task 7: Yr 4 Herbicide Application and Monitoring	*$ 7,560.42*
Task 8: Yr 5 Herbicide Application and Monitoring	*$ 7,560.42*
Phase 2 Total	***$ 15,120.84***

Priority 2 Opportunities

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

Objective 2A: Reduce iceplant cover to 1-5% cover class by year 3 in 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: Complete

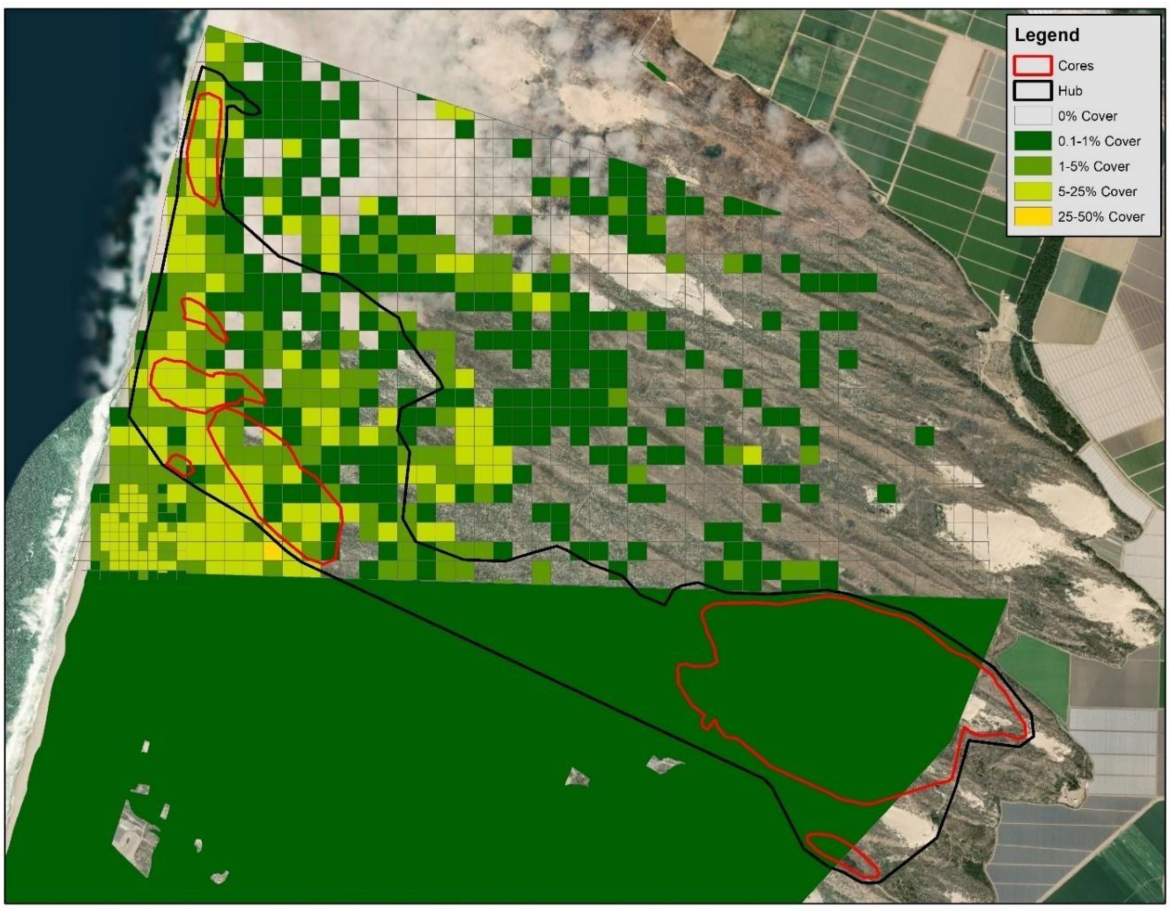


Figure 44: Distribution and abundance of iceplant species mapped in 2017 within the NWR/CSD DPA (Hubs and Cores). **Figure 44: Distribution and abundance of iceplant species mapped in 2017 within the NWR/CSD DPA (Hubs and Cores).**

Figure 44: 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 40: 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 2A Cost Estimates:

Table 41: Cost Estimates for iceplant control in the NWR/CSD DPA (Hubs and Cores).

Opportunitiy 2A: Highway Iceplant (Carpobrotus edulis) and Sea fig (Carpobrotus chilensis) control	
Task 1: Yr 1 Herbicide Application	$ 161,567.60
Task 2: Yr 2 Herbicide Application	$ 134,378.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 106,808.40
Task 4: Reporting & Permitting	$ 10,300.00
Contingency 20% (inflation, unanticipated cost increases)	$ 82,610.80
Phase 1 Total	**$ 495,664.80**

Opportunity 2B: Perennial veldtgrass control

Objective 2B: Reduce perennial veldtgrass cover to 1-5% cover class by year 3 in 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: Complete

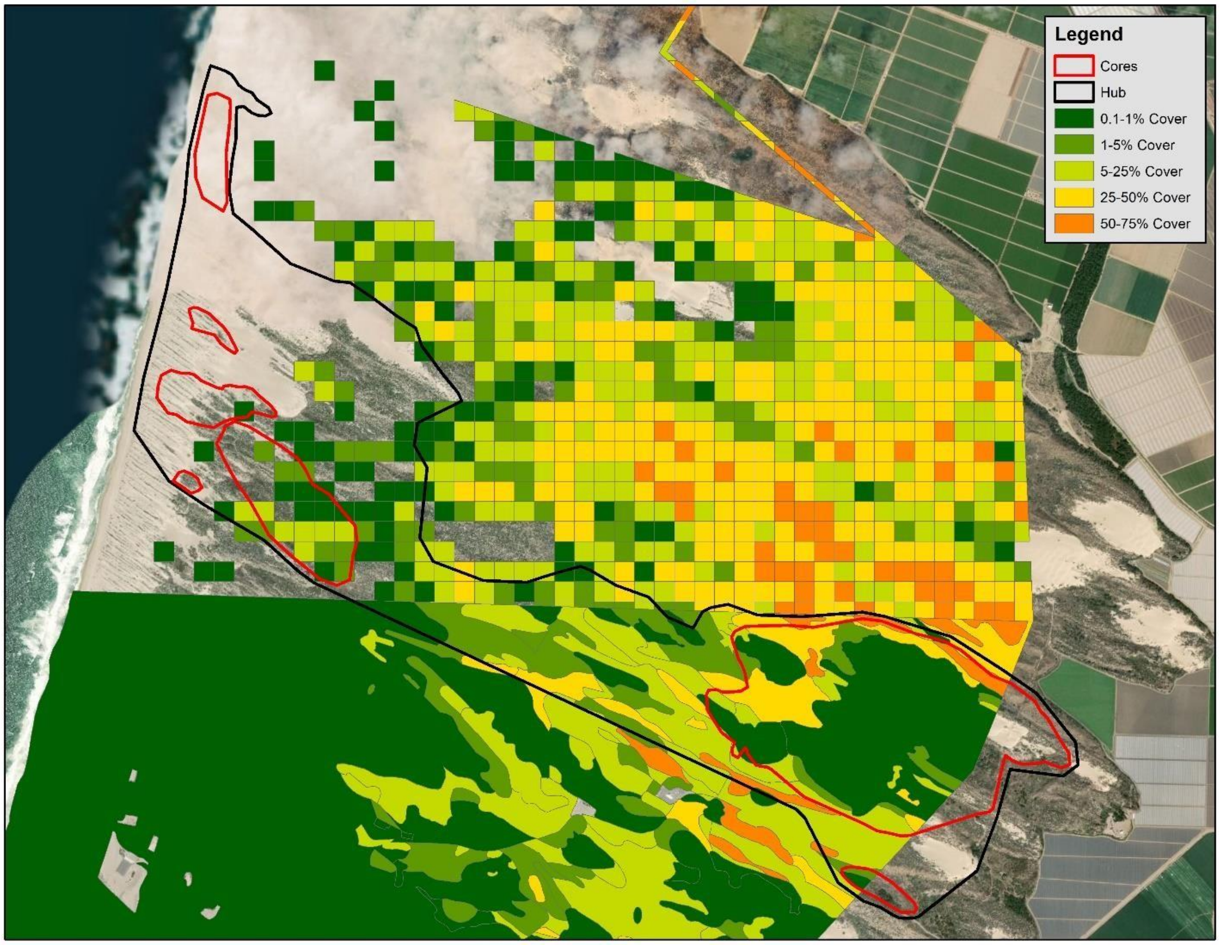


Figure 45: Distribution and abundance of perennial veldtgrass mapped in 2017 within the NWR/CSD DPA (Hubs and Cores).

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. 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 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 42: 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 2B Cost Estimates:
Cost estimate is based on ground application of herbicide. This cost could be decreased by augmenting with aerial herbicide applications.

Table 43: Cost Estimates for veldtgrass control in the NWR/CSD DPA (Hubs and Cores).

Opportunity 2B: Perennial veldtgrass (Ehrharta calycina) control	
Task 1: Yr 1 Herbicide Applications (2)	$ 135,593.00
Task 2: Yr 2 Herbicide Applications (2)	$ 109,483.40
Task 3: Yr 3 Herbicide Applications (2) and Monitoring	$ 83,157.80
Task 4: Reporting & Permitting	$ 15,400.00
Contingency 20% (inflation, unanticipated cost increases)	$ 68,726.84
Phase 1 Total	**$ 412,361.04**
Task 5: Yr 4 Herbicide Applications (2)	*$ 54,978.20*
Task 6: Yr 4 Seeding and Monitoring	*$ 14,427.80*
Task 7: Yr 5 Herbicide Application (2)	*$ 36,714.00*
Task 8: Yr 5 Seeding and Monitoring	*$ 14,427.80*
Project Total:	***$ 120,547.80***

Opportunity 2C: Rare plant species habitat enhancement

Objective 2C: Reduce non-native invasive plant cover to 1-5% cover class by year 3 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: Complete

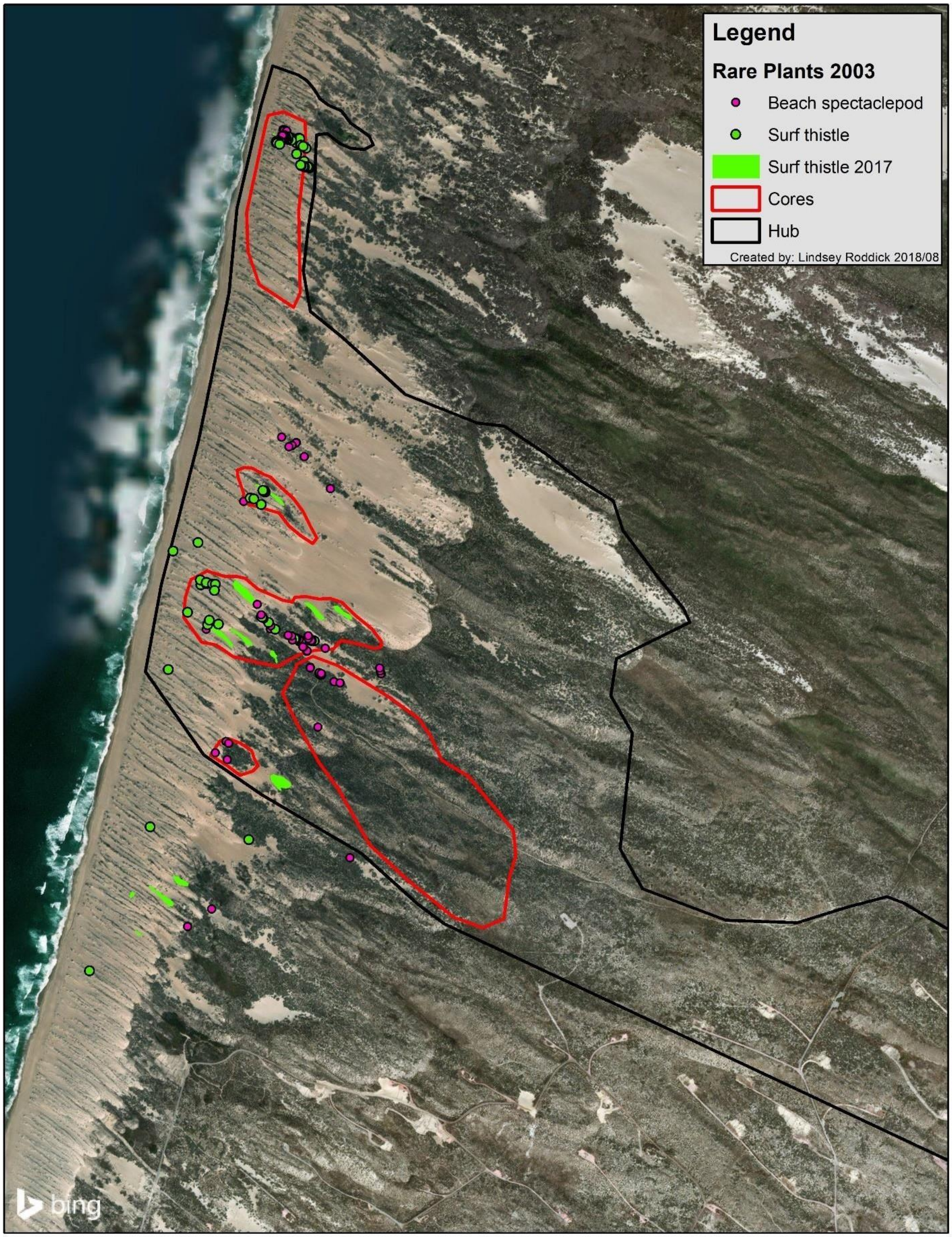


Figure 46: Surf thistle and Beach spectaclepod found in the NWR/CSD DPA.

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

Table 44: 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 45: 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 2C Cost Estimates:

Table 46: Cost Estimates for invasive plant control in the NWR/CSD DPA (Cores).

Opportuntiy 2C: Rare Plant Species Habitat Enhancement	
Task 1: Yr 1 Survey and Workplan	$ 11,847.76
Task 2: Yr 1 Herbicide Application	$102,416.61
Task 3: Yr 2 Herbicide Application and Monitoring	$ 75,441.13
Task 4: Yr 3 Herbicide Application and Monitoring	$ 54,986.13
Task 5: Reporting & Permitting	$ 7,700.00
Contingency 20% (inflation, unanticipated cost increases)	$ 50,478.32
Phase 1 Total	**$302,869.94**
Task 6: Yr 4 Herbicide Application and Monitoring	*$ 34,272.63*
Task 7: Yr 5 Herbicide Application and Monitoring	*$ 34,272.63*
Phase 2 Total	***$ 68,545.25***

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

Objective 2D: Reduce infestation of *Senecio elegans* to 1-5% cover class with no range expansion within the NWR/CSD DPA by year 3.

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: Complete – identified as “dark green” polygons in Figure 47.

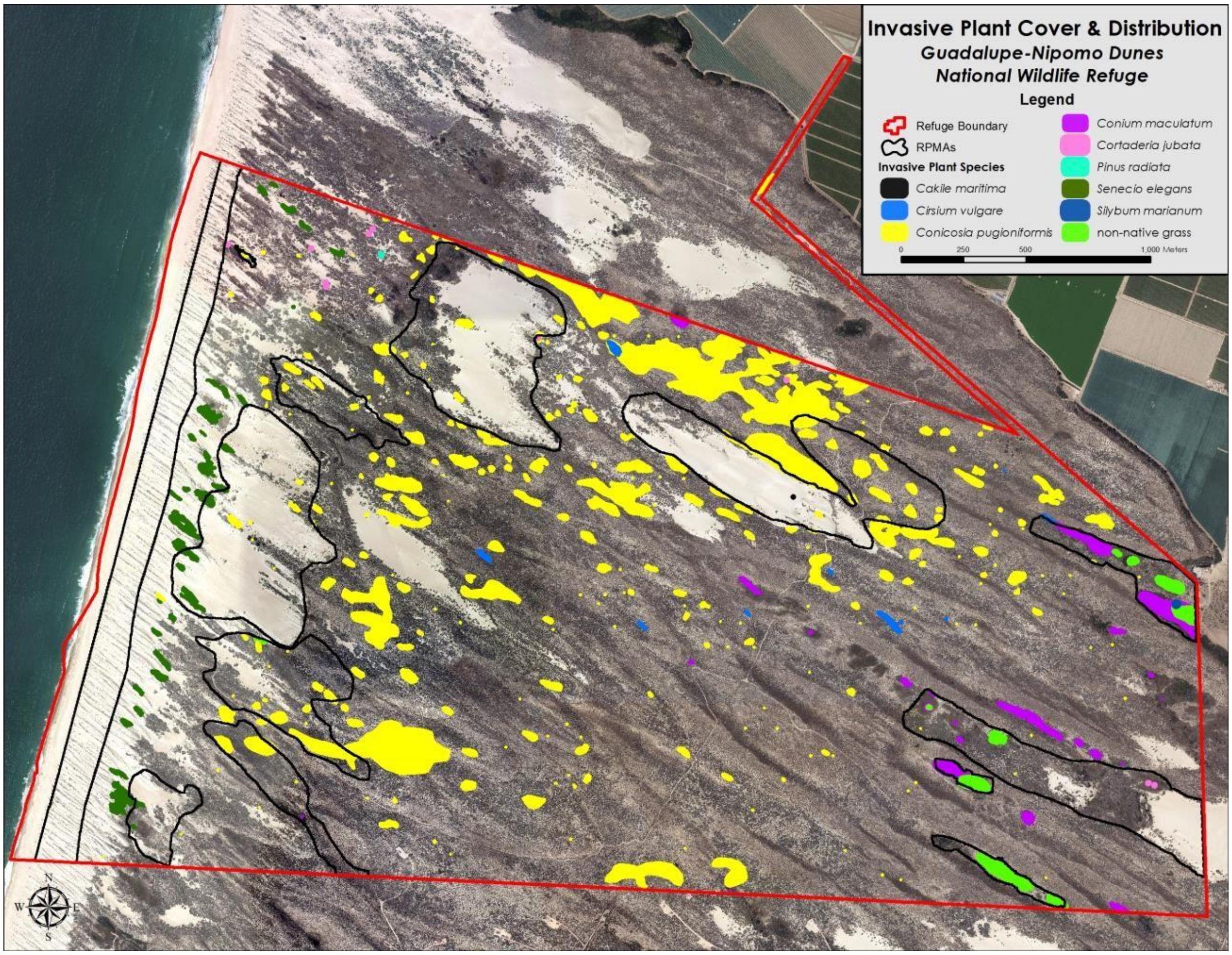


Figure 47: Map of invasive plant cover and distribution documented during February 2016 GNDNWR aerial surveys.

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 47: 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															
			Annual Herb -- Life cycle:	Fruit					Active growth		Flower				Fruit
Purple ragwort (*Senecio elegans*)	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 Cost Estimates:

Table 48: Cost Estimates for control of purple ragwort.

Opportunitiy 2D: Purple ragwort (Senecio elegans) Control	
Task 1: Yr 1 Herbicide Application and Baseline Survey	$ 9,765.05
Task 2: Yr 2 Herbicide Application	$ 8,975.05
Task 3: Yr 3 Herbicide Application and Monitoring	$ 8,975.05
Task 4: Reporting & Permitting	$ 7,700.00
Contingency 20% (inflation, unanticipated cost increases)	$ 7,083.03
Phase 1 Total	**$ 42,498.16**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 4,747.09*
Task 6: Yr 5 Herbicide Application, and Monitoring	*$ 4,691.96*
Phase 2 Total	***$ 9,439.05***

Opportunity 2E: Feral Pig control

Objective 2E: Reduce feral pig populations by 90% annually on the entire GNDNWR for 3 yrs. Assess removal interval after year three.

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

Opportunity 2E Cost Estimates:

Table 49: Cost Estimates for feral pig control.

Opportunitiy 2E: Feral Pigs (Sus scrofa) Eradication:		
Task 1: Yr 1 Aerial Feral Pig Eradication	$	16,020.00
Task 2: Yr 2 Aerial Feral Pig Eradication	$	16,020.00
Task 3: Yr 3 Aerial Feral Pig Eradication	$	11,020.00
Task 4: Reporting & Permitting	$	4,090.00
Contingency 20% (inflation, unanticipated cost increases)	$	9,430.00
Phase 1 Total	**$**	**56,580.00**
Task 5: Yr 4 Aerial Feral Pig Eradication	*$*	*11,020.00*
Task 6: Yr 5 Aerial Feral Pig Eradication	*$*	*11,020.00*
Phase 2 Total	***$***	***22,040.00***

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 50: 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 51: 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 European beachgrass cover to 1-5% cover class by year 3 in the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of *European beachgrass* maintained at a 1-5% cover class value throughout the

NWR/CSD DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 European beachgrass cover to 1-5% cover class by year 3 in the NWR/CSD DPA (Hub & Core) to improve nesting habitat for Western snowy plover.**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of European beachgrass maintained at a 1-5% cover class value throughout the NWR/CSD DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 by year three within a previously fenced buffer around Myrtle Pond.**

Performance monitoring will occur in Years 1 and 3 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 by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 iceplant cover to 1-5% cover class by year 3 in the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of iceplant (*Carpobrotus* spp.) maintained at a 1-5% cover class value throughout the NWR/CSD DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 perennial veldtgrass cover to 1-5% cover class by year 3 in the NWR/CSD DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the

NWRCSD DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 non-native invasive plant cover to 1-5% cover class by year 3 within the Core areas of the NWR/CSD DPA to enhance habitat for surf thistle and beach spectaclepod.**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of invasive plant cover maintained at a 1-5% cover class value throughout the NWRCSD DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 infestation of *purple ragwort* to 1-5% cover class with no range expansion within the NWR/CSD DPA by year 3.**

Performance monitoring will occur in Years 1 and 3 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 by Year 3. This is considered the "knock down"

Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 feral pig populations by 90% annually on the entire GNDNWR for 3 yrs. 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. In Years 1 and 3 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 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.

Monitoring Cost Estimates:

Monitoring cost estimates are based on performance monitoring for Priority 1 Opportunities, releve monitoring, and reporting.

Table 52: Performance Monitoring cost estimates for the NWR/CSD DPA.

MWRCSD DPA Monitoring	
Task 1: Yr 1 Grid Monitoring	$ 6,511.60
Task 2: Yr 1 Releve Monitoring	$ 8,256.20
Task 3: Yr 3 Grid Monitoring	$ 12,013.20
Task 4: Yr 3 Releve Monitoring	$ 8,256.20
Task 5: Final Reporting	$ 5,670.00
Contingency 20% (inflation, unanticipated cost increases)	$ 8,141.44
Phase 1 Total	**$ 48,848.64**
Task 6: Yr 5 Grid Monitoring	*$ 6,511.60*
Task 7: Yr 5 Releve Monitoring	*$ 8,256.20*
Phase 2 Total	***$ 14,767.80***

Rancho Guadalupe

Site Description

Rancho Guadalupe Dune Protected Area is located within the boundaries of the Rancho Guadalupe Dunes Preserve. It is bordered by the Santa Maria Estuary to the north and private agricultural land to the south. Santa Barbara County Parks oversees the management of this park which has been focused on visitor services and management of the parking lot in the foredunes. Gordon Sand Company leases a bordering property and has access to the open sand through a sand road within the boundaries of this DPA.

Rancho Guadalupe Dune Protected Area was selected as a DPA because of its unique assemblage of plant species, typical of the southern region of the GNDC. The coastal foredunes are a popular breeding area for western snowy plovers and CNPS listed rare plants such as dandelion (*Malocothrix incana*) and crisp monardella (*Monardella undulata* ssp *crispa*). The coastal dune scrub habitat within this DPA is relatively intact with a low invasion of perennial veldtgrass. Small depressions in the coastal dune scrub are home to an occurrence of La Graciosa thistle, a federally endangered species last seen in 2015. Surf thistle (*Cirsium rhothophilum*), a California state threatened species can also be found in this DPA.

Not much is known about the faunal species inhabiting this region, but it is an important corridor for large mammals. This DPA connects protected regions to the south, like Vandenberg Air Force Base, to important food and water sources of the Santa Maria River. Mountain lions, bobcats and black bears have been spotted periodically in this region. It is also a popular birding site as many birds use and breed near the Santa Maria River.

Figure 48: Coastal dune scrub in the Rancho Guadalupe DPA.

Management challenges in this DPA include

neighboring private property with different management priorities. The leased access road of the

Gordan Sand Company runs directly through a population of surf thistle. The neighboring property is highly invaded by perennial veldtgrass (*Ehrharta calycina*) which is promoted for grazing cattle. This threat of invasive species is a constant management challenge. European searocket (*Cakile maritima*) is present throughout the foredune habitat, which is outcompeting native foredune plant species. Santa Barbara County Parks does not currently have funds for management of invasive species in their budget and resources are focused on maintenance of visitor services.

Management History

Management records for the Rancho Guadalupe Dunes Preserve are sparse and difficult to come by. The following is a synopsis of what we do know.

Santa Barbara County Parks has periodically performed manual removal of invasive plants since 2011. This has largely focused on iceplant (*Carpabrotus spp)*, European searocket and black mustard (*Brassica nigra*). Work was done by Santa Barbara County Parks staff and volunteers recruited by the Dunes Center. Invasive plant removal has focused on the foredunes north and south of the parking lot. Additionally, jubatagrass (*Cortaderia jubata*) was discovered and removed by park staff in 2011(Melissa Kelley, 2016 Snowy Plover monitoring report).

Herbicide spraying has been done by the Land Conservancy of San Luis Obispo County. In 2000 and 2001 a 10x10 foot patch of European beachgrass (*Ammophila arenaria)* was sprayed on the beach (Skinner, 2017). This was a relatively small area in the foredunes just south of the parking lot. 2017 surveys indicated no European beachgrass present, so this population is assumed to be eradicated. In addition, 33 acres of perennial veldtgrass received treatment in 2003. This was in an area known as the land management unit CNLM. The goal for this area was to eliminate a heavy infestation of perennial veldtgrass and prevent its spread into adjacent pristine habitats.

The target management objective was containment. The infestation level was noted at 2 – 25% coverage. Treatment involved an application with the herbicide Fusilade DX (fluazifop-p-butyl) during the months of January and February. A visual survey in September 2003 estimated that 95% of the perennial veldtgrass was eliminated in the areas treated (Skinner et al., 2003). Herbicide treatments do not appear to have persisted past 2003.

Habitat Closures:
Throughout the year, RGDP has vehicle access to a beach parking lot. The access is periodically closed along the 2-mile access road for SB County Parks to clear the road of sand. During the snowy plover nesting season (March 1st –September 27th) visitors are restricted to the 2-mile long access road, parking area, and the beach west of a symbolic fence line. County staff maintain a presence during open hours throughout the breeding season to deter trespassers in the nesting zones.

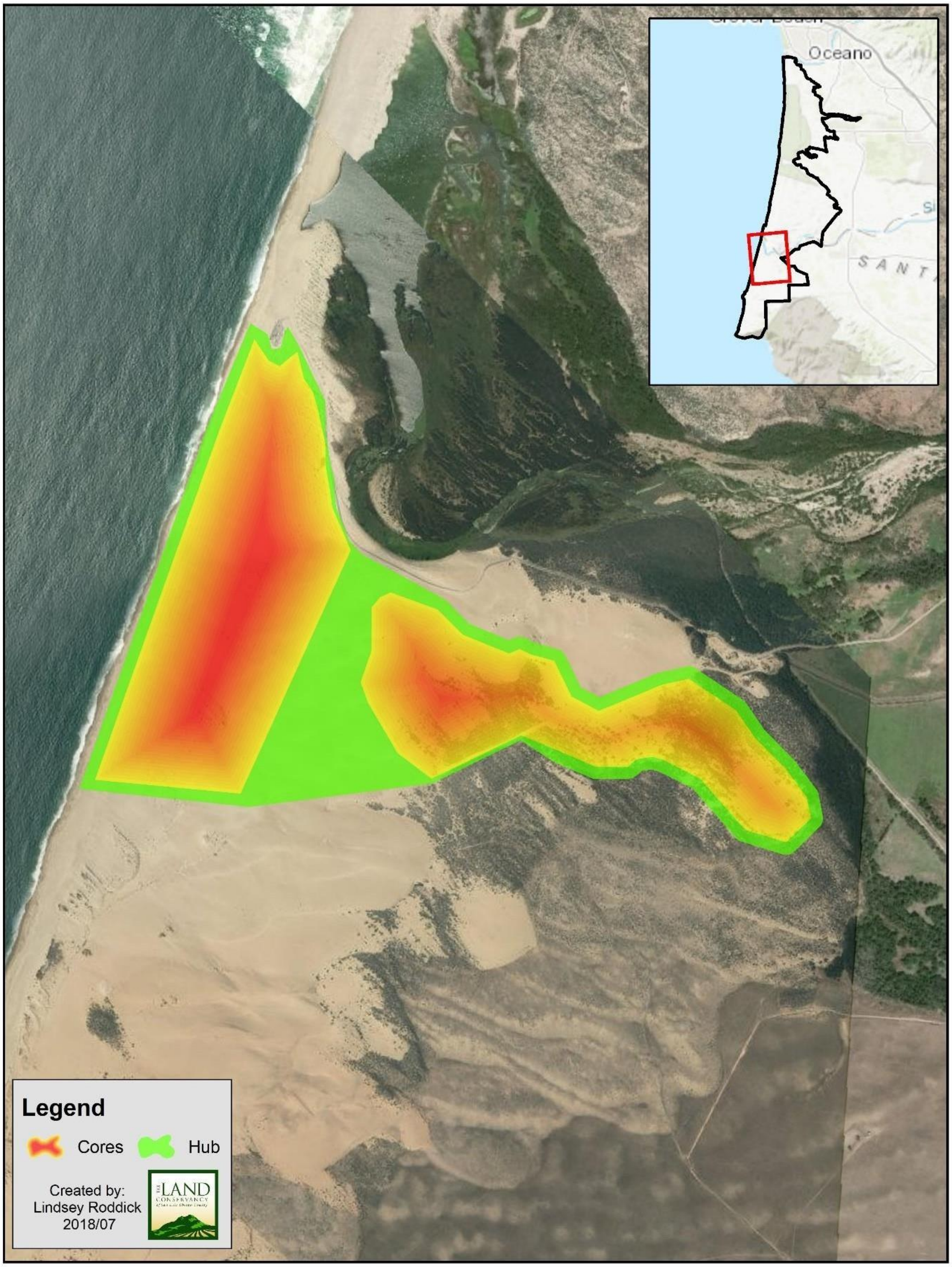


Figure 49: Boundary of the Rancho Guadalupe Dunes County Park DPA.

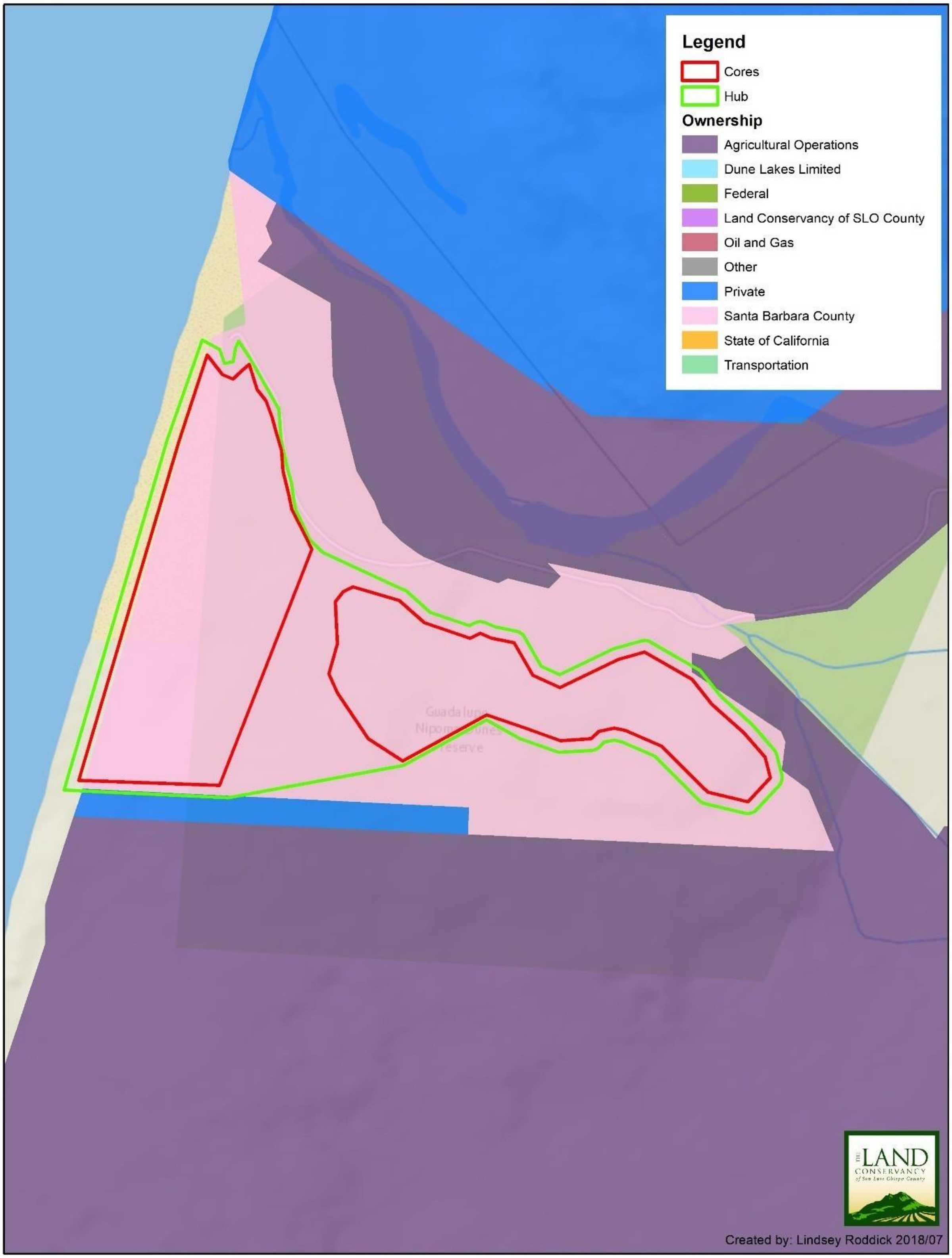


Figure 50: Property Ownership of the Rancho Guadalupe Dunes County Park DPA.

Site Assessment

The site assessment for the Rancho Guadalupe 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:

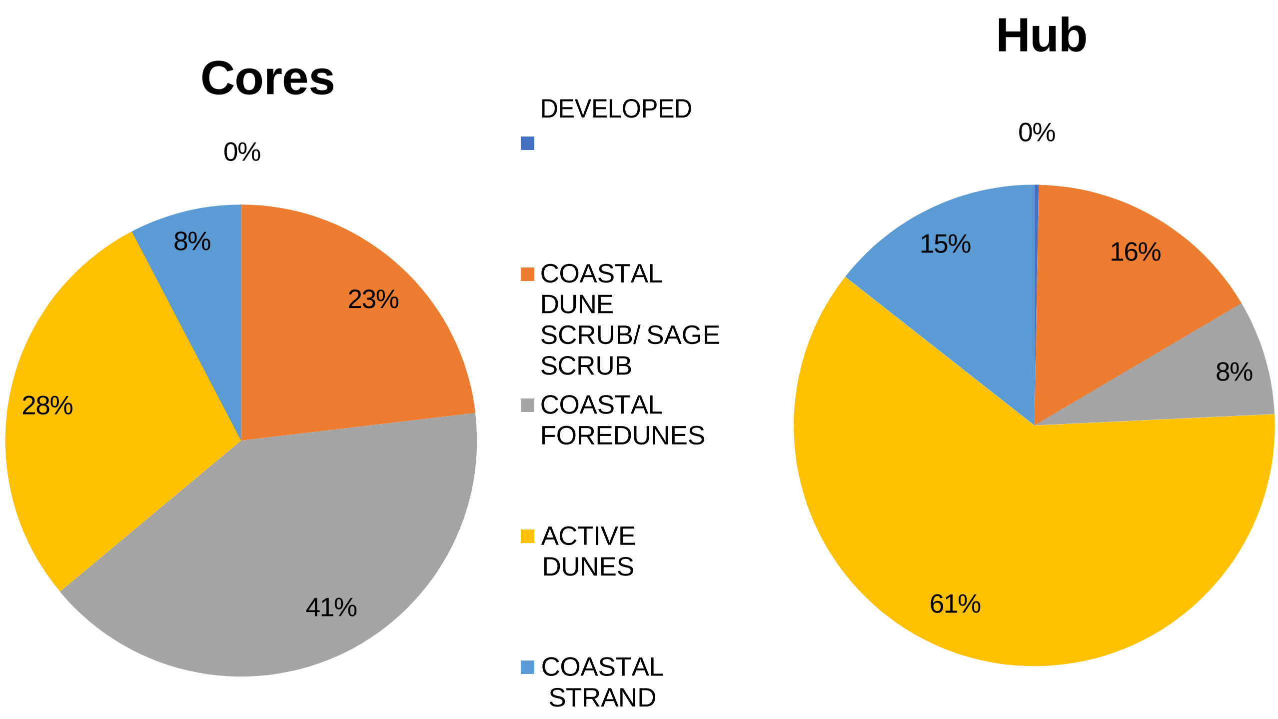
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the Rancho Guadalupe Dunes County Park DPA. Those species are included in the table below.

Table 53: Conservation Targets likely to occur at the Rancho Guadalupe DPA.

Bird Fine Filter Species	**Flora Fine Filter Species**
Bewick's Wren	*Cirsium rhothophilum* (surf thistle)
blue gray gnatcatcher	*Dithyrea maritima* (beach spectaclepod)
bushtit	*Erigeron blochmaniae* (Blochman's leafy Daisy)
California quail	*Erysimum suffrutescens* (suffrutescent wallflower)
California least tern	*Horkelia cuneata* ssp. *puberula* (Mesa horkelia)
California thrasher	*Malacothrix incana* (dunedelion)
California towhee	*Monardella undulata* ssp. *crispa* (dune mint)
killdeer	*Mucronea california* (California spineflower)
lesser goldfinch	*Senecio blochmaniae* (Blochman's groundsel)
loggerhead shrike	
mourning dove	
peregrine falcon	**Mammal Species**
redtailed hawk	*Canis latrans* (coyote)
spotted towhee	*Chaetodipus californicus* (California pocket mouse)
western snowy plover	*Didelphis virginiana* (Virginia opossum)
white-crowned sparrow	*Dipodomys heermanniarenae* (Lompoc kangaroo rat)
wrentit	*Felis* (or *Puma*) *concolor* (mountain lion)
	Lepus californicus (black-tailed jackrabbit)
Reptile & Amphibian Fine Filter Species	*Lynx rufus* (bobcat)
Unknown	*Mephitis mephitis* (striped skunk)
	Mustela frenata (long-tailed weasel)
	Neotoma macrotis (duskyfooted woodrat)
	Odocoileus hemionus (mule deer)
	Otospermophilus beecheyi (California ground squirrel)
	Peromyscus maniculatus (deer mouse)
	Procyon lotor (northern raccoon)
	Scapanus latimanus (broad-footed mole)
	Sylvilagus audubonii (desert cottontail)
	Urocyon cinereoargenteus (gray fox)
	Ursus americanus (American black bear)
*all conservation targets were selected solely on available habitat and not by occurences. Dated occurrence data was used in collection of rare plant conservation targets	

Habitats

The Rancho Guadalupe DPA (Hubs and Cores) is composed of the following habitat types:



Habitat	Core Acres	Core %	Hub Acres	Hub %
DEVELOPED	0.00	0.00%	0.29	0.29%
COASTAL DUNE SCRUB/ SAGE SCRUB	56.68	23.14%	16.48	16.23%
COASTAL FOREDUNES	99.96	40.80%	7.85	7.74%
ACTIVE DUNES	69.55	28.39%	62.26	61.34%
COASTAL STRAND	18.80	7.67%	14.62	14.41%
	244.98		**101.50**	

Figure 51: Types and Percent Cover of Habitats within the Rancho Guadalupe Dunes County Park DPA.

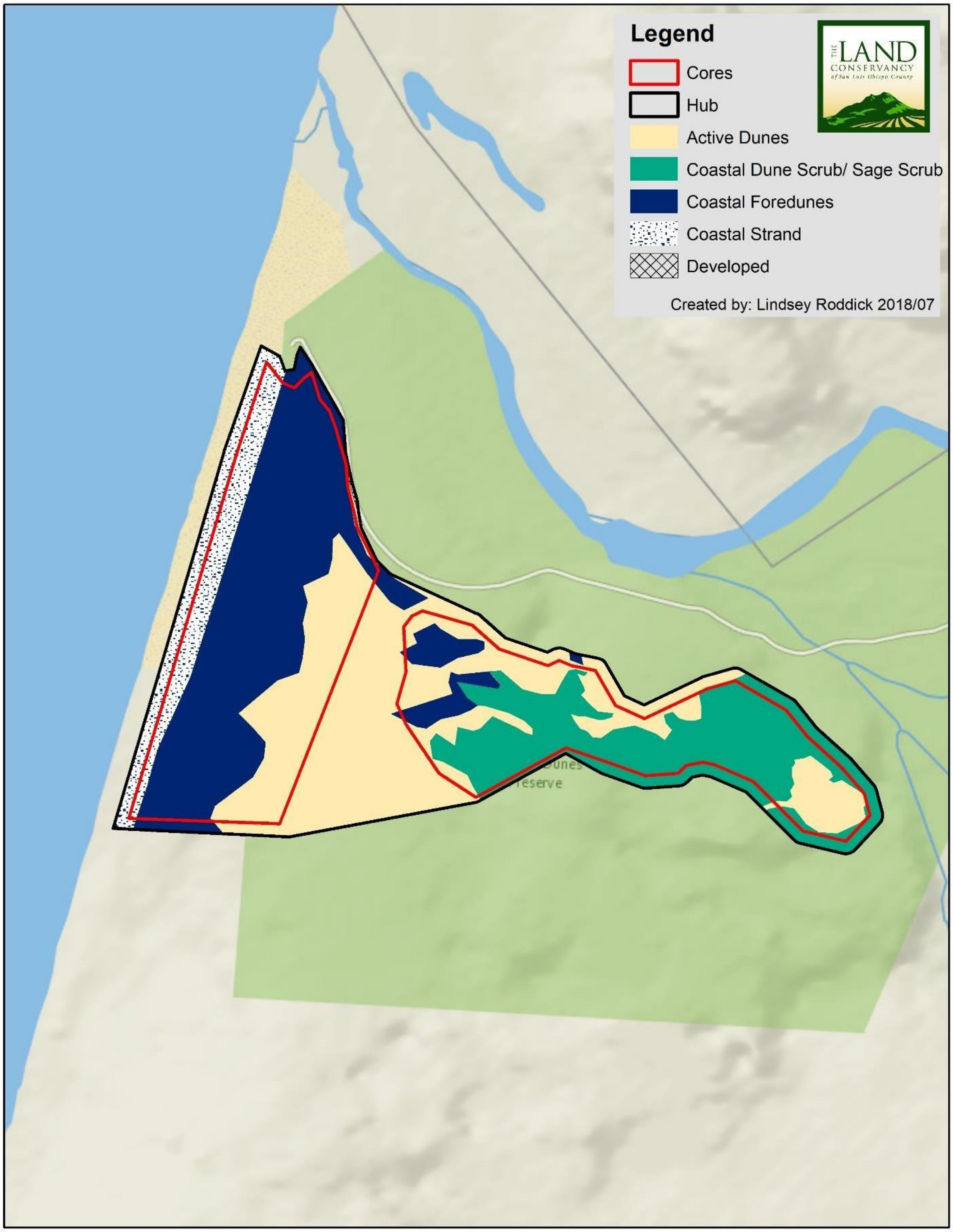


Figure 52: Habitat Types of the Rancho Guadalupe Dunes County Park DPA.

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 54.

Table 54: Species list for ground survey of Rancho Guadalupe Dunes County Parks.

Method	Species	Common Name	Family	Conservation Status	Cal-IPC Ranking
Documented Invasive Plants *Map Using a Grid System* *(6 Species)*	*Ammophila arenaria*	European beachgrass	Poaceae	*invasive plant*	High
	Cakile maritima	European sea rocket	Brassicaceae		Limited
	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	Fabacee		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- 36 Invasive Plants, 7 Special Status Native Plants & 1 Invasive Animal

Rancho Guadalupe Dunes County Park Ground Survey

The Rancho Guadalupe Dunes County Park survey was completed by field surveyors on foot using a $50m^2$ grid system to accurately map percent cover of the major invasive species and listed plant species. The $50m^2$ grid was selected as the appropriate size for ground evaluation because any larger would be difficult to see each entire grid while on the ground. When less prominent species on the list are encountered, polygons were made documenting number of individuals, current phenology and percent cover (Table 55 & 56). The survey data was collected using ArcGIS Collector application on an iPad/tablet. Percent cover and total net and gross acres for each invasive species was calculated. Certified Western Snowy Plover monitor, Tom

Applegate was contracted to execute the survey in nesting regions to insure no nests were harmed or disturbed.

Table 55: Attribute field information associated with polygon data recorded during the Rancho Guadalupe Dunes County Park 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

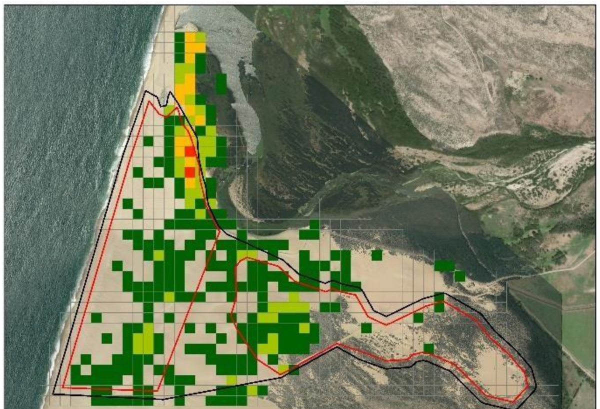
Table 56: Attribute field information associated with grid data recorded during the Rancho Guadalupe Dunes County Park aerial survey.

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%**.
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%**.
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).
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).
CAMA_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 CAMA_Cover x the Gross_Acres (Post-survey).

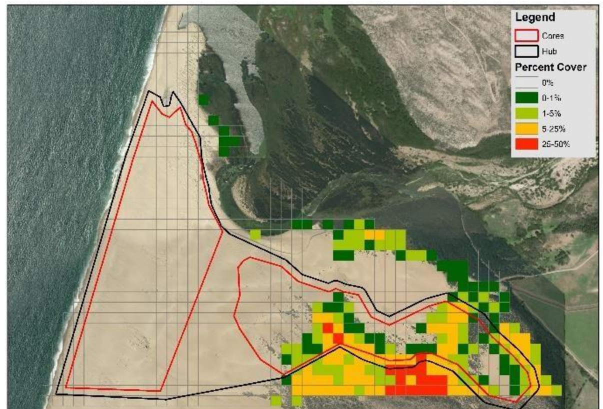
The survey began 5/8/2017 and was completed 8/3/2017 with twenty-five days in the field. Thirty-six invasive plant species, seven rare plant species and one nonnative animal were surveyed for throughout Rancho Guadalupe Dunes County Park. Invasive plant target species were selected by the Dunes Collaborative and informed by the Invasive Plant Inventory and Early Detection Prioritization Tool (Olsen & Hall, 2015). Some species were specified to be surveyed only within DPAs. DPAs had not been selected for this region so documentation of these species was completed for the entire survey area when possible. Santa Barbara County Parks requested adding European sea rocket to the grid mapping as it is prevalent throughout Rancho Guadalupe Dunes County Park and is a top management concern.

Native plant species La Graciosa thistle (*Cirsium scariosum* var. *loncholepis*), beach spectaclepod (*Dithyrea maritima*), surf thistle (*Cirsium rhothophilum)* which are known to occur in the park were added due to their special status. Federally endangered, Nipomo lupine (*Lupinus nipomensis*), Gambel's watercress (*Nasturtium gambelii*), Marsh sandwort (*Arenaria paludicola*) and Beach layia (*Layia carnosa*) were added to the survey list because of their known occurrences in similar coastal dune habitats near or in the GNDC. In addition to plants, feral pig evidence and habitat damage was also documented.

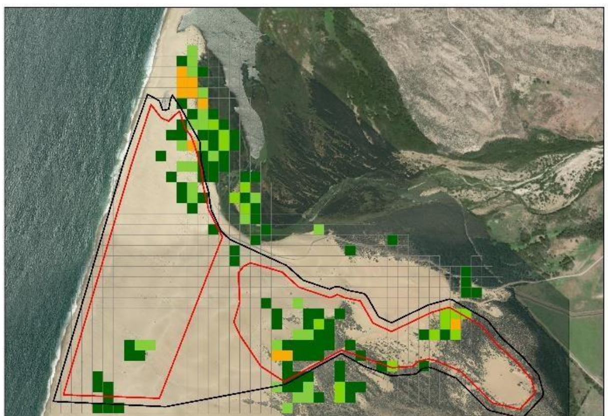
Results of the assessment are depicted in Figure 53.



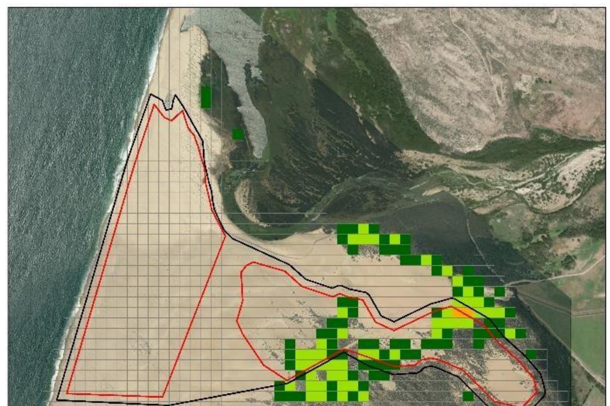
European searocket (*Cakile maritima*)



Perennial veldtgrass (*Ehrharta calycina*)



Iceplant (*Carpobrotus* spp.)



Narrow-leaved iceplant (*Conicosia pugioniformis*)

Figure 53: Distribution and abundance of four widespread invasive plants at the Ranch Guadalupe DPA.

Table 57: Acreage estimates for widespread invasive species within the Rancho Guadalupe DPA (Hubs & Cores).

	Cores		**Hub**	
Species Name	Net Acres	Gross Acres	Net Acres	Gross Acres
Carpobrotus chilensis	0.524	28.13	0.064	5.152
Carpobrotus edulis	0.146	8.76	0.0466	2.265
Conicosia pugioniformis	0.628	30.39	0.199	11.499
Ehrharta calycina	3.537	48.992	1.903	20.252
Cakile maritima	1.718	98.366	0.337	28.252

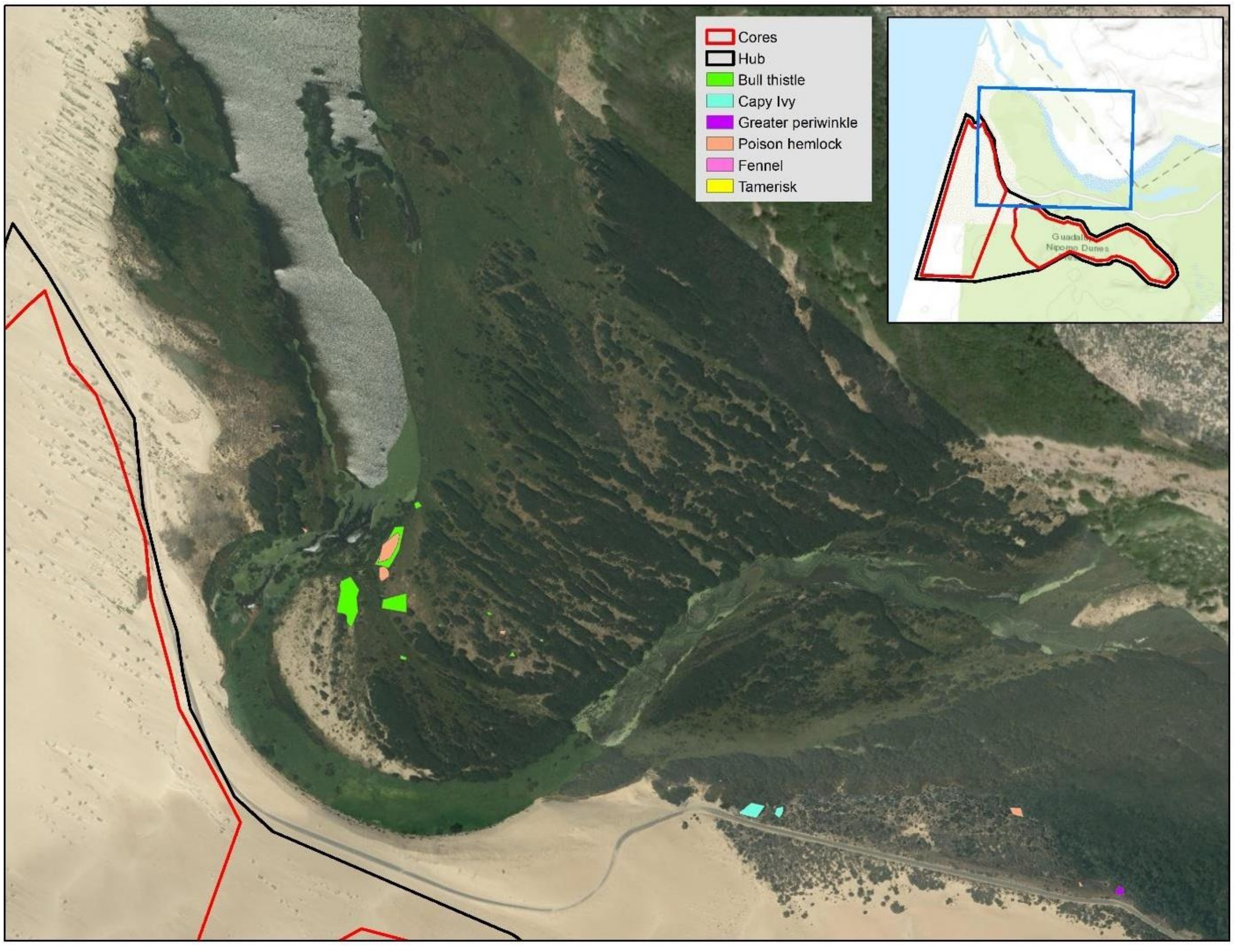


Figure 54: Polygon maps for invasive species found during the 2017 site assessment of Rancho Guadalupe Dunes Preserve.

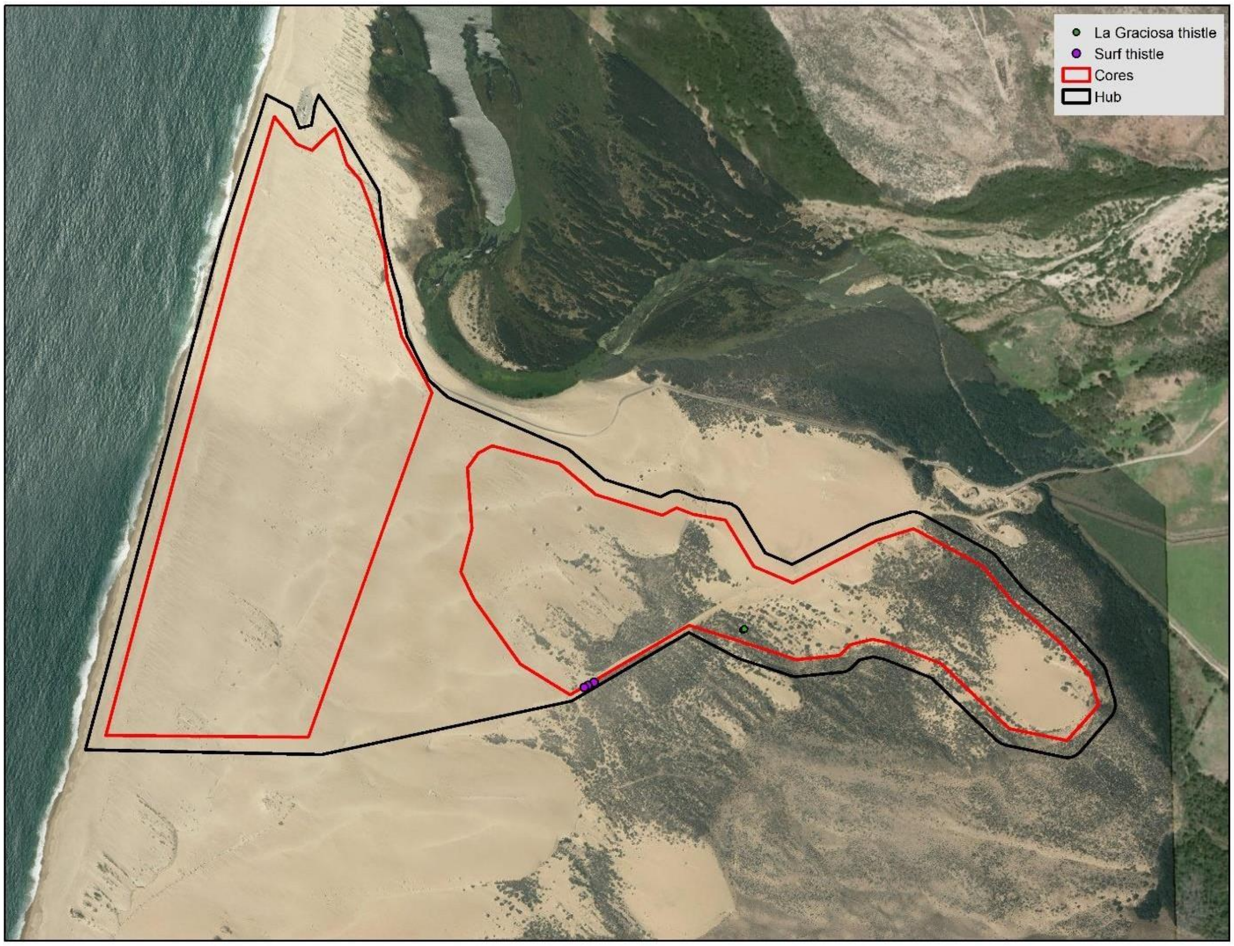


Figure 55: Rare plants found during the 2017 site assessment of Rancho Guadalupe Dunes Preserve.

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

Western snowy plover (*Charadrius nivosus nivosus*) habitat enhancement
The Pacific population of the Western snowy plover (WSP) is federally listed under the Endangered Species Act of 1973 as "threatened". Populations breed above the high tide line on coastal beaches, sand spits, dune backed beaches, and sparsely-vegetated dunes. They nest annually on the coastal strand and foredunes of this DPA. In 2017, sixty-one nests were discovered by Tom Applegate during an annual survey. Critical habitat in this area is considered recovery unit (5), San Luis Obispo to Ventura Counties, by US Fish and Wildlife Service. The primary cause of their decline is loss of habitat, poor reproductive success, resulting from human disturbance, predation, and inclement weather.

This combined with permanent or long-term loss of nesting habitat to encroachment of the non-native European beachgrass has led to a decline in active nesting, as well as an overall decline in the breeding and wintering populations of WSP along the pacific coast (U.S. Fish and Wildlife Service, 1993). The WSP Recovery Plan lists encroachment of European beachgrass as one of the most significant causes of habitat loss for coastal breeding WSP (U.S. Fish and Wildlife Service, 2007). In addition to loss of nesting habitat, introduced beachgrass may adversely affect WSP food sources by depressing the diversity and abundance of sand-burrowing arthropods. Other non-native species, such as Iceplant have also been noted as reducing WSP breeding and foraging habitat.

This DPA is one of the few places in the GNDC that has healthy foredunes lacking invasion from European beachgrass. Recovery goals for WSP include conducting intensive ongoing management for the species and its habitat and developing mechanisms to ensure management in perpetuity. Habitat enhancement opportunities exist by early detection and rapid response protocols for beachgrass. Control of existing invaders like iceplant will also have beneficial impacts on WSP.

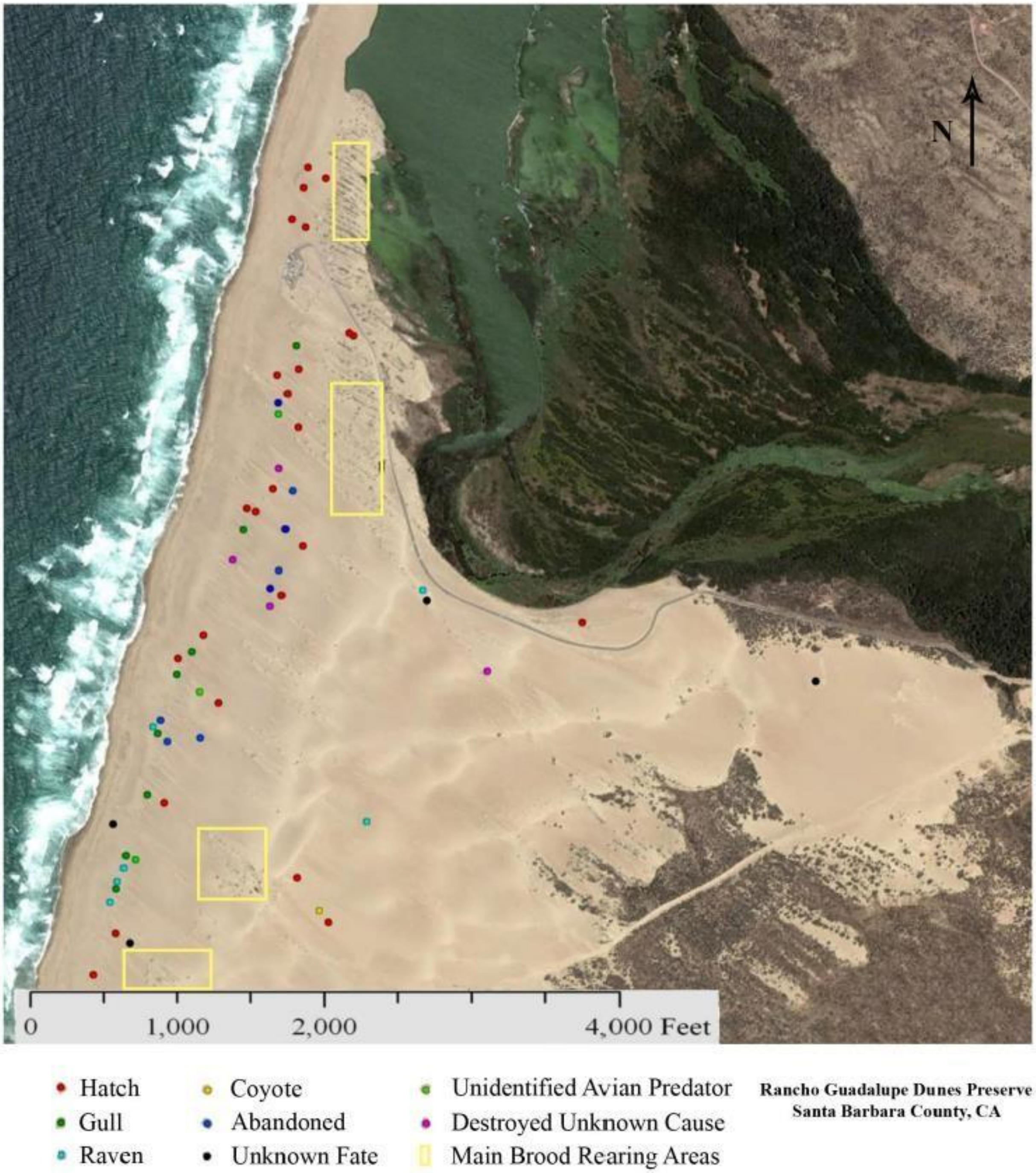


Figure 56: Snowy plover nest locations and fates during the 2017 breeding season. Image courtesy of Tom Applegate, Wildwing Consulting.

California least tern (*Sterna antillarum brownie*) habitat enhancement

CA least tern are the smallest North American tern, nesting on open sand, sand-shell beaches, and sand-fill sites where little vegetation exists. Breeding colonies are typically located within close proximity to waterways where birds forage for small fish. CA least tern is federally listed as “endangered”. It has historically nested on the Rancho Guadalupe Dunes Preserve (RGDP). They have been documented nesting at this site as recently as 2018 (Applegate, 2018). The potential for large breeding colonies exists on RGDP, and ways to improve nesting conditions and habitat should be considered when developing management plans for the area. Current threats to nesting habitat for Terns and WSP are the exotic plants sea rocket and iceplant.

Priority 2 Opportunity

Highway Iceplant (*Carpobrotus edulis*) and Sea fig (*Carpobrotus chilensis*) control
Both species of iceplant create a dense mat on the surface of the ground, displacing native plant and animal species. They are also known to lower soil pH and influence nutrient dynamics. C. edulis is ranked as “high” by the California Invasive Plant Council (Cal-IPC). Species ranked “High” have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. While C. chilensis is ranked “Moderate” by Cal-IPC. Plants ranked “Moderate” are species that have a substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetative structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent on ecological disturbance. Sea fig has been naturalized longer, introduced during the pre- Spanish settlement of CA, and in general is considered less invasive because it produces less seeds and expands less rapidly. However, the two iceplants are known to hybridize making it difficult to distinguish the two species in terms of impacts and management. Both species are present throughout the DPA. It was ranked as a Priority 2 Opportunity because of the potential impacts to nesting snowy plover habitat and high probability for success due to the short-lived seedbank (< 3 yrs.). Successful control has included both mechanical and chemical control.

European Searocket (*Cakile maritima*) control
European searocket covers much of the foredune habitat in this DPA at a low percent cover. It is ranked by the California Invasive Plant Council as “limited”. These species are invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology results in low to moderate rates of invasiveness, but they can become locally problematic. At the Rancho Guadalupe DPA, European searocket has led to a reduction in native foredune plant species, especially Abronia ssp. and Dundelion (Malacothrix incana). Fruits are adapted for both long and short distance dispersal by wind and water and can establish very quickly. European searocket is considered an annual but can be biennial. Control can be successful with hand pulling as well as chemical control. It is listed as a priority because it is moderately invasive and occupies habitat suitable for nesting by CA least tern and WSP. Given its dispersal mechanism, it is unlikely that eradication

would ever be possible. Work on this plant should be considered a long-term management strategy.

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. Perennial veldtgrass is a perennial grass which releases hundreds to thousands of seed creating extensive seedbanks.

Inland, coastal dune scrub habitats within this DPA have relatively low percent cover of perennial veldtgrass (approximately 5-25% on average) but is bordered by well established, larger patches to the south. 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.

La graciosa thistle habitat enhancement

This short-lived perennial thistle is listed as threatened by the state of California and also listed as endangered under the federal Endangered Species Act. It grows in riparian habitat and around seeps, swales or marshes. It was last found within the boundaries of this DPA in 2015. Occurrences were revisited in 2017 with no findings. Protection of seeps and small swales from invasive species would allow better habitat for this species.

Surf thistle habitat enhancement:

Surf thistle is a perennial thistle listed as threatened by the state of California. Its range is limited to the coastal dunes in San Luis Obispo and Santa Barbara Counties. Plants were found along the sand road within the boundaries of this DPA in 2017. Individuals are in danger of being trampled, as the road is actively used to collect sand for Gordan Sand Mill. Surveying for these individuals should continue and protective fencing around the individuals would provide protection from traffic on the road.

Priority 3 Opportunities

Feral Pigs (Sus scrofa) control:
Evidence of feral pigs were reported in a 2017 invasive species survey conducted by LCSLO. Feral pig foraging activities can result in serious disturbance of soils and associated plants and animals. Fencing around sensitive areas provides a short-term solution but trapping and shooting is the most effective method of removal. Feral pig control was put in Priority 3 because the probability of success is considered low. Feral pigs come into this DPA through private property along the Santa Maria Estuary and neighboring Corralitos Ranch. With an unknown source population and no evidence of control by these neighbors, the actual success of trapping and shooting pigs is questionable.

Management Objectives, Actions, Method, Timeline and Budgets

Priority 1 Opportunities

Opportunity 1A: Western snowy plover (*Charadrius nivosus nivosus*) habitat enhancement

Objective 1A: Reduce invasive species cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA Core closest to the ocean, i.e. the foredunes.

Action 1A.1: Do baseline survey of dominant invasive species cover classes throughout the Rancho Guadalupe 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: Complete

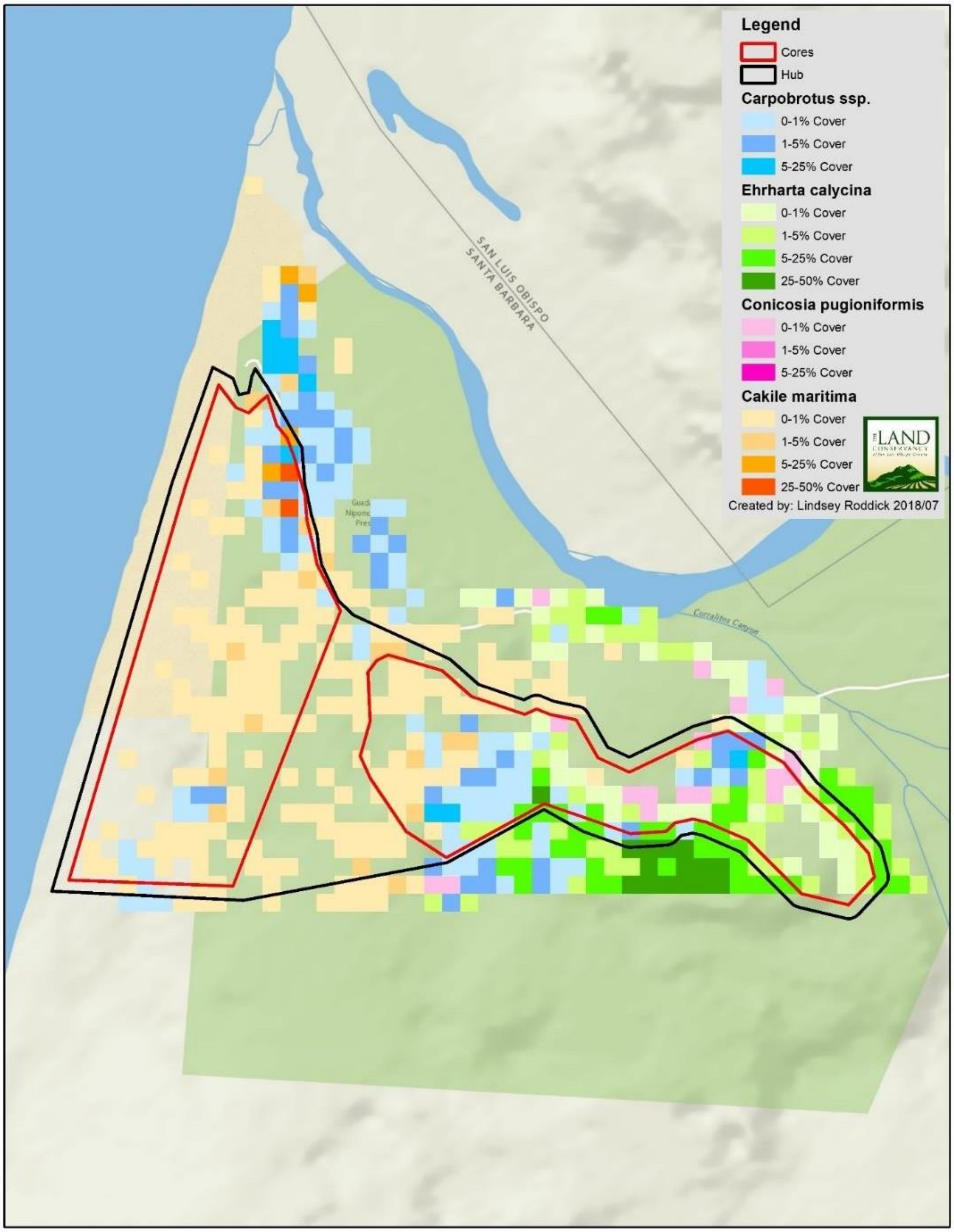


Figure 57: 50-meter grid baseline survey of dominant weed cover in the Rancho Guadalupe DPA.

Action 1A2. Control invasive species in the core area closest to the foredunes. Species present include both European searocket and iceplant.

Table 58: Invasive species infestation acreage in foredune core of Rancho Guadalupe DPA.

Species Name	Net acres	Gross acres
Cakile maritima	1.512	65.526
Carpobrotus chilensis	0.282	16.868

Methods:

European searocket is so well established in coastal California that its control may not be possible or appropriate. There are two types of seeds, one type floats and is water dispersed coming in from the ocean. The other type drops near the parent plant and is wind dispersed. If control is undertaken, care should be taken to assess carefully whether it is truly having an impact on native taxa.

Manual removal is effective but must be done every couple of months during the rainy season when plants are germinating. Plants should be buried or removed from the site to ensure they do not re-root after being pulled.

Chemical spot treatments with glyphosate containing herbicide is also effective. Chemical control should happen before plants begin to develop fruits. This should be considered a long-term maintenance activity. Control may only be necessary in years when the population gets above 1-5% cover class threshold levels.

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 are 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 gets 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 other invasive species don't replace the iceplant. This plant grows in dense mats having more of an impact than European searocket. In addition, the likelihood of reintroduction is lower than searocket, making it possible to practically eliminate this plant from the DPA with periodic long-term follow-up to maintain iceplant free areas.
A logical outcome for this objective would be 0-1% cover of iceplant and 1-5% cover of European searocket.

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 5, monitoring and removal can be reduced to every other year.

Table 59: Seasonal treatment strategies for iceplant and European searocket.

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											
ANNUALS															
European searocket (*Cakile maritima*)		Annual Herb -- Life cycle:		Active growth		Flower					Fruit				
	Manual	before seeding	2+ Years	Hand pull plants or cut just below soil surface with "hula hoe" or other similar implement. Must be repeated.											
	Chemical	apply to actively growing plants before seed set	2+ Years	Glyphosate 2% v/v solution spot application											

Opportunity 1A Cost Estimates:

Table 60: Cost Estimates for ground application component.

Opportuntiy 1A: Western snowy plover (Charadrius nivosus nivosus) habitat enhancement	
Task 1: Yr 1 Herbicide Application	$ 21,358.80
Task 2: Yr 2 Herbicide Application	$ 12,607.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 7,528.50
Task 4: Regulatory Reporting & Permitting	$ 5,020.00
Contingency 20% (inflation, unanticipated cost increases)	$ 9,302.86
Phase 1 Total	**$ 55,817.16**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 7,528.50*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 7,528.50*
Phase 2 total	***$ 15,057.00***

Opportunity 1B: California least tern habitat enhancement
Objective 1B: Reduce invasive species cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA Core closest to the ocean, i.e. the foredunes.
*NOTE: See Opportunity 1A for Actions, Methods, Schedule, and Cost Estimates.

Priority 2 Opportunities

Opportunity 2A: Highway Iceplant (C. edulis) and Sea fig (C. chilensis) control
Objective 2A: Reduce iceplant cover to 0-1% cover class by year 3 in the RG DPA (Hub & Core).

Action 2A.1: Do baseline survey of C*arpobrotus* spp. cover classes throughout the RG 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: Complete

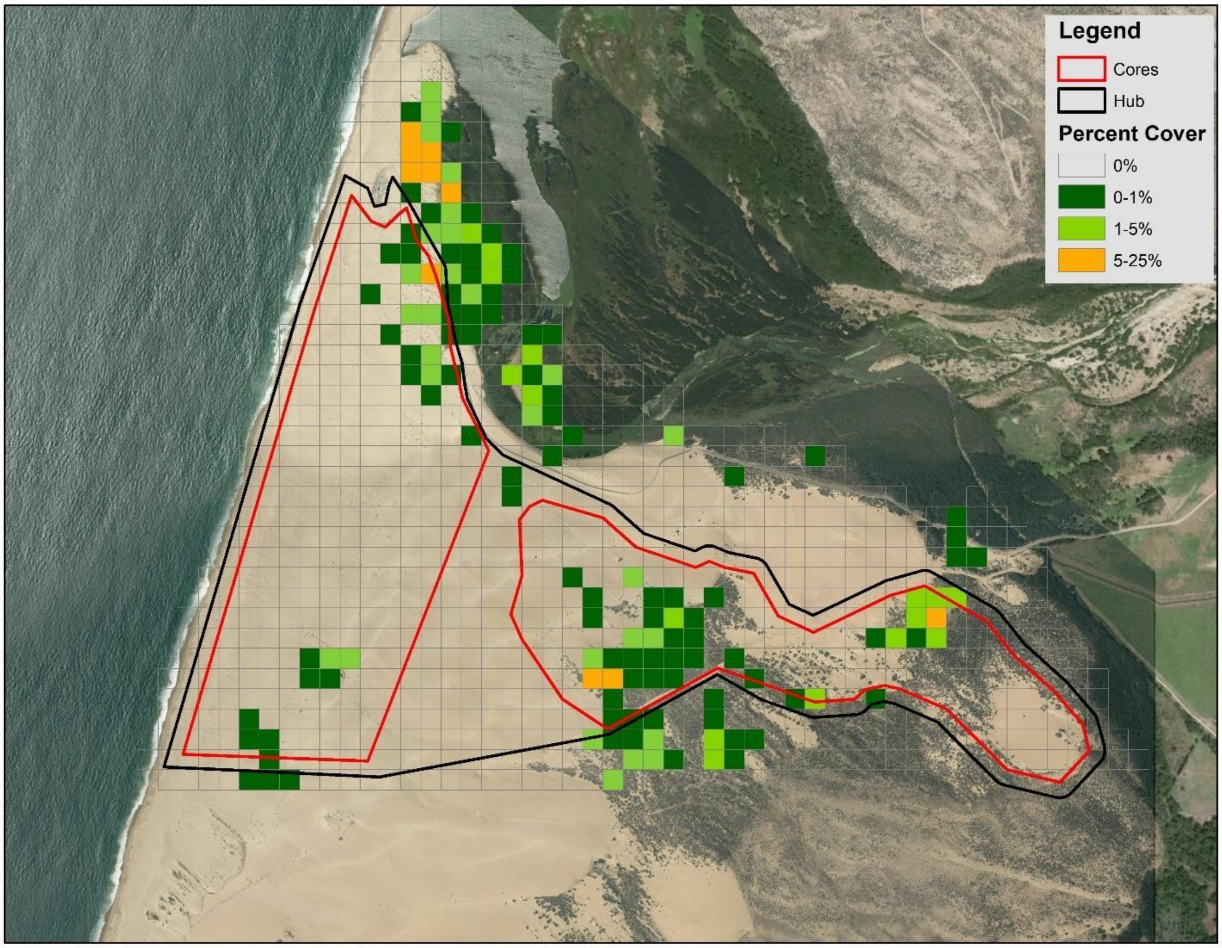


Figure 58: Distribution and abundance of iceplant mapped in 2017 within the Rancho Guadalupe DPA (Hubs and Cores).

Action 2A.2: Reduce iceplant % cover to 0-1% throughout the Rancho Guadalupe DPA.

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 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. 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.

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 5 monitoring and removal can be reduced to every other year.

Table 61: Seasonal treatment strategies for controlling 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															
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 2A Cost Estimates:

Table 62: Cost Estimates for controlling iceplant in Ranch Guadalupe DPA (3 years).

Opportunitiy 2A: Highway Iceplant (Carpobrotus edulis) and Sea fig (Carpobrotus chilensis) control	
Task 1: Yr 1 Herbicide Application	$ 17,905.00
Task 2: Yr 2 Herbicide Application	$ 14,150.50
Task 3: Yr 3 Herbicide Application and Monitoring	$ 6,948.50
Task 4: Regulatory Reporting & Permitting	$ 6,920.00
Contingency 20% (inflation, unanticipated cost increases)	$ 9,184.80
Phase 1 Total	**$ 55,108.80**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 7,170.00*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 6,686.00*
Phase 2 Total	***$ 13,856.00***

Opportunity 2B: European searocket control

Objective 2B: Reduce European searocket cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA (Hubs & Core).

Action 2B.1: Do baseline survey of European searocket cover classes throughout the Rancho Guadalupe 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: Complete

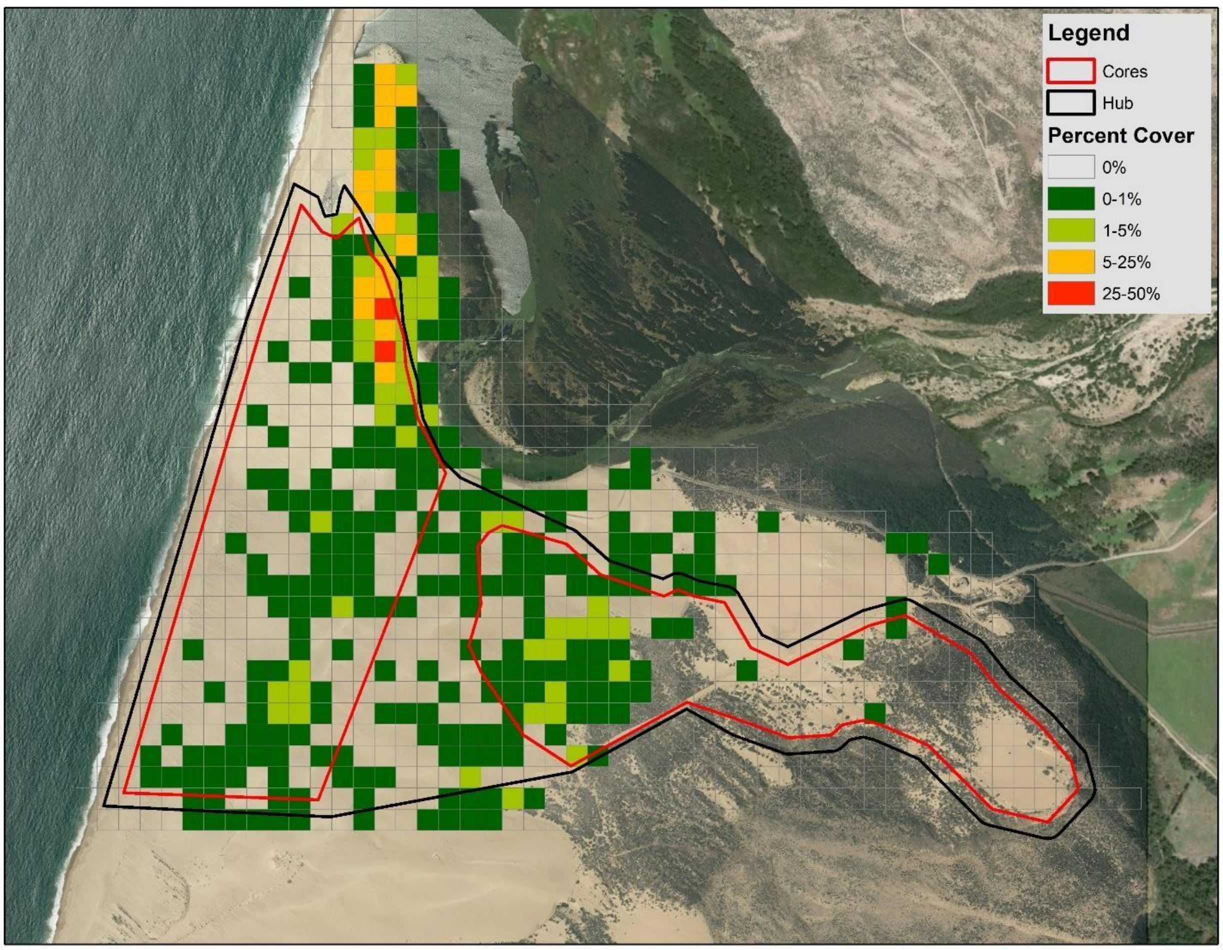


Figure 59: Distribution and abundance of European searocket mapped in 2017 within the Rancho Guadalupe DPA (Hubs and Cores).

Action 2B.2: Control *European searocket* throughout the Rancho Guadalupe DPA (126.62 acres gross, 2.055 acres net).

Methods:
European searocket is so well established in coastal California that its control may not be possible or appropriate. There are two types of seeds, one type floats and is water dispersed coming in from the ocean. The other type drops near the parent plant and is wind dispersed. If control is undertaken, care should be taken to assess carefully whether it is truly having an impact on native taxa.

Manual removal is effective but must be done every couple of months during the rainy season when plants are germinating. Plants should be buried or removed from the site to ensure they do not re-root after being pulled.

Chemical spot treatments with glyphosate containing herbicide is also effective. Chemical control should happen before plants begin to develop fruits. This should be considered a long-term maintenance activity. Control may only be necessary in years when the population gets above 1-5% cover class threshold levels. There is little information on the success of managing the seedbank of European searocket on a scale this large. With only anecdotal information available it is difficult to say what the probability of success would be.

Treatment Schedule:
Herbicide applications will occur once per year for three years, with follow-up monitoring and spot treatments in years 3-5. After year five monitoring and removal can be reduced to every other year. Treatment in the foredunes should occur outside Western snowy plover nesting season (March 1 – September 27th). Preferably in February to allow maximum germination from the seedbank before control. However, it is highly likely that more plants will germinate from the seedbank during nesting season and likely set seed before the end of September.

Table 63: Seasonal treatment strategies for controlling European searocket.

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
ANNUALS															
European searocket (*Cakile maritima*)			Annual Herb -- Life cycle:	Active growth			Flower					Fruit			
	Manual	before seeding	2+ Years	Hand pull plants or cut just below soil surface with "hula hoe" or other similar implement. Must be repeated.											
	Chemical	apply to actively growing plants before seed set	2+ Years	Glyphosate 2% v/v solution spot application											

Opportunity 2B Cost Estimates:

Table 64: Cost Estimates for controlling European searocket in RG DPA (3 years).

Opportunity 2B: European Searocket (Cakile maritima) control	
Task 1: Yr 1 Herbicide Application	$ 18,676.40
Task 2: Yr 2 Herbicide Application	$ 16,896.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 10,306.00
Task 4: Regulatory Reporting & Permitting	$ 5,020.00
Contingency 20% (inflation, unanticipated cost increases)	$ 10,179.68
Phase 1 Total	**$ 61,078.08**
Task 5: Yr 4 Herbicide Application and Monitoring	*$ 10,044.00*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 5,855.00*
Phase 2 Total	***$ 15,899.00***

Opportunity 2C: Perennial veldtgrass control:

Objective 2C: Reduce perennial veldtgrass cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA (Hub & Core).

Action 2C.1: Do baseline survey of perennial veldtgrass cover classes throughout the Rancho Guadalupe 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: Complete

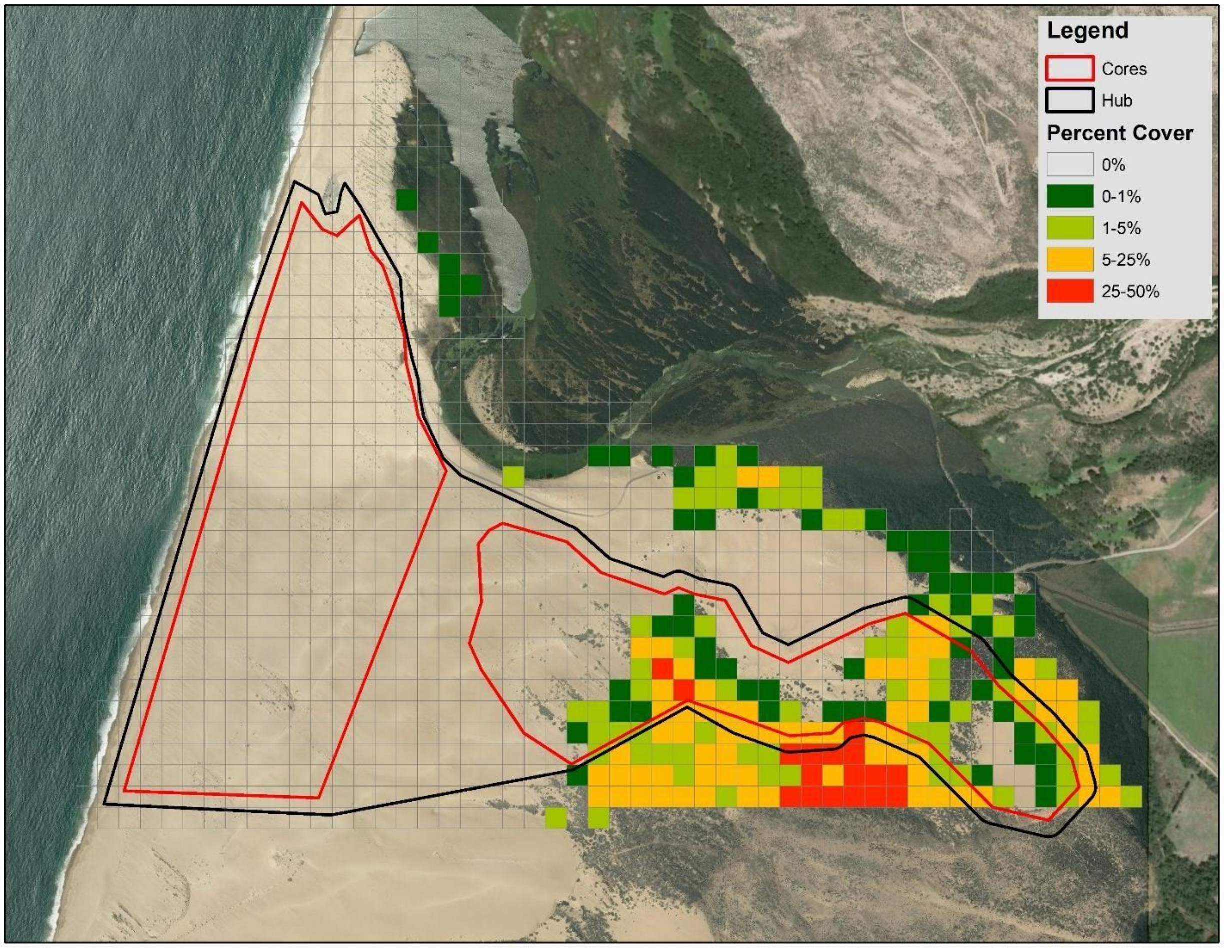
A map 

Figure 60: Distribution and abundance of perennial veldtgrass mapped in 2017 within the Rancho Guadalupe DPA (Hubs and Cores).

Action 2C.2: Control perennial veldtgrass within the Rancho Guadalupe DPA (Cores and Hub) (69.25 acres gross: 5.44 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 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 at the RG 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. 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 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 65: Seasonal treatment strategies for controlling 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 Cost Estimates:

Table 66: Cost Estimates for controlling perennial veldtgrass in the RG DPA (3 years).

Opportunitiy 2C: Perennial veldtgrass (Ehrharta calycina) control	
Task 1: Yr 1 Herbicide Application	$ 63,566.80
Task 2: Yr 2 Herbicide Application	$ 51,474.00
Task 3: Yr 3 Herbicide Application and Monitoring	$ 39,176.00
Task 4: Reporting & Permitting	$ 5,540.00
Contingency 20% (inflation, unanticipated cost increases)	$ 31,951.36
Phase 1 Total	**$191,708.16**
Task 5: Yr 4 Herbicide Application	*$ 37,936.00*
Task 6: Yr 4 Seeding and Monitoring	*$ 7,892.00*
Task 7: Yr 5 Herbicide Application and Monitoring	*$ 30,642.00*
Phase 2 Total	***$ 76,470.00***

Opportunity 2D: La Graciosa thistle habitat enhancement

Objective 2D: Identify and protect potential habitat for La Graciosa thistle within the Rancho Guadalupe DPA by Year 3.

Action 2D.1: Map mesic sites containing suitable habitat for La Graciosa thistle in the Rancho Guadalupe DPA.

Method:
Habitat mapping that has been done for this site is at a course scale that does not capture the mesic micro-habitats preferred by La Graciosa thistle (LGT). A ground survey should be conducted using GIS/GPS technology to identify and map mesic locations containing suitable habitat for La Graciosa thistle. This should occur in a "non-drought" year. Population surveys can occur at the same time. Particular attention should be paid to known historical occurrences of LGT.

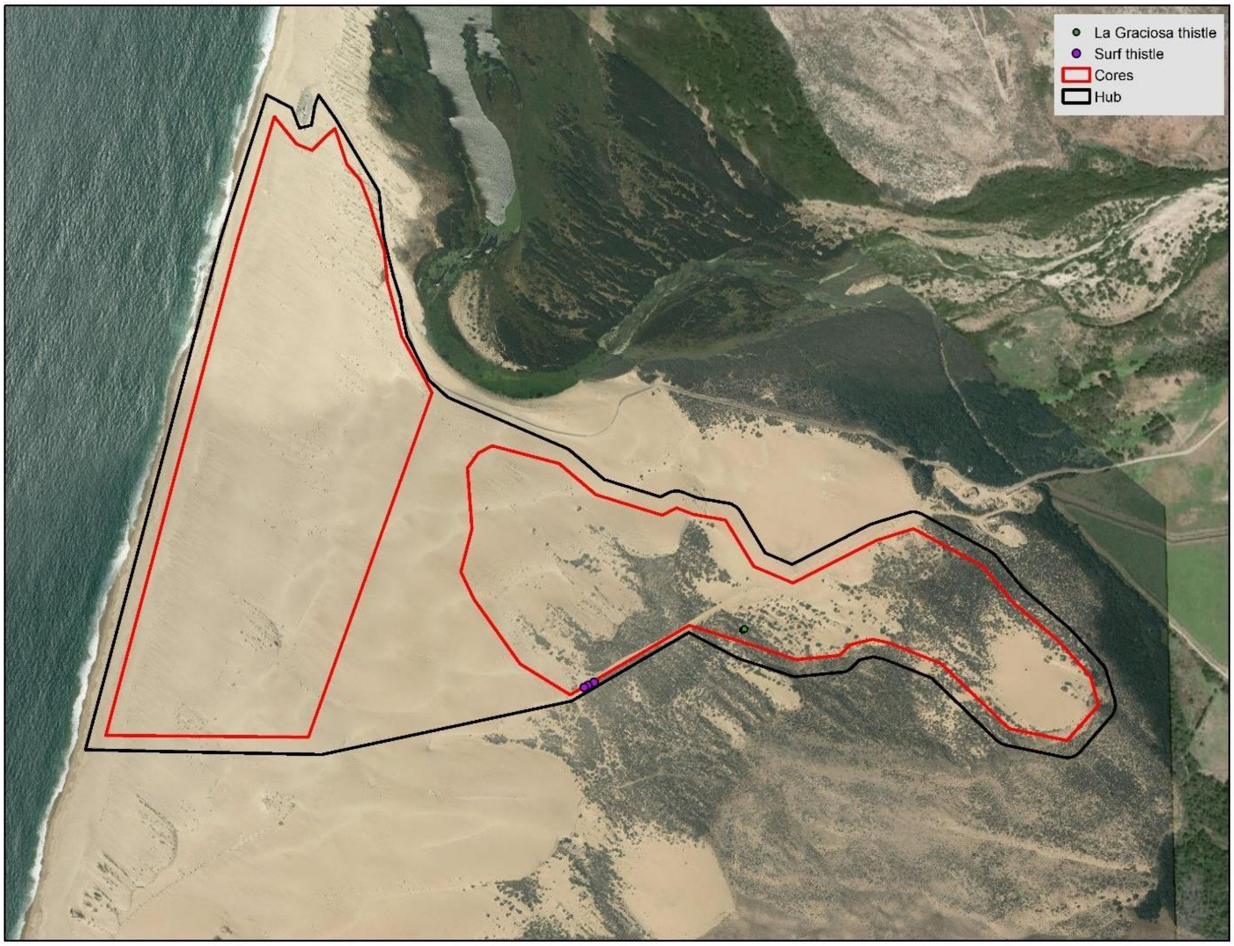


Figure 61: Locations of rare plants mapped in 2017 within the Rancho Guadalupe DPA (Hubs and Cores).

Action 2D.2: If suitable habitat for LGT is found, identify threats to LGT success at these locations.

Method:

Once suitable habitat is identified, the Land Owner (Santa Barbara County Parks), USFWS and CADFW should be consulted with to identify threats to LGT survival in these mesic sites and determine recovery actions to be taken. These actions may include fencing/protection of habitat; invasive species removal or exclusion if appropriate; and active out-plantings of the species.

Opportunity 2D Cost Estimates:

Table 67: Cost Estimates for La Graciosa thistle surveys and habitat enhancement in the Rancho Guadalupe DPA.

Opportuntiy 2E: Surf thistle (Cirsium rhothophilum) habitat enhancement	
Task 1: Yr 1 Fence Construction and Population Count	$ 10,321.20
Task 2: Yr 2 Population Count	$ 2,418.00
Task 3: Yr 3 Population Count	$ 2,418.00
Task 7: Reporting & Permitting	$ 3,600.00
Contingency 20% (inflation, unanticipated cost increases)	$ 3,751.44
Phase 1 Total	**$ 22,508.64**
Task 5: Yr 4 Fence Maintenance and Population Count	*$ 4,821.00*
Task 6: Yr 5 Population Count	*$ 2,418.00*
Project Total:	***$ 7,239.00***

Opportunity 2E: Surf thistle habitat enhancement

Objective 2E: Passively increase the size of the known surf thistle population in the Rancho Guadalupe DPA by Year 3.

Action 2E.1: Fence and Track the survival of the 1 known population of surf thistle along the Gordon Sands Road over the next 3 years (Figure 61).

Method:
In 2017 the entire Rancho Guadalupe Dunes Preserve was surveyed for occurrences of surf thistle. During this survey, one population was discovered along an active road. To achieve this objective, a fence will be placed around this population and communication to Gordon Sands employees will be conducted to ensure this population is allowed to flourish. Population counts will be conducted annually to track the success of this population.

Opportunity 2E Cost Estimates:

Table 68: Cost Estimates for surf thistle surveys and protection in the Rancho Guadalupe DPA.

Opportuntiy 2E: Surf thistle (Cirsium rhothophilum) habitat enhancement	
Task 1: Yr 1 Fence Construction and Population Count	$ 10,321.20
Task 2: Yr 2 Population Count	$ 2,418.00
Task 3: Yr 3 Population Count	$ 2,418.00
Task 7: Reporting & Permitting	$ 3,600.00
Contingency 20% (inflation, unanticipated cost increases)	$ 3,751.44
Phase 1 Total	**$ 22,508.64**
Task 5: Yr 4 Fence Maintenance and Population Count	*$ 4,821.00*
Task 6: Yr 5 Population Count	*$ 2,418.00*
Project Total:	***$ 7,239.00***

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 Rancho Guadalupe DPA are the Western snowy plover and California least tern. These are both Federally listed species under the endangered species act. Both species are ground nesters 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 herbicides 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 69: 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 70: Herbicide toxicity comparison.

Herbicide	Toxicity: Dermal LD50 (rabbits)	Toxicity: Oral LD50 for rats:	Toxicity: LC50 for bluegill sunfish	Effects to cryptogamic soils	Human Risk: Irritating to Skin	Human Risk: Eye Damage	Human Risk: 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 & 1B**: Reduce invasive species cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA Core closest to the ocean, i.e. the foredunes**.

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of invasive species cover maintained at a 1-5% cover class value throughout the RG DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 iceplant cover to 0-1% cover class by year 3 in the RG DPA (Hub & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of iceplant maintained at a 0-1% cover class value throughout the RG DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 0-1% cover class values are being maintained.

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 European searocket cover to 1-5% cover class by year 3 in the Rancho Guadalupe DPA (Hubs & Core).**

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of European searocket maintained at a 1-5% cover class value throughout the RG DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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 perennial veldtgrass cover to 1-5% cover class by year 3 in the BLEA DPA (Hub & Core).

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the RG DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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:* Identify and protect potential habitat for La Graciosa thistle within the Rancho Guadalupe DPA by Year 3.**

Performance monitoring: This is a discrete project initially. A map of suitable habitat for LGT will be mapped and a list of threats to that habitat will be created. Once that is complete, then a long-term plan with performance monitoring criteria can be created.

Protocol: Mapping will utilize on the ground surveys during a non-drought rain event year. Maps will be created using ArcGIS Collector application on a tablet with an external GPS. Suitable habitat type will be noted based on the presence of wetland indicator plants and suitable hydrology.

Actions if Objective is not met: The Objective is a discreet project with a specific product. A rough draft will be submitted to the RTF for review and comment. After the comment period, a final draft will be submitted.

***Objective 2E:* Passively increase the size of the known surf thistle population in the Rancho Guadalupe DPA by Year 3.**

Performance monitoring: This objective is specifically tied to the success of enhancing populations of surf thistle. Monitoring will involve a yearly quantitative assessment of the population status of surf thistle.

Protocol: Yearly population assessment for surf thistle will be made during the flowering season. 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 surf thistle 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 surf thistle population.

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 years 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.

Monitoring Cost Estimates:
Monitoring cost estimates are based on performance monitoring for Priority 1 Opportunities, releve monitoring, and reporting.

Table 71: Monitoring cost estimates for the Rancho Guadalupe DPA.

Rancho Guadalupe DPA Monitoring	
Task 1: Yr 1 Grid Monitoring	$ 3,490.80
Task 2: Yr 1 Releve Monitoring	$ 3,155.40
Task 3: Yr 3 Grid Monitoring	$ 5,971.60
Task 4: Yr 3 Releve Monitoring	$ 3,155.40
Task 5: Final Reporting	$ 5,670.00
Contingency 20% (inflation, unanticipated cost increases)	$ 4,288.64
Phase 1 Total	**$ 25,731.84**
Task 6: Yr 5 Grid Monitoring	*$ 3,490.80*
Task 7: Yr 5 Releve Monitoring	*$ 3,155.40*
Phase 2 Total	***$ 6,646.20***

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 62: 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.

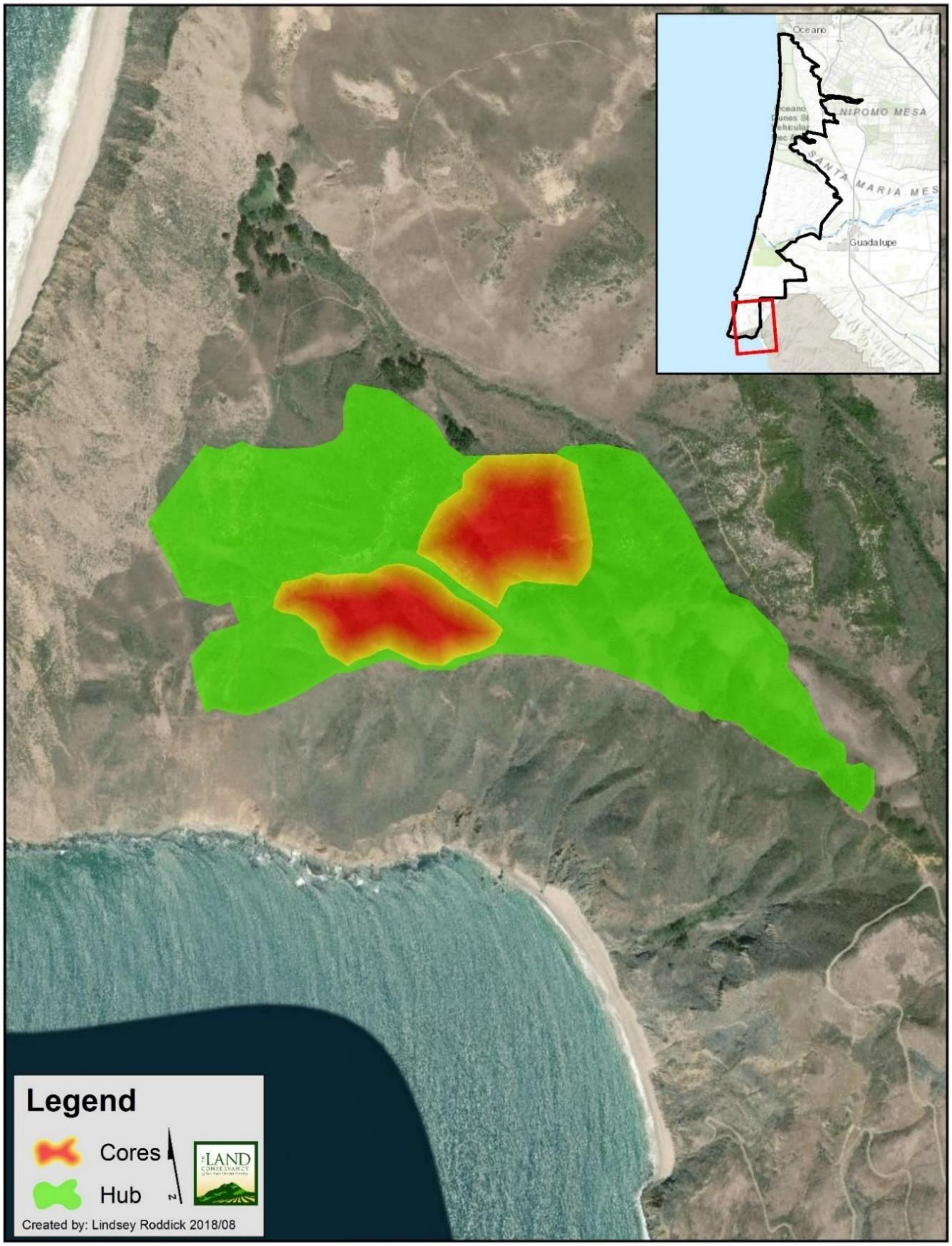


Figure 63: Boundary of the Point Sal Reserve DPA.

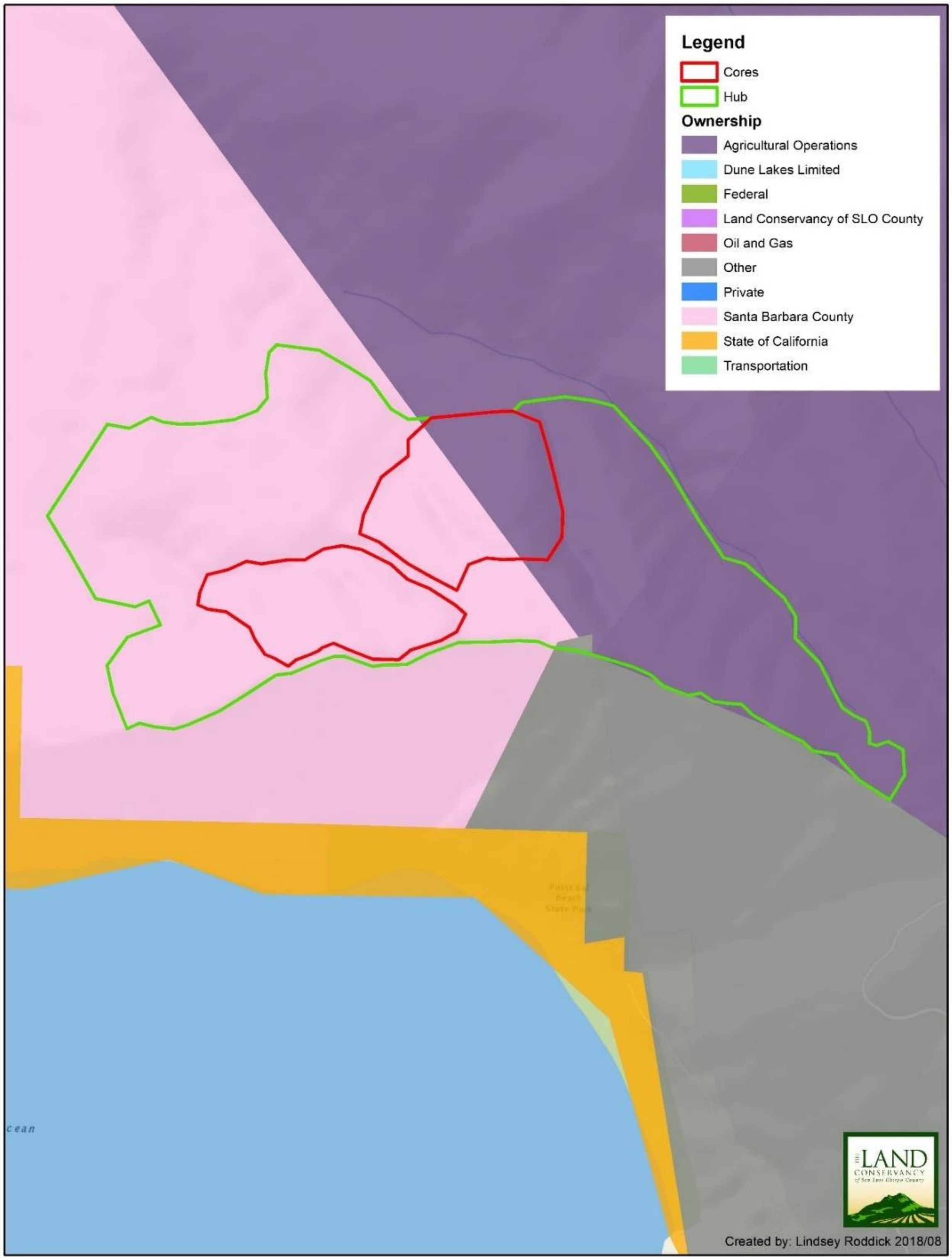


Figure 64: Property Ownership of the Point Sal Reserve DPA.

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:

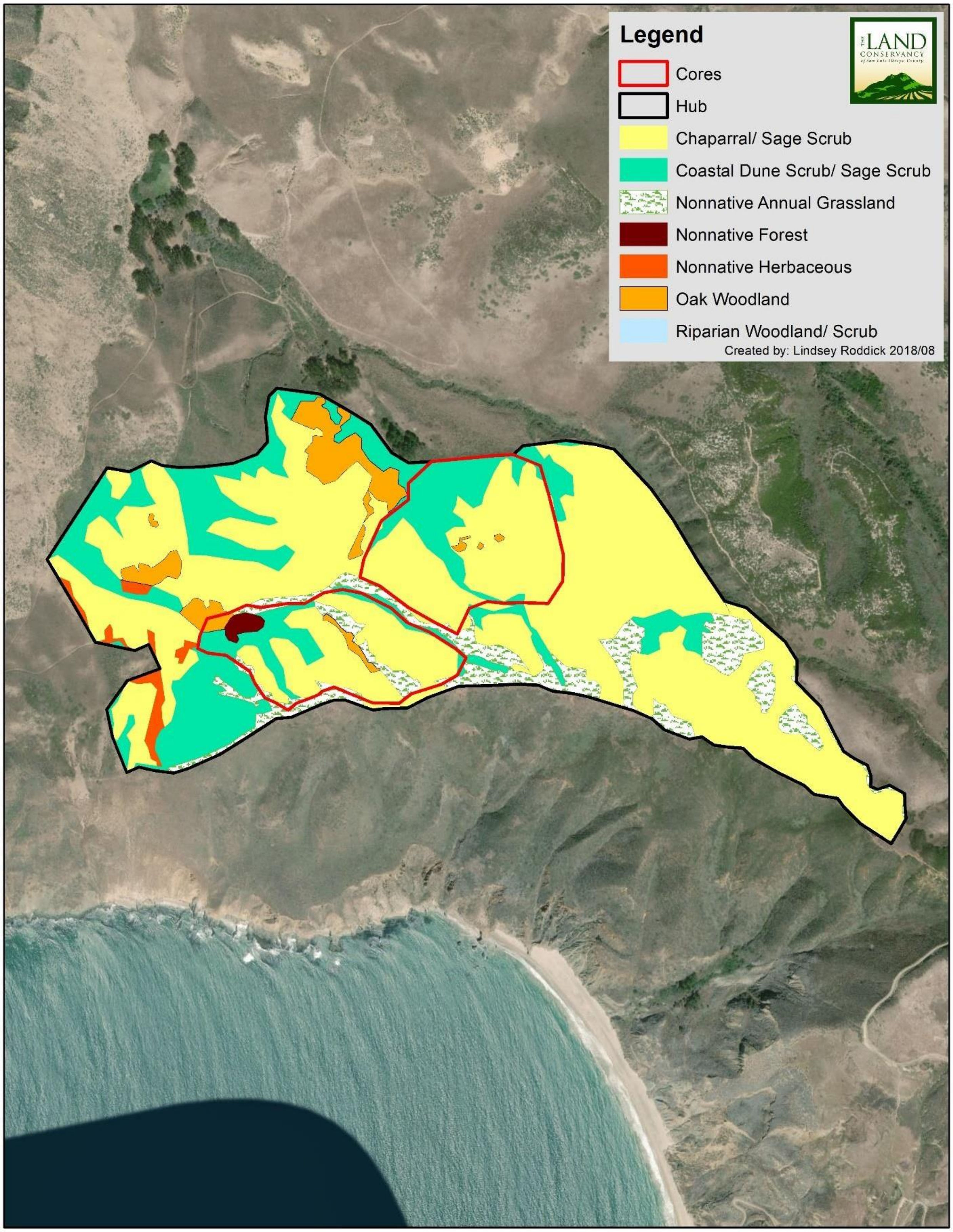
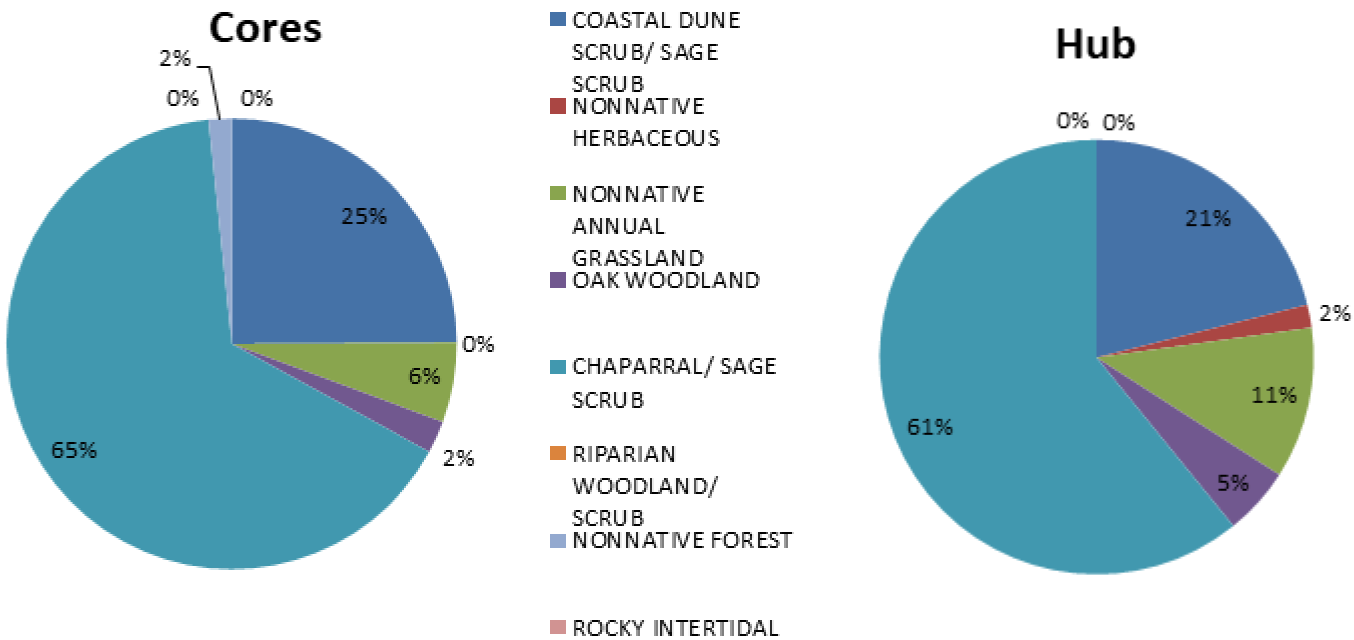


Figure 65: Habitat Types within the Point Sal DPA.



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 66: 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 72: 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	Fabaceae		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 73: 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 74: 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.

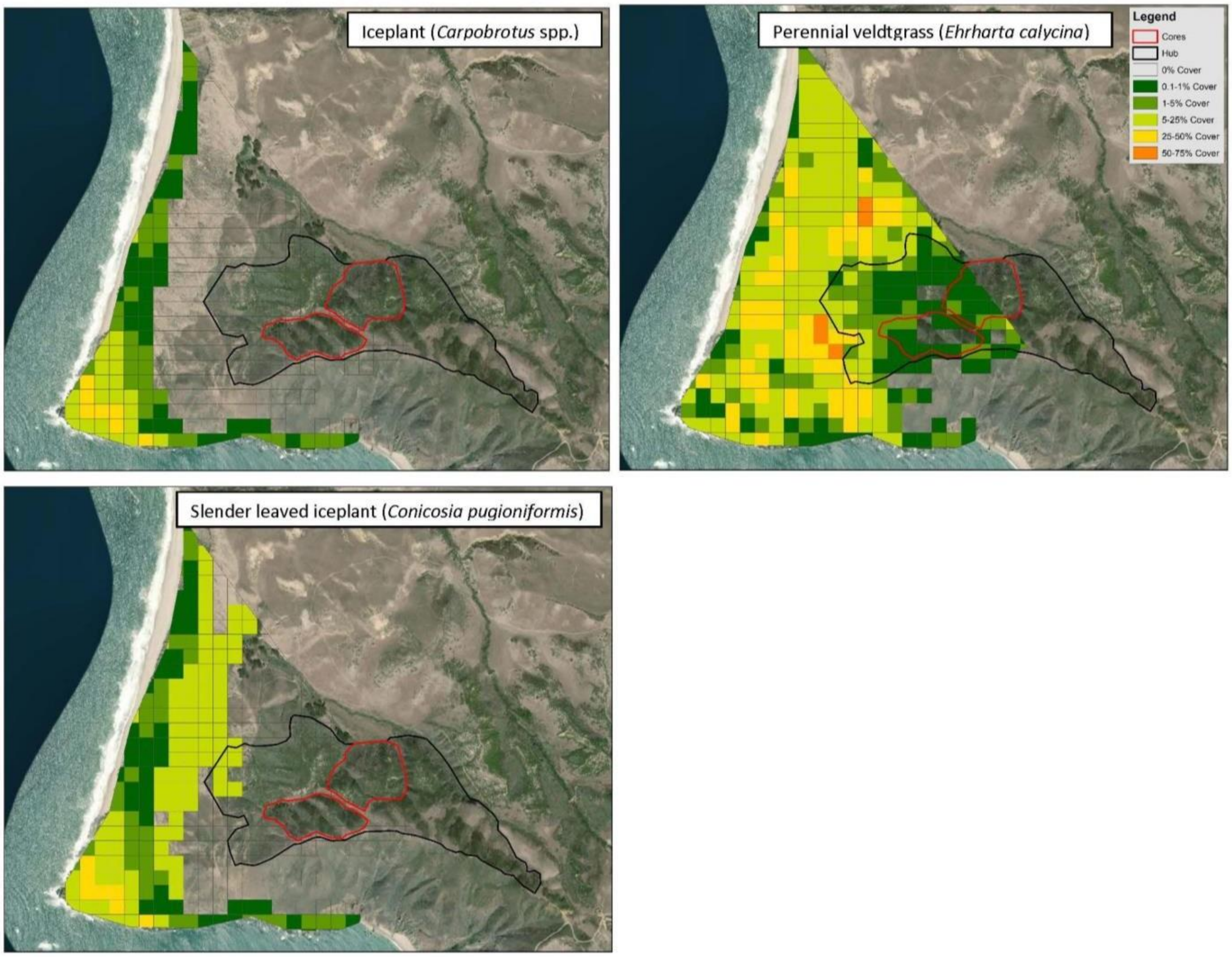


Figure 67: Dominant invasive species in the Point Sal Reserve DPA.

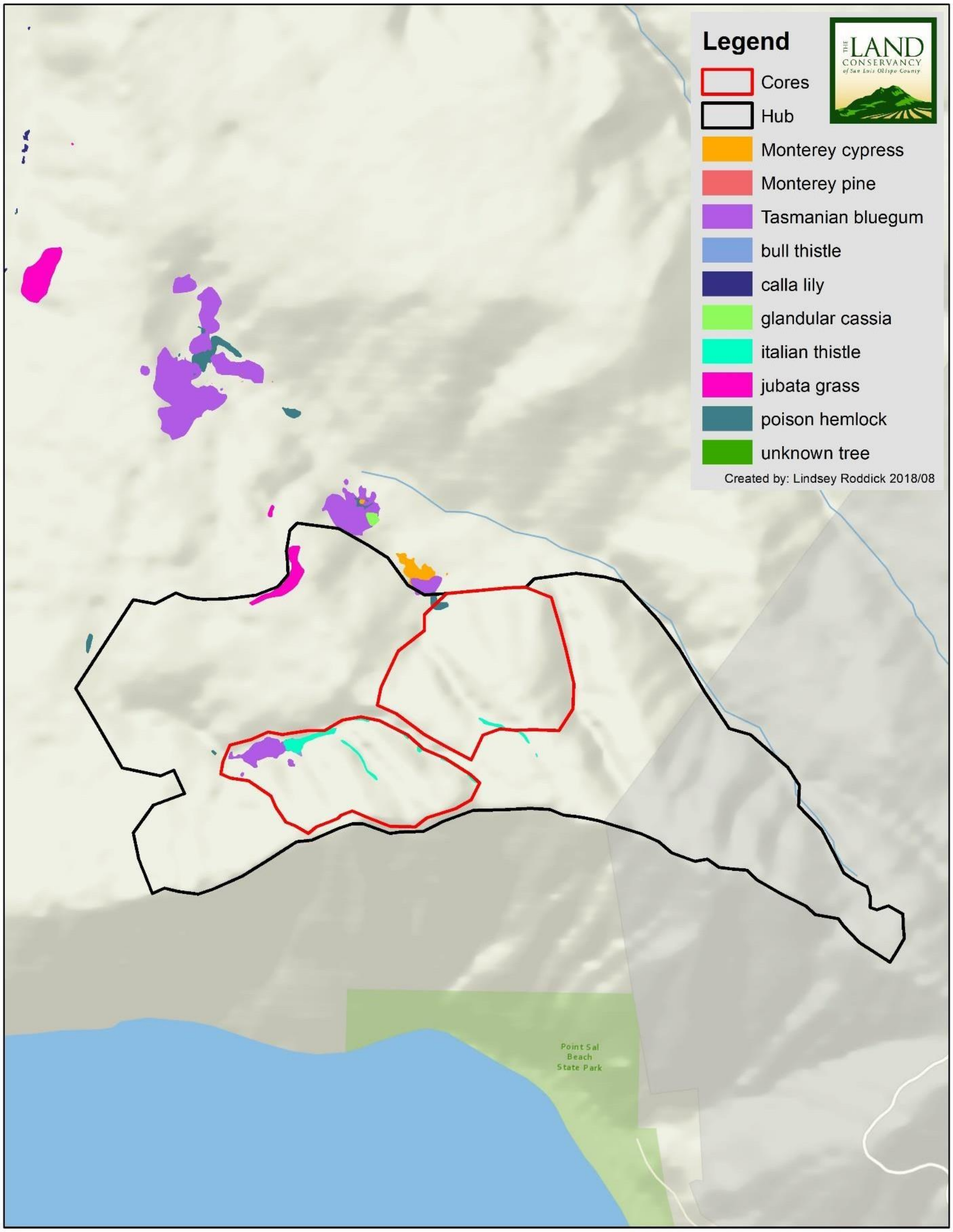


Figure 68: Less common invasive species in the Point Sal Reserve DPA.

Table 75: 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 76: 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 by year three.

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: Do aerial survey utilizing Assessment Mapping Protocol (Appendix A)

Status: Complete

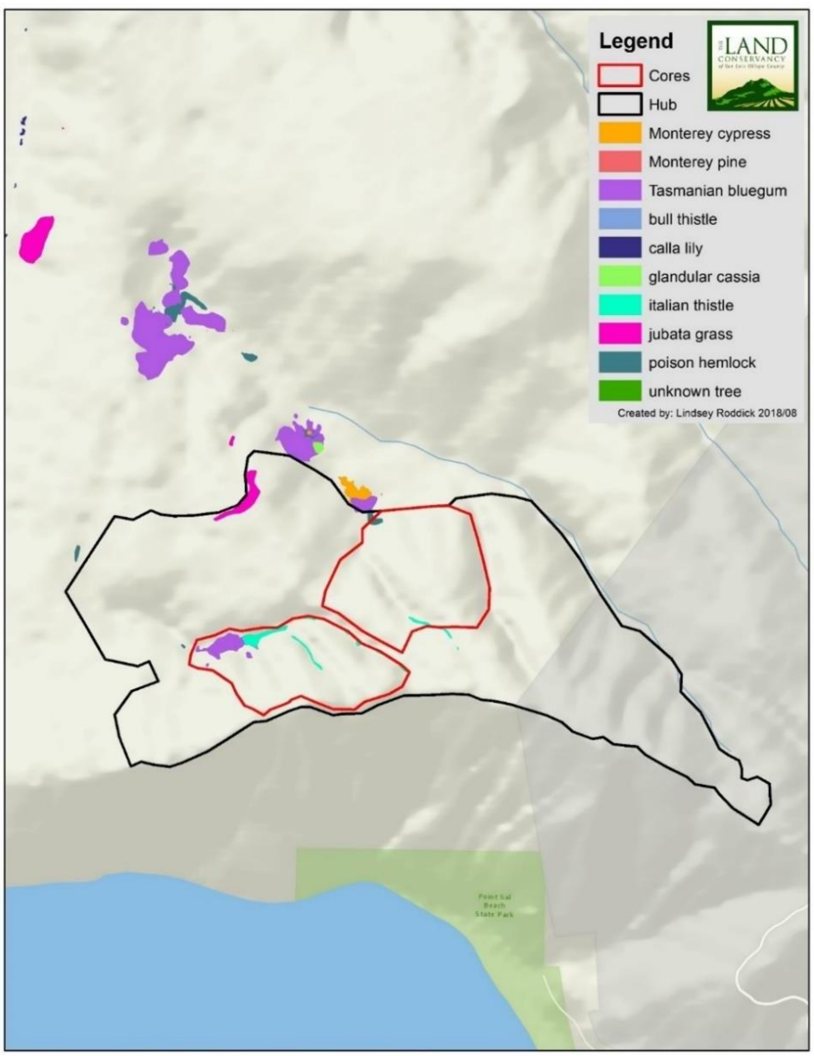


Figure 69: Baseline survey of jubata grass cover in the Point Sal Reserve DPA.

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:
The work will occur in years 1-3. 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 77: 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 1A Cost Estimates:

Table 78: Cost estimates for jubata grass control at the Point Sal Reserve DPA (3 years).

Opportunity 1A: Jubata grass (Cortaderia jubata) eradication	
Task 1: Yr 1 Herbicide Application and Baseline Survey	$ 14,410.60
Task 2: Yr 2 Herbicide Application	$ 8,530.60
Task 3: Yr 3 Herbicide Application and Monitoring	$ 8,400.60
Task 4: Reporting	$ 4,360.00
Contingency 20% (inflation, unanticipated cost increases)	$ 7,140.36
Phase 1 Total	**$ 42,842.16**
Task 5: Yr 4 Herbicide Application	*$ 4,854.30*
Task 6: Yr 5 Herbicide Application and Monitoring	*$ 4,984.30*
Project Total:	***$ 9,838.60***

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 79: 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 perennial veldtgrass cover to 1-5% cover class by year 3 in 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: Complete

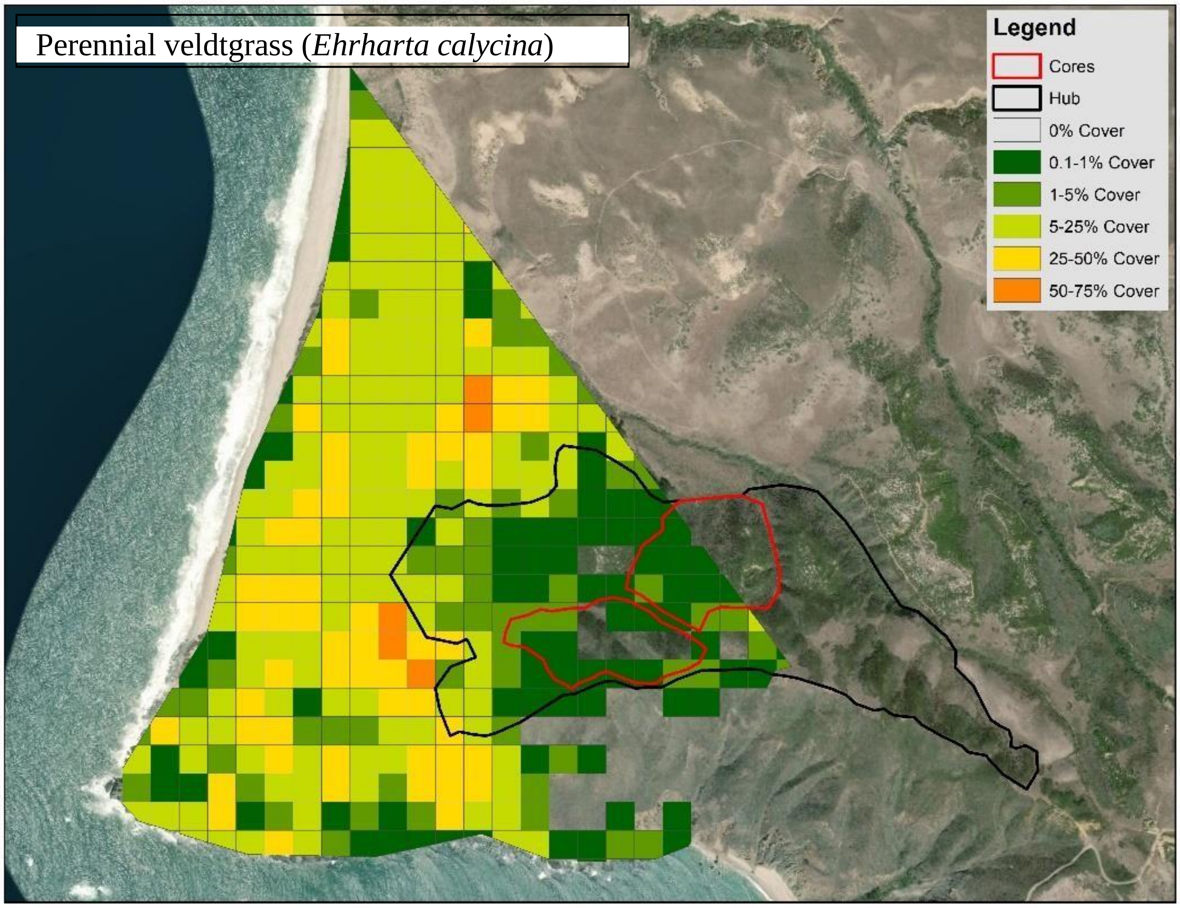


Figure 70: Baseline survey of perennial veldtgrass on the Point Sal Reserve DPA.

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 80: 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 Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
Perennial Veldtgrass (*Ehrharta calycina*)	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 2A Cost Estimates:

Cost estimates assume all work done by ground applications. Cost could come down if aerial application is possible.

Table 81: Cost estimate for perennial veldtgrass control at Point Sal Reserve DPA (3 years).

Opportunity 2A: Perennial veldtgrass (Ehrharta calycina) control	
Task 1: Yr 1 Herbicide Applications (2)	$ 157,545.00
Task 2: Yr 2 Herbicide Applications (2)	$ 126,427.00
Task 3: Yr 3 Herbicide Applications (2) and Monitoring	$ 97,428.00
Task 4: Regulatory Reporting & Permitting	$ 15,400.00
Contingency 20% (inflation, unanticipated cost increases)	$ 79,360.00
Phase 1 Total	**$ 476,160.00**
Task 5A: Yr 4 Herbicide Applications (2)	*$ 66,055.00*
Task 5B: Yr 4 Seeding and Monitoring	*$ 15,351.50*
Task 6A: Yr 5 Herbicide Application (2)	*$ 66,055.00*
Task 6B: Yr 5 Seeding and Monitoring	*$ 15,348.35*
Project Total:	***$ 162,809.85***

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 82: 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 83: Herbicide toxicity comparison.

Herbicide	Toxicity: Dermal LD50 (rabbits)	Toxicity: Oral LD50 for rats:	Toxicity: LC50 for bluegill sunfish	Effects to cryptogamic soils	Human Risk: Irritating to Skin	Human Risk: Eye Damage	Human Risk: 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 by year three.
Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of jubata grass eradicated throughout the Point Sal Reserve DPA by Year 3. Performance monitoring will then switch to long-term early detection and rapid response monitoring once every 5-years to ensure eradication is maintained.

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: Create a sustainable self-sustaining trail system in the Point Sal Reserve DPA by year five.
Performance monitoring criteria will be determined as part of the Trails Assessment.

Objective 2A: Reduce perennial veldtgrass cover to 1-5% cover class by year 3 in the Point Sal Reserve DPA (Hub & Core).
Performance monitoring will occur in Years 1 and 5 to document progress towards meeting the objective of perennial veldtgrass maintained at a 1-5% cover class value throughout the Point Sal Reserve DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long-term maintenance and monitoring with a monitoring interval of once every 5 years to ensure 1-5% cover class values are being maintained.

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.

Monitoring Cost Estimates:

Monitoring cost estimates are based on performance monitoring for Priority 1 Opportunities and reporting.

Table 84: Monitoring costs for Performance monitoring only at the Point Sal Reserve DPA.

Point Sal Reserve DPA Monitoring	
Task 1: Yr 1 Grid Monitoring	$ 1,616.30
Task 2: Yr 1 Releve Monitoring	$ 7,075.75
Task 3: Yr 3 Grid Monitoring	$ 1,616.30
Task 4: Yr 3 Releve Monitoring	$ 7,075.75
Task 5: Final Reporting	$ 5,670.00
Contingency 20% (inflation, unanticipated cost increases)	$ 4,610.82
Phase 1 Total	**$ 27,664.92**
Task 6: Yr 5 Grid Monitoring	$ 1,616.30
Task 7: Yr 5 Releve Monitoring	$ 7,075.75
Project Total:	**$ 8,692.05**

Appendices

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Appendix A: Monitoring to Inform Management: Assessment Protocols

To evaluate the success of restoration projects in the GNDC, contractual objectives were established which must be met to be deemed a success. These objectives contain the SMART criteria: Specific (who, what, where, when, and why); Measurable; Achievable; Results-oriented; and Time-fixed.

In most cases, these objectives focus on control or eradication of the invasive species to a certain threshold value (percent cover). To help measure if an invasive species target threshold is being achieved a protocol was developed by Wildlands Conservation Science for survey mapping in the GNDC capturing the most important information for management accurately and efficiently (Ball & Olthof, 2016). The protocol was established to allow for simple and uniform data sharing between land managers and Dunes Collaborative members.

A target invasive plant species list 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 are to be documented. In addition to invasive species, surveys will 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. Additional invasive and rare plant species can be included on the target species list, depending on the needs of the land managers.

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.

Table 1: Species List for Survey Inventory

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	Fabaceae		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

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 the pre-established grid system. Within each grid cell, additional population attribute information is collected (Table 3).

These methods can be implemented either by aerial collection (100 $meter^2$ grids) or by ground collection (50 $meter^2$ grids). 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 GNDC 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. A survey using both methods was recently used in the GNDC Rancho Guadalupe County Park and Point Sal Reserve (Roddick & Hall, 2018).

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).

Reporting

The findings of the assessment protocol will be included in the overall reporting established by the Monitoring Plan. The Monitoring Plan will include adaptive management decisions based on the findings of this assessment protocol.

Results from this portion of the monitoring plan will include visual and numerical information regarding the following:

- Invasive species
- Special Status Species
- Feral Pigs
- Habitats most affected by invasive species

Invasive Species

Results regarding invasive species will include descriptive information about total acres covered during the survey and how many of the survey species were detected. It will include timing of the survey and any needed information about how the survey was implemented which might affect the outcome (flowering time, major obstacles, etc.). Most importantly, gross and net acres of the detected survey species (Grid: Example Table 4 and polygon/point: example Table 5) will be documented with associate maps indicating location (Figure 3).

Table 4: Example table for grid survey invasive species reporting

Species	Gross Acres	Net Acres
Ehrharta calycina	198.3	29.21
Cakile maritima	185.95	3.97
Conicosia pugioniformis	87.1	1.43
Carpobortus edulis	30.27	0.67
Carpobortus chilensis	75.37	1.94
Ammomphila arenaria	0	0
Total Acres	**393.52***	**37.22**

*Multiple species were found within grid cells so this number is not a sum of each species' gross acres. Each grid cell was only counted once in the gross acres calculation.

Table 5: Example table of polygon/point invasive species reporting

Species	Approximate # Individuals	Gross Acres	Net Acres
Survey Species List			
Annual Grass	N/A	4.4819	1.2269
Cirsium vulgare	156	0.9083	0.0236
Conium maculatum	1125	1.3293	0.38
Delairea odorata	N/A	0.1338	0.0165
Foeniculum vulgare	13	0.0122	0.0002
Tamarix sp	2	0.001	0.0001
Vinca major	N/A	0.0241	0.0036
Additional Survey Species			
Lathyrus latifolius	N/A	0.2692	0.1009
Tetragonia tetragonioides	N/A	0.1063	0.0163
Zantedeschia aethiopica	1	0.001	0
Total Acres		**7.2671**	**1.7682**

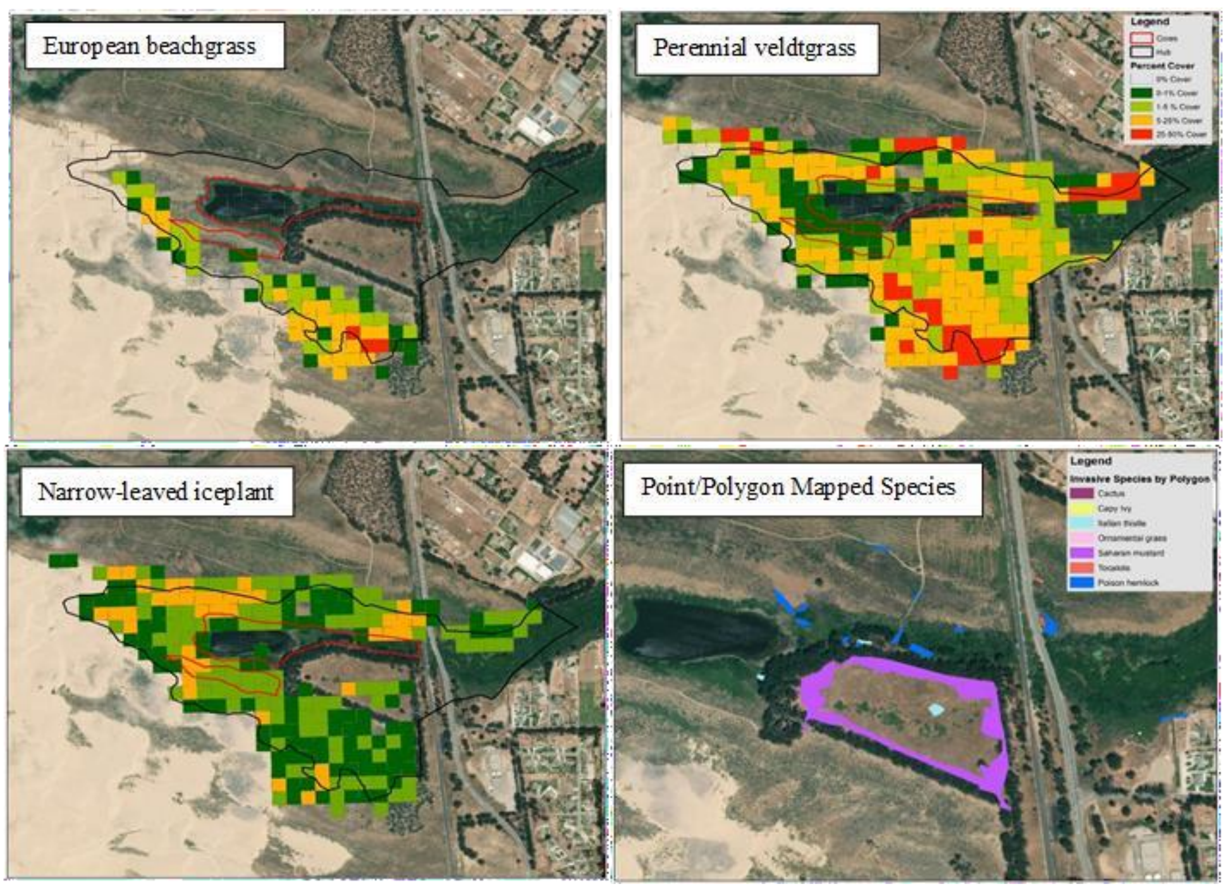


Figure 1: Example figure of Invasive species results.

Special Status Species

Results regarding documented special status plant species will include descriptive information about survey methods, how many of the survey species were detected, current condition, and population size. It will include timing of the survey and any needed information about how the survey was implemented which might affect the outcome (flowering time, major obstacles, etc.). Most importantly, acres or number of individuals, whichever is most appropriate, of the detected survey species will be documented with associate maps indicating location (Figure 4).

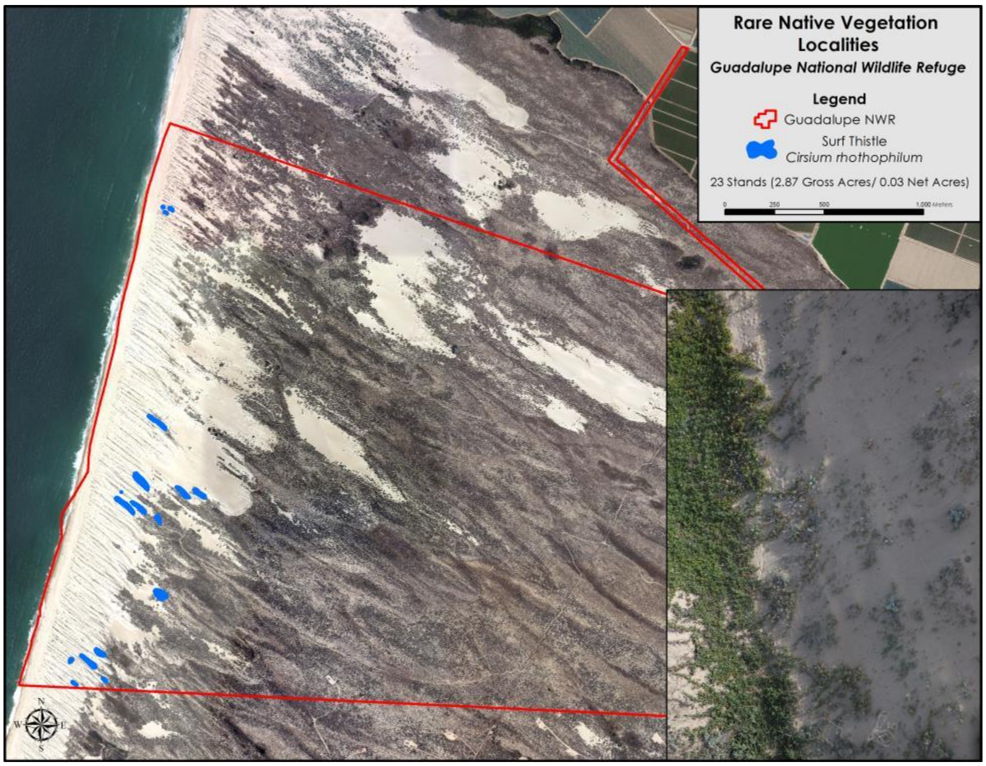


Figure 2: Example figure for rare plant species survey results

Feral Pigs

Results regarding documented feral pigs will include descriptive information about survey methods, how many of the survey species were detected and/or evidence of their presence (vegetation damage and rooting), and estimated population size. It will include timing of the survey and any needed information about how the survey was implemented which might affect the outcome (seasonality, major obstacles, etc.). Most importantly, acres damaged, and number of individuals detected will be documented in addition to associated maps indicating location (Figure 5).

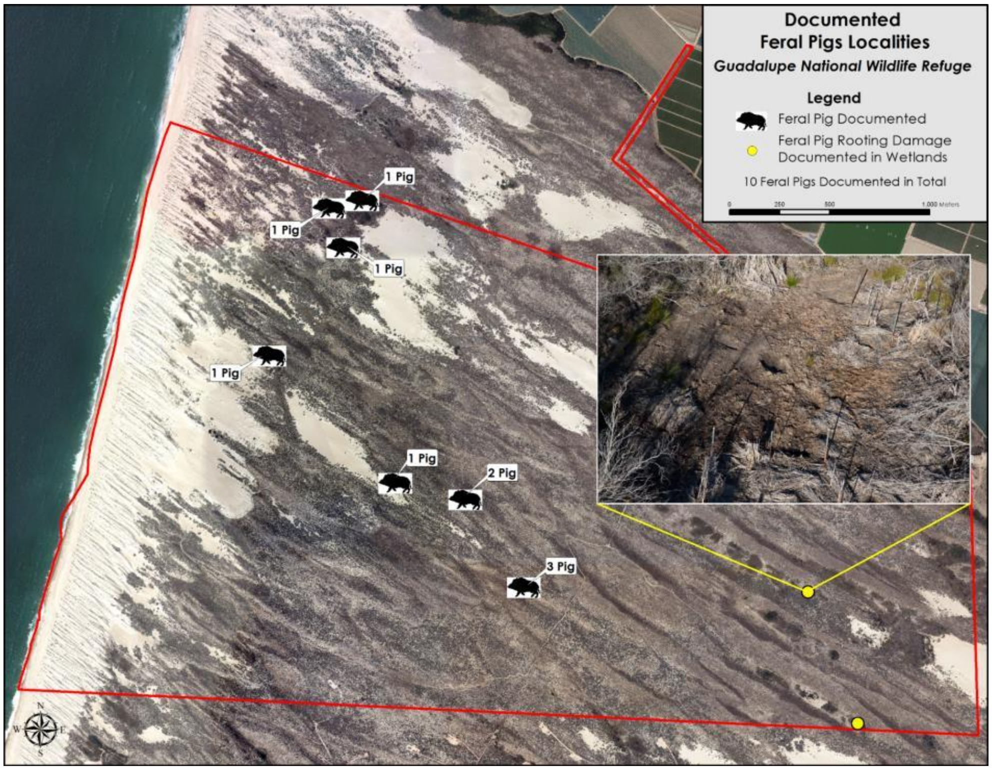


Figure 3: Example figure for feral pig survey results

Habitats most affected by invasive species

This portion of the results will focus on priorities for management. It will outline threatened habitats, especially those with high invasive species cover which are also inhabited by special status plant species. The major invasive species present in each habitat type will be documented in this section.

References

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

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

Roddick, L., & Hall, J. (2018). *Filling Major Data Gaps – Task 5 Implementation from Conservation Strategy/Management Plan Development for the Guadalupe-Nipomo Dunes Complex Project*. San Lu.

Appendix B:

Nipomo Lupine DPA

Site Description

The Nipomo Lupine DPA is located on California State Parks and privately- owned property to the south (Phillips 66 oil refinery and agriculture lands) and is bisected by the Union Pacific Railway. This DPA is the location of the only known natural population of federally endangered Nipomo lupine. Phillips 66 land managers have set aside coastal dune habitat surrounding the refinery to benefit native dune wildlife. The portion of the DPA west of the railway is under a long-term lease to California State Parks and is actively managed to sustain, restore, and enhance the integrity of natural resources on the property. West of the leased land are portions of the Oceano Dunes State Vehicular Recreation Area (ODSVRA). The DPA consists of Central Coast Dune Scrub, invasive non-native herbaceous plants, two freshwater marshes and active dunes. There are also stands of Sydney Golden Wattle on the site.

This DPA was selected by the conservation planning software (both Marxan and Zonation) and local experts because of its unique assemblage of plant species. It is home to a large population of Dune almond (*Prunus fasciculata* var. *punctata*, CNPS Rare Plant Rank 4.3) and the only natural population of the federally endangered Nipomo lupine. This DPA is where excellent spring annual wildflowers appear because of relatively old stabilized dune scrub. Species such as dune larkspur (*Delphinium parryi* ssp. *blochmaniae*), seaside fiddleneck (*Amsinckia spectabilis*), purple owl's clover (*Castilleja exserta*) and phacelia (*Phacelia douglasii*) are found regularly in the spring.

Figure 1: Nipomo Lupine (Lupinus nipomensis)

Other unique species found within this DPA include a diversity of lichens, mosses and vertebrates. The Dune almond is an important substrate for at least thirteen lichen species (Knudsen, 2015). A north facing slope with intact biological soil crust provides another order of biological diversity to this region. The DPA includes open dune scrub habitat as well as a series of small wetlands/riparian areas predominantly occupied by Arroyo willow and the occasional large non-native tree acacias (*Acacia longifolia*) and pines (*Pinus contorta* and *P. radiata*) which offer important faunal breeding and feeding habitat for bird species such great horned owl (*Bubo virginianus*).

Figure 2: Sideside amsinckia (Amsinckia spectabilis)

The western portion of this DPA (west of the railroad tracks) serves as an open space buffer for the Phillips 66 Santa Maria refinery facility. A service road running through the property allows refinery personnel and equipment access for the maintenance of a brine pipeline running from the refinery through the ODSVRA to an oceanic outfall. ODSVRA uses the service road for emergency access to the vehicular area, access to treatment of invasive species and access for ecological surveys. The LCSLO has used the service road for access to monitor the Nipomo lupine. This portion of the DPA is under a long-term lease to California State Parks as part of ODSVRA.

Since the 1980's, State Parks has managed this property to support long term viability of the natural resource features present within the DPA. Restoration efforts in this DPA are focused on management of invasive plant species; this DPA is plagued by dense perennial veldtgrass (*Ehrharta calycina*)- the largest threat to the federally endangered Nipomo lupine. In the past, this region has been a high priority for restoration funds through the Dunes Collaborative Restoration Task Force (RTF) for the removal of perennial veldtgrass for preservation of the Nipomo lupine. Management of the invasive species has focused on removal of perennial veldtgrass by the use of herbicide from the fall through spring (on State Parks-leased property, west of the railroad tracks) and grazed by cattle in the summer (east of the railroad tracks). It is important to note is that management opportunities recommended in this Work Plan do not encompass activities east of the railroad tracks; this portion of the DPA is not managed by State Parks.

Figure 3: Dune almond and Indian paintbrush.

The RTF has discussed the importance of establishing satellite populations of Nipomo lupine on publicly owned land. One satellite population currently exists at Black Lake Ecological Area. In addition, future recovery of Nipomo lupine may be constrained by loss of habitat and the lack of additional habitat for species to populate. The natural population within this DPA is located on ancient sand dunes from the pre-Flandrian era (W. S. Cooper, 1967) which offers the open landscape preferred by Nipomo lupine. Successional movement of newer sand with denser coastal scrub habitat is slowly moving into the Nipomo lupine current populations. Movement east is impossible due to CA Highway 1 and urban development of Nipomo, CA.

Figure 4: Site of native population of Nipomo lupine. Blue flags indicate individuals. Note the density of perennial veldtgrass occupying available space.

Management History

Invasive Plant Control:
LCSLO began the work of removing perennial veldtgrass and European beachgrass from the Nipomo lupine DPA in 1999 with grants available through the Guadalupe Nipomo Dunes Collaborative and a second grant from San Luis Obispo County. Activities under these grants focused on eliminating extensive infestation of perennial veldtgrass and European beachgrass. Techniques employed involved mechanical weed whacking to reduce biomass followed by herbicide treatments with a grass specific herbicide, primarily Fusilade DX (fluazifop-p-butyl). Mechanical weed whacking as a treatment has not been employed since 2001. LCSLO has conducted veldgrass control via herbicide from 1999 – 2008, and from 2013 – 2014. The RTF has funded veldtgrass control efforts for State Parks over the last 5 – 7 years including the use of ground-based hand crews. In 2009, approximately 18 acres were treated. State Parks has gained great efficiencies over the years as invasive species management approaches are further refined.

In 2015, manual removal of veldtgrass west of the railroad tracks was completed by the California Conservation Corps (CCC) supervised by Coastal San Luis Resource Conservation District (CSLRCD) and State Parks. This effort provided a reduction of seedbank that decreased veldt grass presence and reduced the work load for the subsequent 2016-2018 treatments which enhanced defensible areas in the DPA. These treatment areas are also good defensible buffers.

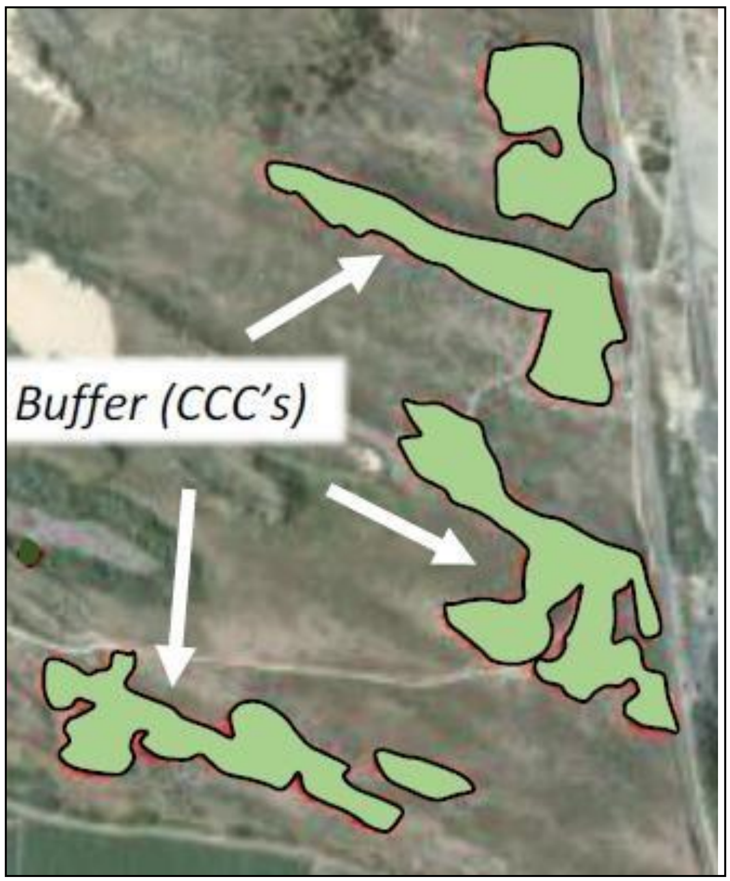


Figure 5: 2015 CCC manual removal of veldtgrass west of railroad tracks

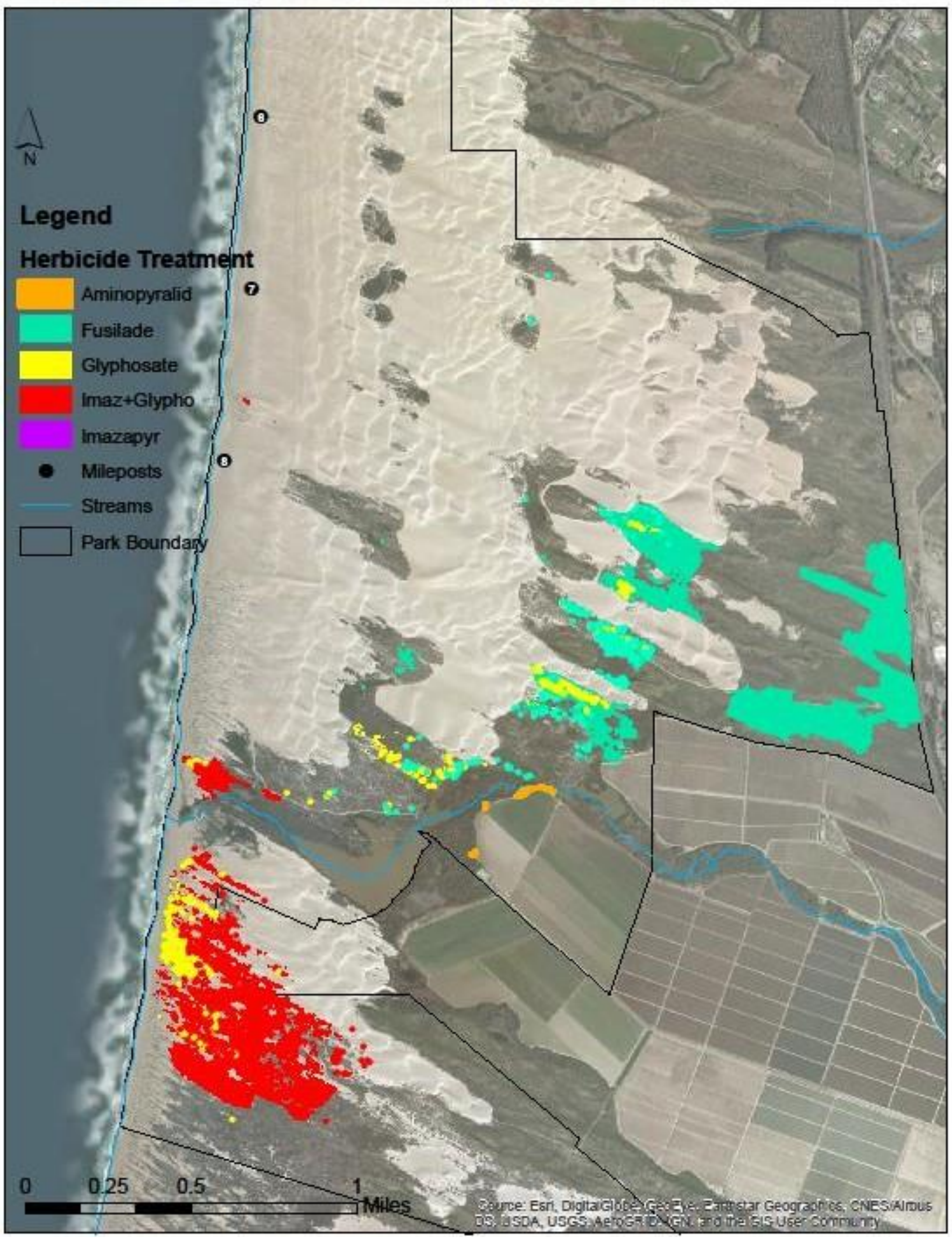
From 2016 – 2018, 64 acres of perennial veldtgrass-specific control was conducted annually west of the railroad tracks by State Parks under a California Endangered Species Act (CESA) 2081(a) permit. The permit is valid from 2016 – 2020. Three out of five treatments have been accomplished to date. By 2017 approximately 260 acres of perennial veldtgrass was reduced to 31 acres.

Second Round Veldt Grass Removal at Phillips 66 Buffer

Several lessons learned from the history of treatments include:

1- Timing—for ground crews it is important to spray after sufficient rainfall, usually 0.5 inches, the best time to treat is when veldtgrass is in the early seedling stage;
2- Direction—Initiate treatment from the westernmost edge of the infestation moving inland; and
3- Equipment—pick-up trucks containing 200 gallon liquid tanks, 600-foot hose and power sprayer are essential along with an all-terrain vehicle containing a 30 gallon liquid tank, hose reel and power sprayer to reach remote areas.

ODSVRA Herbicide Treatments 2011-2018



Habitat Restoration Projects:

From 2009 – 2017, Boyscout Camp (the westernmost part of the hub area on State Parks property) has undergone habitat restoration including local collection of dune vegetation and stabilization of the western sand sheet that has been chronically encroaching into this island for many years. In addition, a large project was undertaken to stabilize a large sand sheet in order to maintain access along a Conoco service road. A summary of these restoration efforts is as follows:

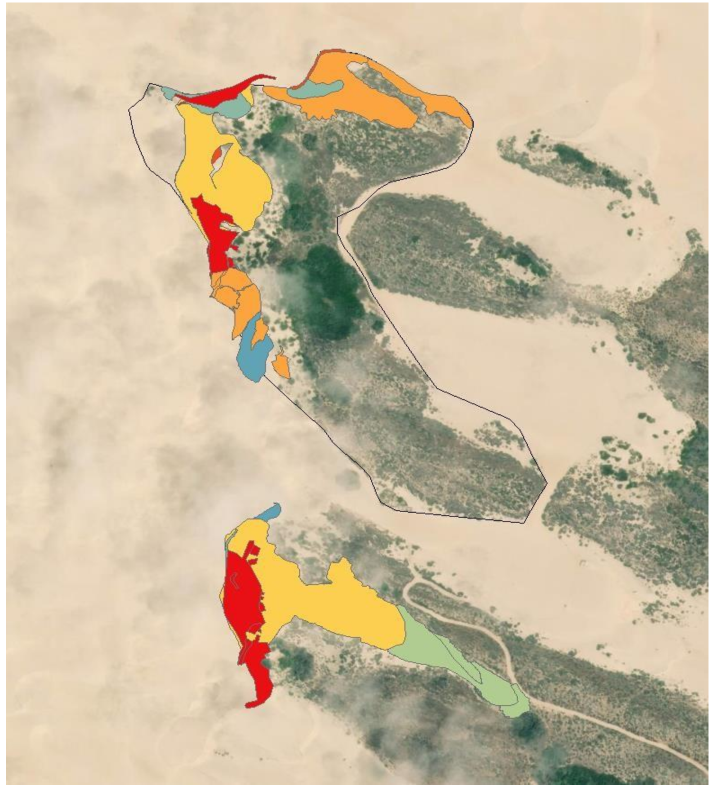


Figure 6: Restoration efforts at Boy Scout Camp (northern polygon) and Conoco (southern polygon) from 2009 – 2017.

Location	2009	2010	2011	2012	2013	2015	2016	2017	Total
Boy Scout Camp		4.56	7.61	1.88	0.98	1.37	1.03	1.23	18.66
Conoco	2.74	6.27				0.51	0.16	1.99	11.67
Total (acres)	**2.74**	**10.83**	**7.61**	**1.88**	**0.98**	**1.88**	**1.19**	**3.22**	**30.33**

Figure 7: Boundary of the Nipomo Lupine DPA with Core and Hub areas.

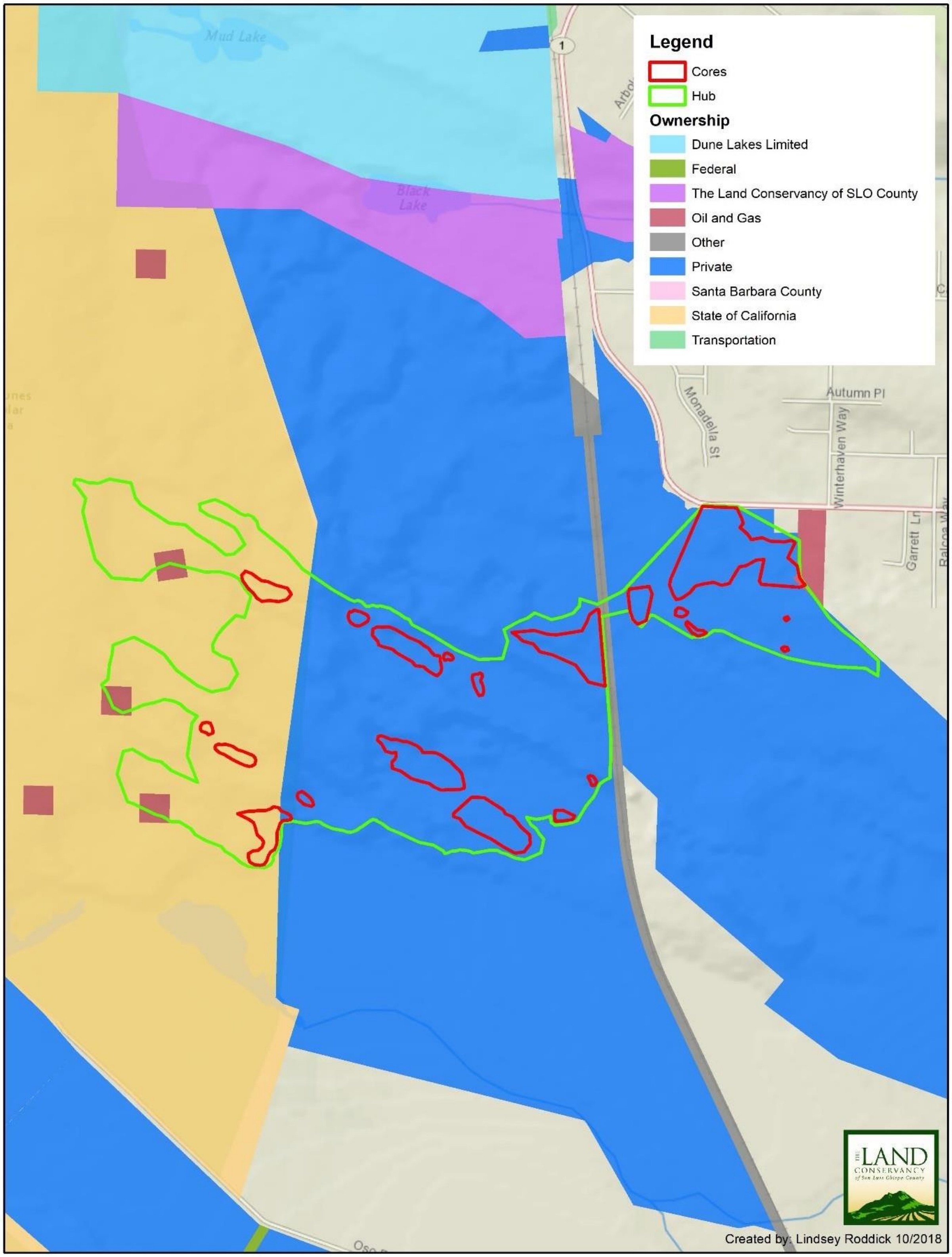


Figure 8: Property ownership within the Nipomo Lupine DPA with Core and Hub areas identified.

Site Assessment

The site assessment for Nipomo Lupine DPA is a snapshot in time setting representing a baseline of site conditions during the years 2017-2018. This includes a species inventory as well as geospatial data for habitat types, conservation targets, and threats.

Species Inventory

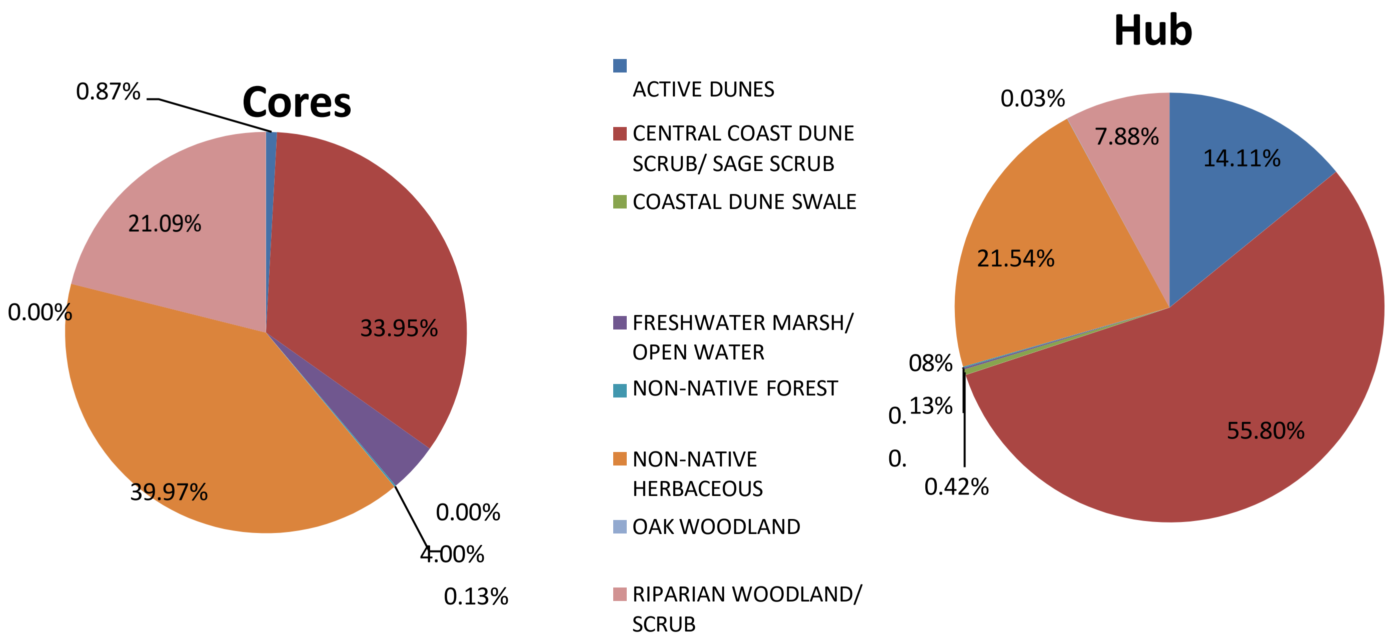
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the Nipomo Lupine DPA. Those species are included in the table below.

Table 1: Conservation targets known or likely to occur at Nipomo Lupine DPA.

Bird Fine Filter Species	Flora Fine Filter Species
American goldfinch	*Abronia maritima* (beach sand verbena)
American kestrel	*Astragalus nuttallii* var. *nuttallii* (Nuttall's milkvetch)
Anna's hummingbird	*Chenopodium littoreum* (coastal goosefoot)
Bewick's Wren	*Cladium californicum* (California sawgrass)
brown-headed cowbird	*Delphinium parryi* var. *blochmaniae* (dune larkspur)
bushtit	*Erigeron blochmaniae* (Blochman's leafy Daisy)
California quail	*Erysimum suffrutescens* (suffrutescent wallflower)
California thrasher	*Horkelia cuneata* ssp. *puberula* (Mesa horkelia)
California towhee	*Horkelia cuneata* ssp. *sericea* (Kellogg's horkelia)
chestnut-backed chickadee	*Juncus acutus* ssp. *leopoldii* (Leopold's rush)
common yellowthroat	*Leptodactylon californicum* ssp. *tomentosum* (prickly phlox)
downy woodpecker	*Lupinus nipomensis* (Nipomo lupine)
great horned owl	*Monardella undulata* ssp. *crispa* (dune mint)
house finch	*Monardella sinuata* ssp. *sinuata* (dune mint)
Hutton's vireo	*Monardella undulata* ssp. *undulata* (dune mint)
lesser goldfinch	*Mucronea californica* (California spineflower)
loggerhead shrike	*Orobanche parishii* ssp. *brachyloba* (Parish's broomrape)
mourning dove	*Prunus fasciculata* var. *punctata* (dune almond)
northern flicker	*Scrophularia atrata* (black flowered figwort)
Nuttall's woodpecker	*Senecio blochmaniae* (Blochman's groundsel)
orange-crowned warbler	
red-tailed hawk	**Mammal Species**
spotted towhee	*Canis latrans* (coyote)
Swainson's thrush	*Chaetodipus californicus* (California pocket mouse)
tree swallow	*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)
	Peromyscus californicus (California mouse)
	Peromyscus maniculatus (deer mouse)
	Procyon lotor (northern raccoon)
	Reithrodontomys megalotis (western harvest mouse)
	Scapanus latimanus (broad-footed mole)
	Sylvilagus audubonii (desert cottontail)
	Sylvilagus bachmani (brush rabbit)
	Ursus americanus (American black bear)

Habitats

The Nipomo Lupine DPA (Hubs and Cores) is composed of the following habitat types:



Habitat Type	Core Acres	Core %	Hub Acres	Hub %
ACTIVE DUNES	0.60	0.87%	56.95	14.11%
CENTRAL COAST DUNE SCRUB/ SAGE SCRUB	23.53	33.95%	225.27	55.80%
COASTAL DUNE SWALE	0.00	0.00%	1.71	0.42%
FRESHWATER MARSH/ OPEN WATER	2.77	4.00%	0.53	0.13%
NON-NATIVE FOREST	0.09	0.13%	0.34	0.08%
NON-NATIVE HERBACEOUS	27.70	39.97%	86.94	21.54%
OAK WOODLAND	0.00	0.00%	0.12	0.03%
RIPARIAN WOODLAND/ SCRUB	14.62	21.09%	31.82	7.88%
TOTAL	**69.32**		**403.69**	

Figure 9: Types and Percent Cover of Habitats within the Nipomo Lupine DPA.

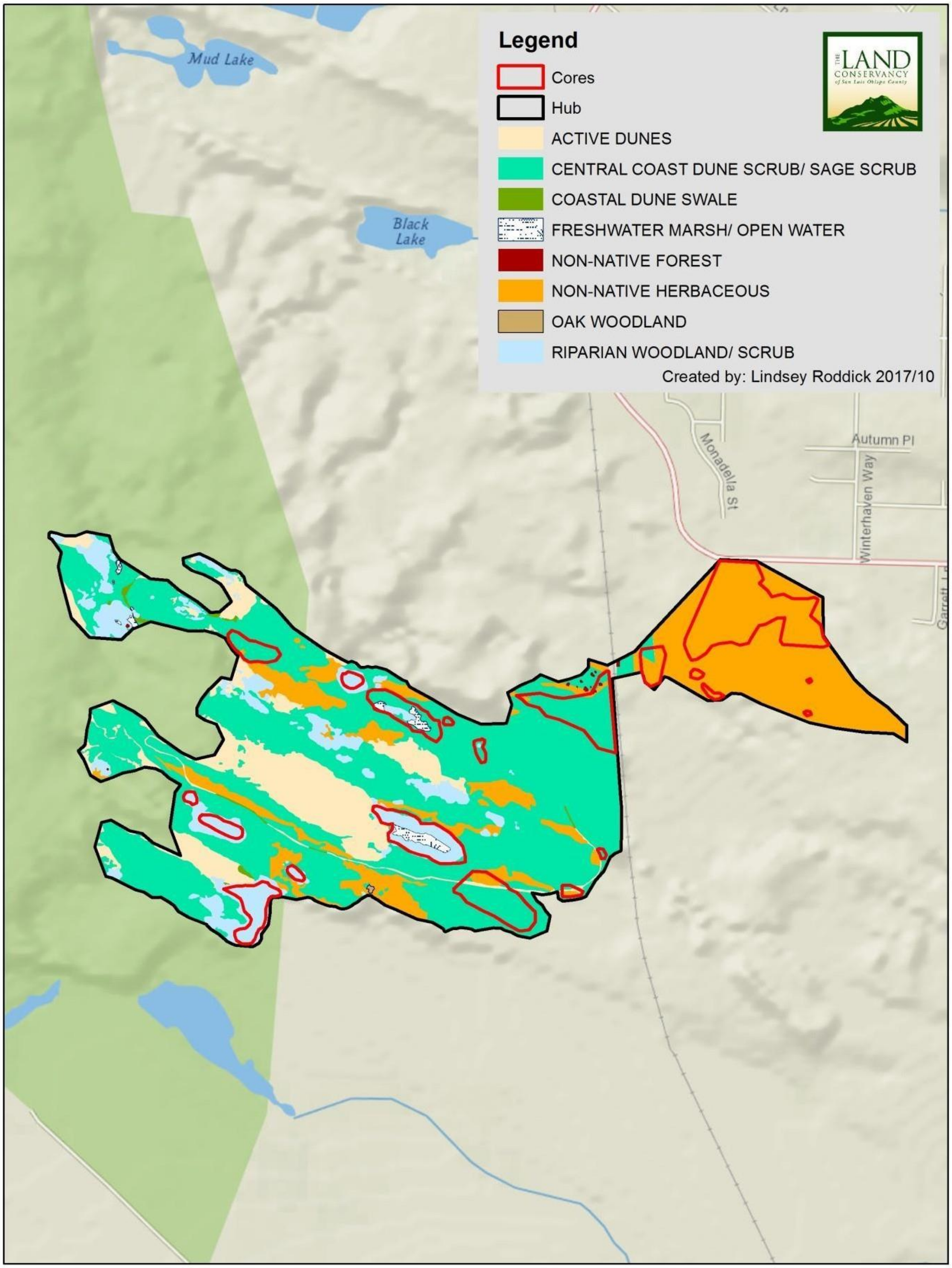


Figure 10: Habitat Types within the Nipomo Lupine DPA.

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 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 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 2.

Table 2: Species target list for Nipomo Lupine 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 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 3 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 3 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 4).

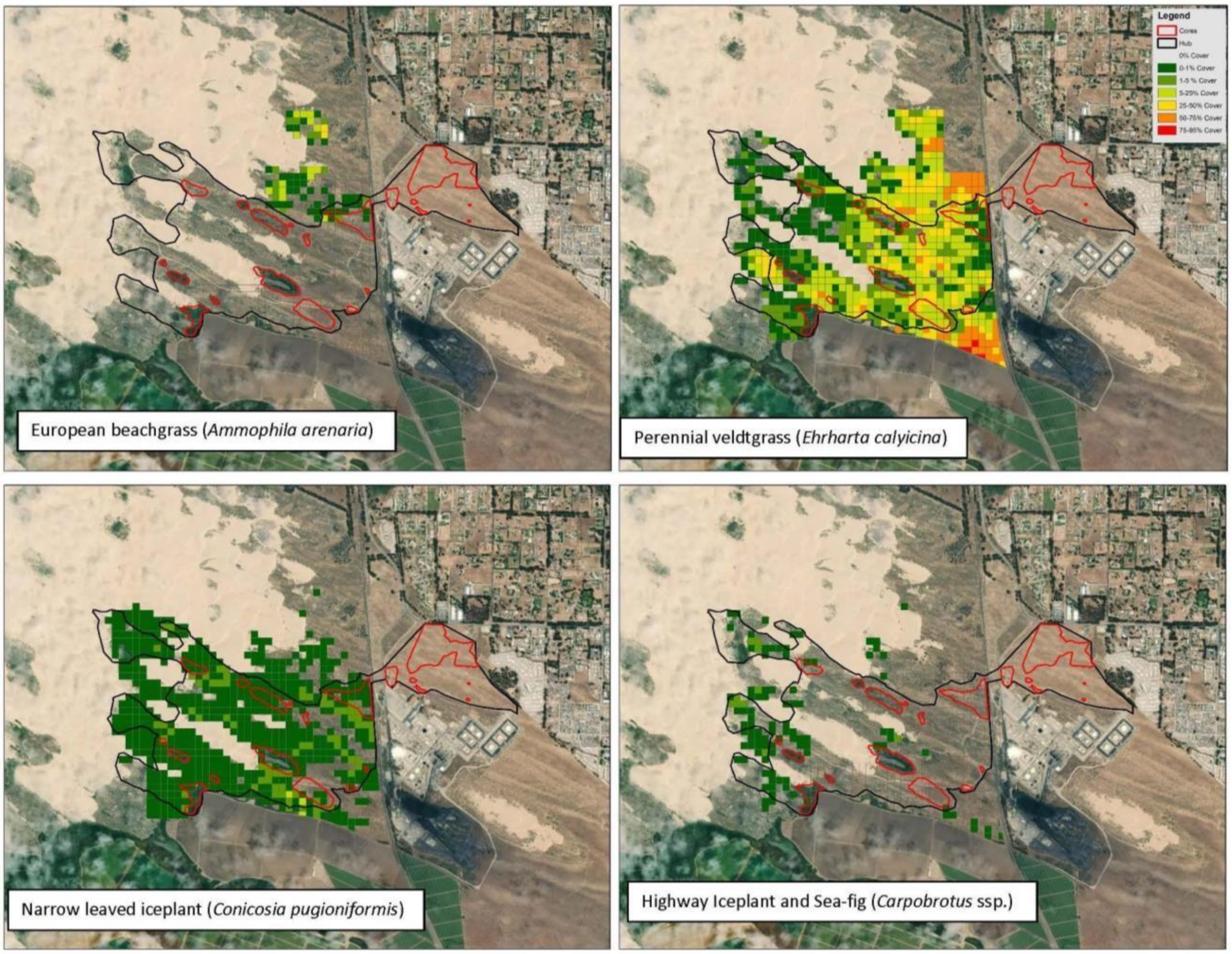
Table 3: Attribute field information associated with polygon data recorded during the survey.

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 4: 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 survey results are given in the maps and graphs below.



	Cores		Hub	
	Net Acres	**Gross Acres**	**Net Acres**	**Gross Acres**
Ehrharta calycina	3.323	32.775	28.352	269.523
Conicosia pugioniformis	0.207	26.997	2.405	258.460
Carpobrotus edulis	0.005	1.098	0.184	39.114
Ammophila arenaria	0.027	2.679	0.153	6.395

Figure 11: Distribution and abundance maps of dominant invasive species in the Nipomo Lupine DPA.

Opportunity Prioritization

Based on the assets and threats in the Nipomo Lupine 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 veldt grass (Ehrharta calycina) control

The Nipomo Lupine DPA contains dense perennial veldtgrass, especially within the coastal scrub habitat types. Perennial veldtgrass 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 shrub-dominated coastal dune scrub into a grassland. Perennial veldtgrass presents the largest threat to the federally endangered Nipomo lupine; it releases hundreds to thousands of seeds which fall near the parent plant and disperse short distances with wind. In the past, this DPA has been a high priority for restoration funds through the Dunes Collaborative RTF for the removal of perennial veldtgrass in order to preserve the Nipomo lupine.

Successful control methods utilize herbicide to kill the plant before it has the opportunity to go to flower or seed. Where appropriate, aerial application of herbicide to control perennial veldtgrass would be most effective, as certain areas are very dense.

It is anticipated that perennial veldt grass can be brought to manageable levels in this DPA, 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. ODSVRA is currently treating perennial veldtgrass in the western regions of this DPA and the RTF has funded State Parks to treat near Nipomo lupine populations since 2009. Management of the veldtgrass in this DPA has focused on removal through the use of herbicide from fall through spring (on ODSVRA-leased property, west of the railroad tracks) and grazing by cattle in the summer (east of the railroad tracks).

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.

Enhance Nipomo lupine habitat

The large majority of the only known natural population of Nipomo lupine is found within this DPA (small populations found in Cal Trans right-of-way and around the PG&E substation are not within this DPA). The natural population within this DPA is located on ancient sand dunes from the pre-Flandrian era (W. S. Cooper, 1967) which offers the open landscape preferred by Nipomo lupine. Successional movement of newer sand with denser coastal scrub habitat is slowly moving into the Nipomo lupine current populations. Nipomo lupine cannot migrate east due to CA Highway 1 and the urban development of Nipomo, CA. Restoration efforts should include holistic approaches that work in conjunction with adaptive monitoring to maximize successful habitat enhancement and expansion of Nipomo lupine. Approaches such as selective hand removal of dune scrub, scarification of Nipomo lupine seeds, and other preferred disturbance measures, when coupled with control of perennial veldtgrass, should be included in the suite of best management approaches will be considered and applied to introduce the appropriate level of disturbance to allow Nipomo lupine to thrive.

Priority 2 Opportunities

European beachgrass (Ammophila arenaria) control

Dense populations of European beachgrass are found in northern region of this DPA, but the most extensive beachgrass occurs outside of the DPA. European beachgrass forms a dense cover, spreading from rhizomes that excludes many native taxa and unnaturally stabilizes moving sand. RTF has funded treatment of European beachgrass from 2005-2010. State Parks is currently treating portions of the European beachgrass in this DPA and will continue to manage this invasive species. Control and eradication are most successful with a combination of prescribed fire followed by herbicide application and/or chemical control exclusively. ODSVRA has had success with both treatment methods.

Controlling European beachgrass is a priority 2 because, although there is a high probability of success, the majority of beachgrass needing to be treated is outside the DPA and is managed with other sources. It spreads predominantly from rhizomes and does not appear to develop extensive seedbanks in the GNDC. Because this is a distinct population, there is a high probability to achieve eradication without threat of re-introduction from outside areas.

Identify/ explore novel ways to promote expansion of Nipomo lupine

- Experimental outplanting of Nipomo lupine

Assess species responses to treatment

- Managing for federally-endangered la graciosa thistle (*Crisium scariosum* var. *loncholepsis*, CNPS Rare Pant Rank 1B.1LGT) viability through survey, vegetation management where necessary, and experimental outplanting.

Priority 3 Opportunities

Priority 3 Opportunities include the following:

Willow woodland & wetland viability management

- management of willow woodlands to support continued habitat viability
- Management of water quantity to support willow woodland and wetland viability

Explore modified land management and additional restoration opportunities

- Restoration of disturbed areas around roads and current vehicular paths of travel
- Control of sand movement into vegetated islands within the SVRA, primarily Boyscout Island, but others as well (ongoing activity)
- Early detection of weeds along railroad corridor

Assess species responses to treatment

- Assessing small mammal populations and understanding their response to treatment
- Surveys for herpetological resources and their response to treatment
- Surveys for breeding birds, and breeding bird response to treatments

Management Objectives, Actions, Method, Timeline and Budgets

The following Opportunity 1A combines control of perennial veldtgrass using aerial application via helicopter coupled with follow up on-the-ground spray crew treatments.

Opportunity 1A: Perennial veldt grass (Ehrharta calycina) control

The Nipomo Lupine DPA is plagued by dense perennial veldtgrass, especially within the coastal scrub habitat type. 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. Perennial veldtgrass presents the largest threat to the federally endangered Nipomo lupine; it releases hundreds to thousands of seeds which fall near the parent plant and disperses short distances with wind. In the past, this DPA has been a high priority for restoration funds through the Dunes Collaborative RTF for the removal of perennial veldtgrass in order to preserve the Nipomo lupine.

It is anticipated that perennial veldtgrass can be brought to manageable levels in this DPA, 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. State Parks is currently treating perennial veldtgrass in the western regions of this DPA and the RTF has funded State Parks in treatment near Nipomo Lupine populations since 2009. Management of the veldtgrass in this DPA has focused on removal through the use of herbicide in the fall (on State Parks-leased property, west of the railroad tracks) and grazed by cattle in the summer (east of the railroad tracks).

Successful control methods use herbicide to kill the plant before it has the opportunity to go to flower. An aerial application of herbicide to control perennial veldtgrass complimented by spray crew treatments will offer the most effective and efficient approach. A summary of actions for Opportunity 1A are summarized below. The map following the summaries will provide further visual clarification.

Action 1A.1: Control perennial veldtgrass via helicopter using Clethodim (a monocot specific herbicide) within the Nipomo lupine DPA at Phillips 66 lease site (cores and hub areas) while creating defensible spaces to minimize reintroduction from plant propagules. This approach will occur twice per year for three years across 167 acres (light blue in Phillips 66 hub). The first helicopter treatment will occur after monitoring for presence of veldtgrass seedlings after 0.5 inches of rainfall (October-January). The second treatment is one month after the first helicopter treatment.

Action 1A.2: Conduct follow-up control of perennial veldtgrass in areas treated via helicopter in Action 1A.1 via ground spray crew using Clethodim (a monocot specific herbicide) within the Nipomo lupine DPA at Phillips 66 lease site (cores and hub areas) across 130 acres. It is assumed that Action 1A.1 will be conservatively and approximately 25% successful. This approach will occur once per year for three years across 130 acres with a decreasing cost per acre each year due to an assumed reduced level of spraying effort but still including a survey of most of the hub area (light blue in Phillips 66 hub). This action will occur one month after helicopter treatment is completed to ensure early detection of resprouts in treated areas. This treatment will occur one month after first helicopter treatment.

Action 1A.3: Control perennial veldtgrass in hub areas that cannot be sprayed via helicopter in Phillips 66 lease site with spray crew (i.e., pink areas within wetland buffer- 29 acres). This treatment will occur twice per year with decreasing level of spray effort for years 2-3. This treatment will occur up to one week after the first helicopter treatment.

Action 1A.4: Control perennial veldtgrass via helicopter using Sethoxydim (a monocot specific herbicide) within the Nipomo lupine DPA at State Parks (cores and hub areas) while creating defensible spaces to minimize reintroduction from plant propagules. This approach will occur twice per year for three years across 86 acres (light green, dark green in State Parks including hub area). This treatment will coincide with Action 1A.1.

Action 1A.5: Conduct follow-up control of perennial veldtgrass in areas treated via helicopter in Action 1A.4 via ground spray crew using Sethoxydim (a monocot specific herbicide) within the Nipomo lupine DPA at State Parks (cores and hub areas) across 86 acres. It is assumed that Action 1A.5 will require follow-up surveys and treatment across all 86 acres due to the known effectiveness of the herbicide being used to be less than Clethodim. This approach will occur once per year for three years across 86 acres with a decreasing cost per acre in years 2-3 due to an assumed reduced level of spraying effort but still including a survey of most of the hub area (light green, dark green in State Parks including hub area). This action will occur one month after helicopter treatment is completed to ensure early detection of resprouts in treated areas.

Action 1A.6: Control perennial veldtgrass in remaining hub/State Parks area (that cannot be treated with helicopter) with spray crew (yellow, light yellow in 40.5 acres). This treatment will occur twice per year with decreasing level of spray effort for years 2-3. This treatment will occur one month after helicopter treatment.

Action 1A.7: Control perennial veldtgrass via helicopter using Clethodim (a monocot specific herbicide) within the Nipomo lupine DPA at Phillips 66 lease site in areas outside of core and hub in order to create defensible spaces to minimize reintroduction from plant propagules. This approach will occur twice per year for three years across 102 acres and does not include follow-up spray crew treatment (dark blue in Phillips 66 hub). As such, for 3 years, 102 acres will be surveyed and treated via helicopter. The first helicopter treatment after monitoring for presence of veldtgrass seedlings after 0.5 inches of rainfall (October-January), and will coincide with other helicopter treatments to maintain cost effectiveness.

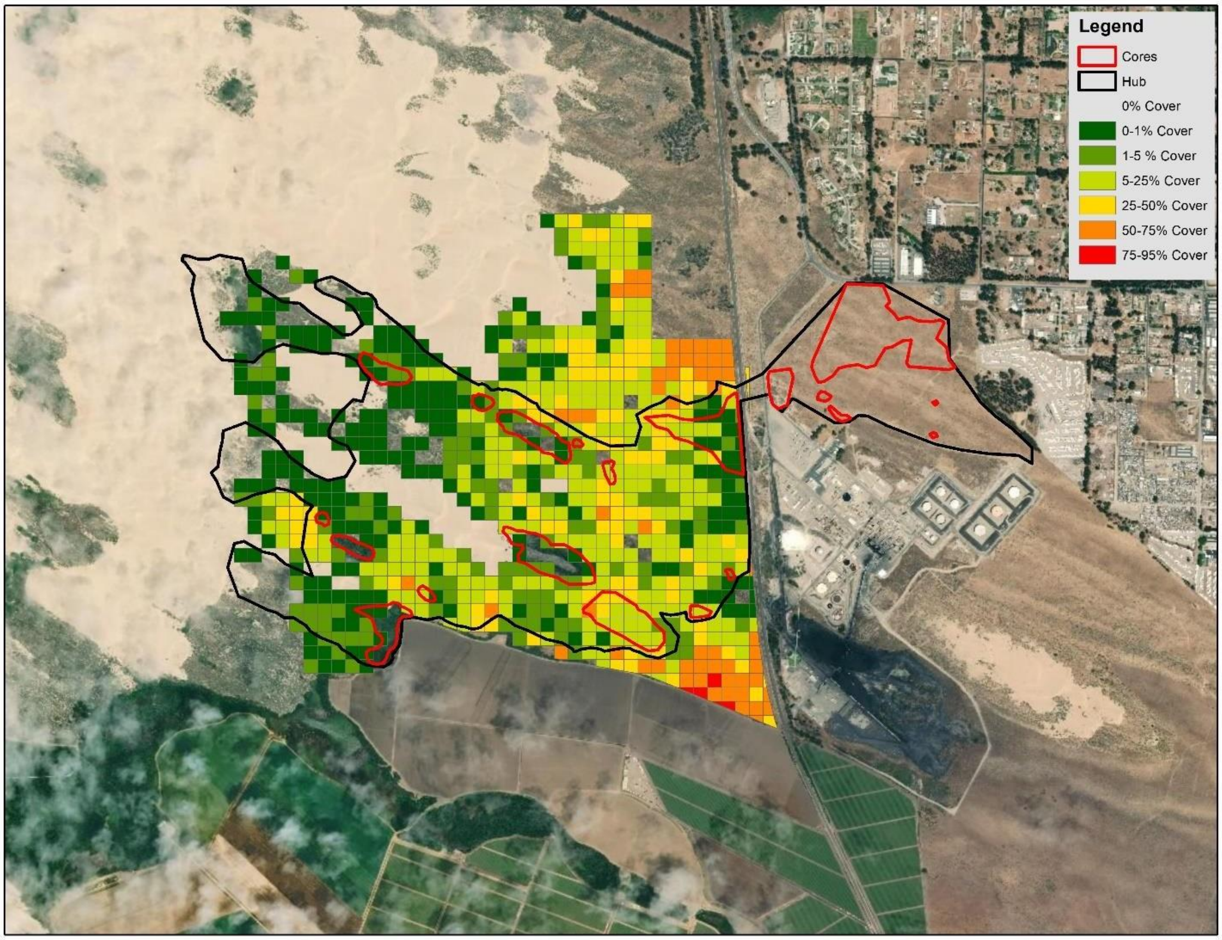


Figure 12: Distribution and abundance of perennial veldtgrass mapped in 2017 within the Nipomo Lupine DPA (Hubs and Cores).

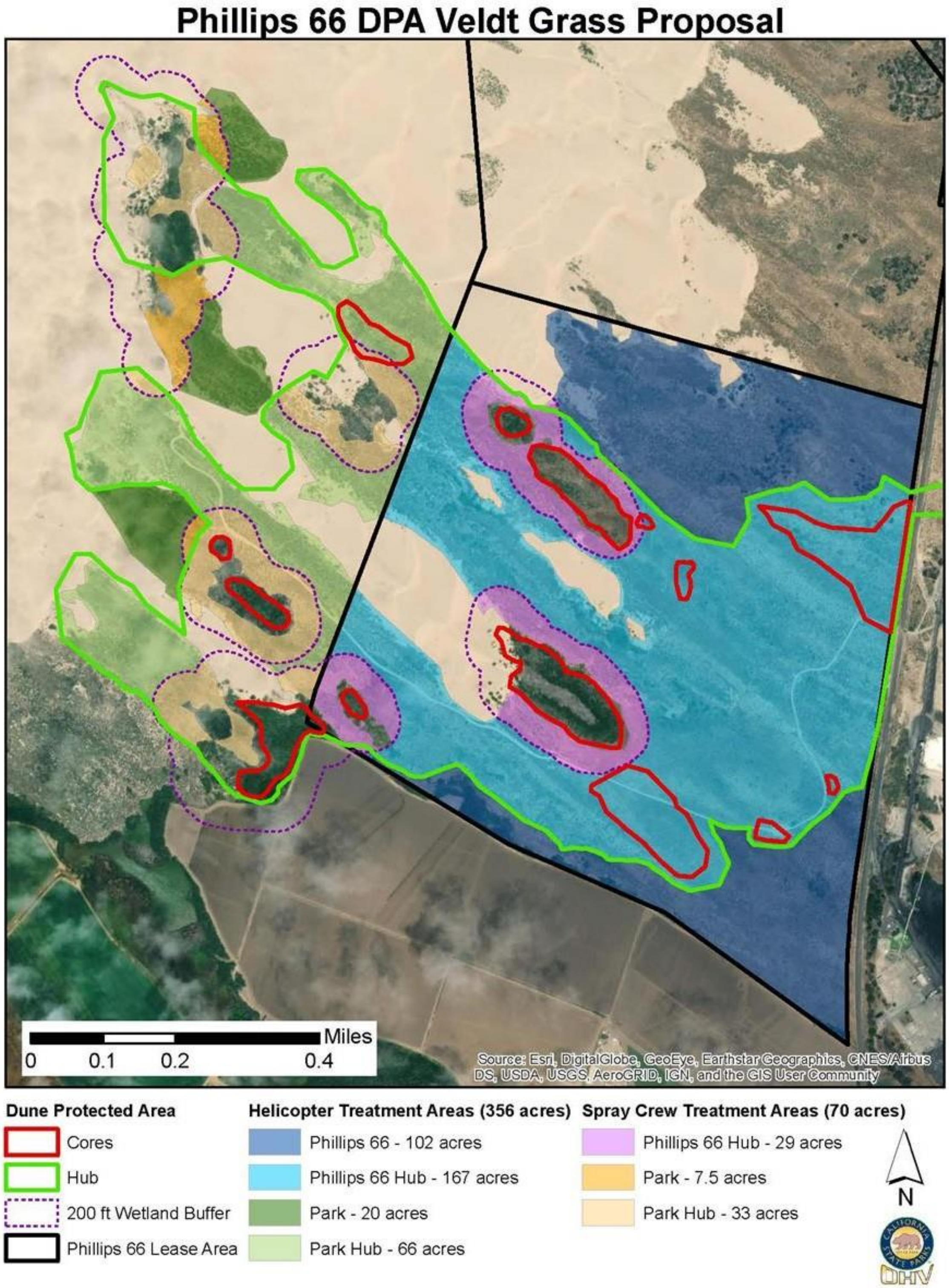


Figure 13: Perennial veldtgrass control in Nipomo Lupine DPA.

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. 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.

First treatments are expected to occur between October and January, after the first rain of the season. Follow up treatments in March may overlap with nesting bird season (3/1 or 3/15, variable).

Table 5: 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 1A Cost Estimates:

Nipomo Lupine DPA Monitoring	Cost/3 years
Opportunity 1A.1: Perennial Veldtgrass Control P66 (Helicopter Treatment)	$35,070.00
Opportunity 1A.2: Perennial Veldtgrass Control P66 (Spray Crew Follow-up Treatment)	$92,300.00
Opportunity 1A.3: Perennial Veldtgrass Control P66 (Spray Crew Treatment- no Helicopter)	$72,500.00
Opportunity 1A.4: Perennial Veldtgrass Control State Parks (Helicopter Treatment)	$18,060.00
Opportunity 1A.5: Perennial Veldtgrass Control State Parks (Spray Crew Follow-up Treatment)	$61,060.00
Opportunity 1A.6: Perennial Veldtgrass Contorl State Parks (remaining Park Area)	$101,250.00
Opportunity 1A.7: Perennial Veldtgrass Control P66 (Helicopter, outside of core/hub)	$21,420.00
Phase 1 Total	**$401,660.00**

Opportunity 1 B: Nipomo lupine habitat enhancement
The large majority of the only known natural population of Nipomo lupine is found within this DPA. Proposed restoration efforts include holistic approaches that work in conjunction with adaptive monitoring to maximize successful habitat enhancement and expansion of Nipomo lupine. Approaches such as selective hand removal of dune scrub, soil scarification, and other preferred disturbance measures, when coupled with control of perennial veldtgrass, should be included in the suite of best management approaches will be considered and applied to introduce

the appropriate level of disturbance to allow Nipomo lupine to thrive. The effort includes 4 staff to induce disturbance measures twice per year for 3 years throughout the entire DPA.

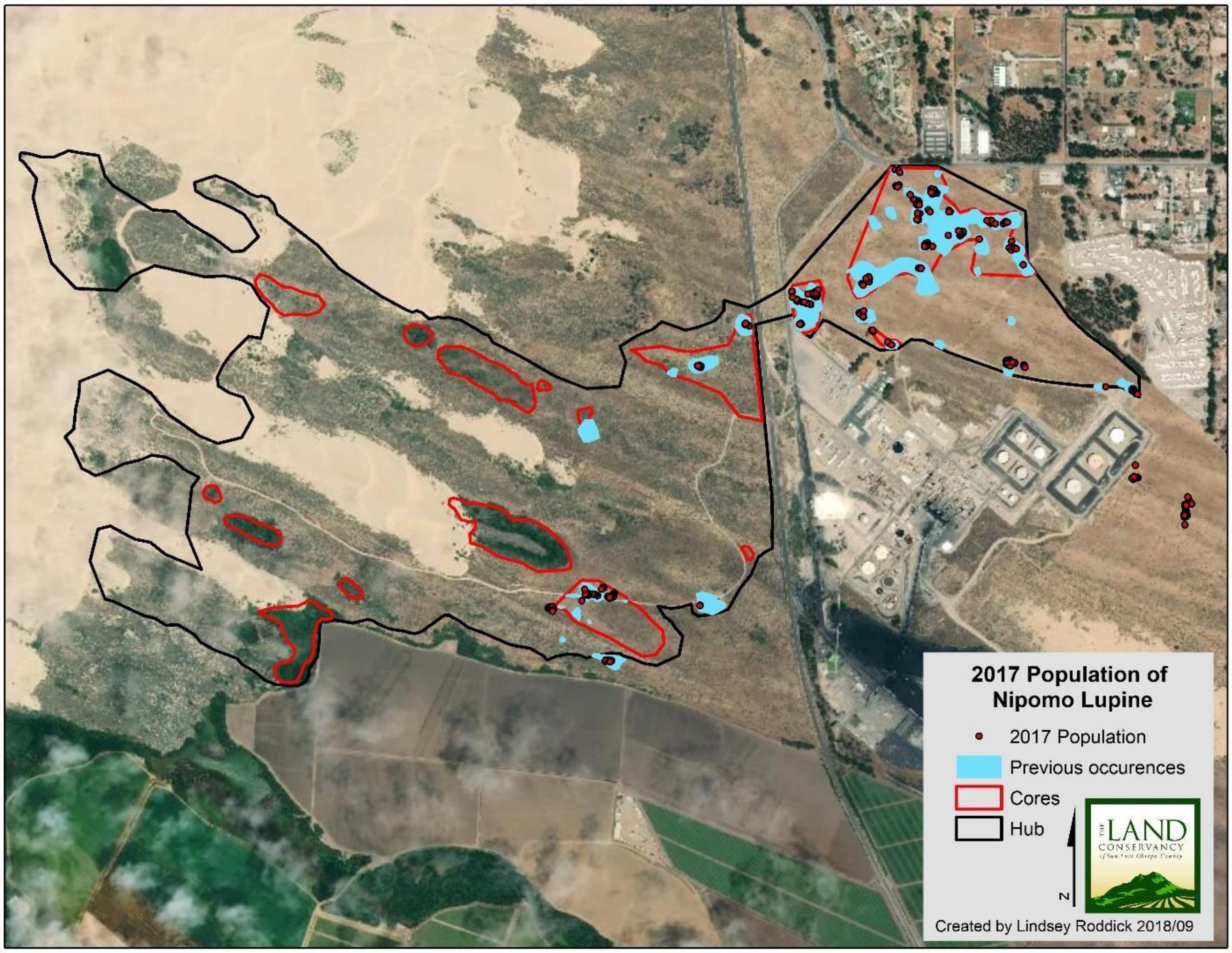


Figure 14: Known Nipomo lupine population within Nipomo Lupine DPA.

Schedule:

Visual estimates of vegetative cover in occupied habitat areas will be conducted after the Nipomo lupine have set seed for the season. Areas where vegetation removal or other types of soil manipulation will be identified and appropriate treatments will be determined based on best available science and in close coordination with appropriate state and federal wildlife agencies. Treatments will occur prior to germination of Nipomo lupine or in October – December of each year. Monitoring will occur during the spring (typically April – May) and may be modified if any fecundity surveys are implemented.

Opportunity 1B Cost Estimate:

Opportunity 1B	**Cost/3 years**
Opportunity 1B: Nipomo lupine habitat enhancement	$30,000.00
Phase 1 Total	**$30,000.00**

Opportunity 2A: European beachgrass (*Ammophila arenaria*) control

Dense populations of European beachgrass are mainly located outside of this DPA to the north. State Parks intends to continue to manage European beachgrass and as such this is not included with priority 1 actions. RTF has funded treatment of European beachgrass 2005-2010. State Parks is currently treating portions of the European beachgrass in this DPA. Control and eradication are most successful by chemical control. Because this is a distinct population, there is a high probability to achieve eradication without threat of re-introduction from outside areas.

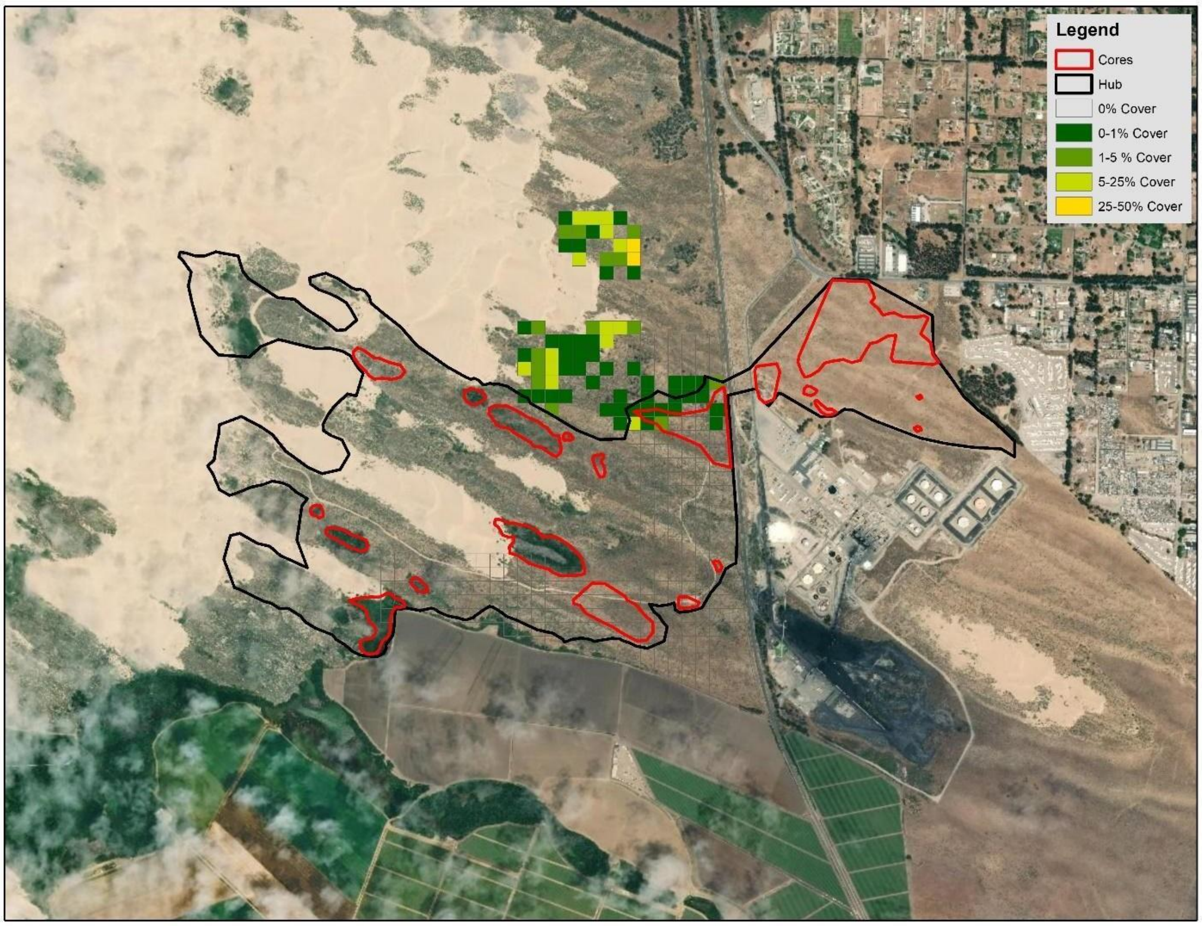


Figure 15: Distribution and abundance of European beachgrass mapped in 2017 within the Nipomo Lupine DPA (Hubs and Cores).

Opportunity 2A Cost Estimate:

No cost estimate was determined for this restoration opportunity.

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 Nipomo lupine DPA are the endangered Nipomo lupine, dune larkspur, intact soil crusts, dune almond, a diversity of lichens and mosses, vertebrates (including nesting birds), and wetland areas.

The following practices will be implemented working around these resources.

- Breeding birds- avian resources avoidance. State Parks will closely coordinate with CDFW to ensure helicopter treatments to not affect avian resources.
- Permit measures will be followed.
- Known Nipomo lupine areas will be clearly marked in field, and all crews will be educated on sensitivity of foot traffic.
- While working in zones containing dune almond during the growing season, considerable care will be taken to avoid trampling.
- Impacts will be minimized in areas where intact soil crusts are present; to the extent feasible, crews will stay on existing paths and trail. Disturbance of existing plants will be minimized, and all crews will reduce spread of weeds via transport of seed on clothing and boots.
- Small wetlands/riparian areas: A 200-ft buffer has been identified within which no herbicide treatment will occur.

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 (PCA) 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 6: 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 7: 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.

<u>Management Activity Monitoring:</u>
All management activities will be tracked using ESRI ArcGIS.

<u>Monitoring to Inform Management:</u>
This monitoring type is specific for each Objective. Objectives are listed below with expected values and descriptions of monitoring protocols.

Objective 1A: Reduce perennial veldtgrass (*Ehrharta calycina*) cover to 10% cover class by year 3 in the Nipomo lupine DPA (Hub and Cores).

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of *E. calycina* maintained at a 10% cover class value throughout the DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure cover class values are being maintained.

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 (Dunes Collaborative 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: Nipomo lupine habitat enhancement

Performance monitoring will occur on an annual basis and with be coordinated with other monitoring of Nipomo lupine populations. The goal of this effort is to promote growth and seed production of Nipomo lupine through reduction of competition and introduction of appropriate disturbance regimens. It will be difficult to determine the effects of treatments versus normal population variation in any given year. Therefore, monitoring will compare untreated areas with treated areas where practical. The goal of this effort will be an increase in germination, flowering, and seed set (or other appropriate peer-reviewed metrics) in Nipomo lupine each year and cumulatively after the three years of treatment.

Protocol:
Visual estimates of vegetative cover in occupied habitat areas will be conducted after the Nipomo lupine have set seed for the season. Areas where vegetation removal or other types of soil manipulation will be identified, and appropriate treatments will be determined based on best available science and in close coordination with appropriate state and federal wildlife agencies. Each year, treatments will be evaluated based on visual observations during the peak flowering period for the Nipomo Lupine. Comparative monitoring will occur in treated versus untreated areas to discern effects of treatments from normal population variation. In consultation with subject matter experts and wildlife agencies, monitoring may also look at species fecundity metrics like plant density, flower density, seed set, or other metrics.

Actions if Objective is not met: If this objective is not met, additional consultation with academics, subject matter experts, and state and federal wildlife agencies will be initiated. Modifications to treatments or methods will be considered as appropriate.

<u>Baseline Monitoring:</u>
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 determine 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, this 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.

Monitoring Cost Estimates:

Monitoring cost estimates are based on performance monitoring for Priority 1 Opportunities, releve monitoring, and reporting.

Table 8: Monitoring cost estimates for Nipomo lupine DPA.

Nipomo Lupine DPA Monitoring	Cost/3 years
Monitoring	$35,000.00
Phase 1 Total	**$35,000.00**

Appendix C:

Big Coreopsis Hill DPA

Site Description

Figure 1: Giant coreopsis *(Leptosyne gigantea*) at Big Coreopsis Hill.

Big Coreopsis Hill DPA contains land owned by State Parks and privately- owned agricultural properties just south of Oso Flaco Lake and is near the Guadalupe-Nipomo Dunes National Wildlife Refuge. The site is bordered by active agricultural operations to the north. The private landowners are supportive of preserving the site in perpetuity but no conservation easement is yet held on the property.

The site is not currently actively managed and sees minimal human disturbance. The DPA can be accessed via a private road for ODSVRA and the Guadalupe-Nipomo Dunes National Wildlife Refuge. There is no public access from the inland side but it is accessible by foot from the beach (.6 miles inland). This DPA was selected for its intact habitats and unique plant species assemblage.

GNDC advocate, Kathleen Goddard Jones was particularly fond of this site because of its beautiful blooms. During the spring, the north-facing slope of the valley is covered with dune larkspur (*Delphinium parryi* ssp. *Blochmaniae),* carnival poppy (*Hesperomecon linearis*) and the beloved giant coreopsis (*Leptosyne gigantea*). The valley appears to be somewhat resistant to invasion by perennial veldtgrass (*Ehrharta calycina*), probably because of the colder and wetter conditions found at the bottom of the valley.

Figure 2: Coreopsis Hill looking north at Oso Flaco Lake and neighboring agricultural lands.

Figure 3: Big Coreopsis Hill looking toward ocean.

Big Coreopsis Hill DPA is currently experiencing natural successional change as a large active dune is moving eastward through the stabilized coastal dune scrub bordering this DPA. The blowout of active sand is encouraging new plant species such as dune mints (*Monardella* spp.) and nonnative European sea rocket (*Cakile maritima*) to establish. Successional changes offer a diversity of species but also bring new invasive species to which management must adapt.

There are many information gaps that limit our understanding of this DPA. Big Coreopsis Hill is visited each year by botanists of CNPS to record species presence and population numbers. This region was extensively surveyed in 1995 for vegetation types and floral species by Arthur Hazebrook (Hazebrook, 1995). Occurrence data for natural resources within this DPA is incomplete.

Major management challenges in this DPA include the threat of invasive species from areas outside of the DPA. Perennial veldtgrass is dense in the areas to the east of the DPA and has potential to invade the DPA if not managed. No invasive species management is currently being done within this DPA but the neighboring ODSVRA has actively managed for European beachgrass and perennial veldtgrass. The agricultural operation to the north presents a potential source of nonnative seed and agricultural invasive species, specifically that of annual grasses. Surrounding private ownership presents an opportunity to build relationships and expand management of this DPA by exploring opportunities to control invasive species from outside of the DPA.

This DPA has many data gaps that will be addressed through a preliminary site assessment. The table below is a plant list compiled by a recent survey.

Scientific Name	**Common Name**
FERNS	
DENNSTAEDIACEAE	**Bracken Family**
Pteridium aquilinum	Western brackenfern
EUDICOTS	
ADOXACEAE	**Muskroot Family**
Sambucus nigra ssp. caerulea	blue elderberry
AIZOACEAE	**Fig-Marigold Family**
**Carpobrotus chilensis*	sea fig
**Carpobrotus edulis*	freeway iceplant
**Conicosia pugioniformis*	narrow leaved iceplant
ANACARDIACEAE	**Sumac or Cashew Family**
Toxicodendron diversilobum	poison oak
APIACEAE	**Carrot Family**
**Conium maculatum*	*poison hemlock
**Foeniculum vulgare*	*fennel
ARALIACEAE	
Hydrocotyle verticillata	whorled marshpennywort
ASTERACEAE	**Sunflower Family**
Achillea millefolium	yarrow
Ambrosia chamissonis	beach bur
Ambrosia psilostachya	ragweed
Artemisia californica	California sagebrush
Artemisia dracunculus	tarragon
Baccharis glutinosa	saltmarsh baccharis
Baccharis pilularis	coyote brush
**Carduus pycnocephalus*	*Italian thistle
**Centaurea melitensis*	*tocalote
Cirsium occidentale var. occidentale	cobweb thistle
Cirsium rhothophilum	**surf thistle**
**Cirsium vulgare*	*bull thistle
Coreopsis [Leptosyne] gigantea	giant coreopsis
Corethrogyne filaginifolia	California sandaster
Deinandra paniculata	**paniculate tarplant**
Ericameria ericoides	mock heather
Erigeron canadensis	horseweed
Erigeron blochmaniae	**Blochman's leafy daisy**
Eriophyllum staechadifolium	lizard tail

Scientific Name	**Common Name**
Hazardia squarrosa	sawtooth goldenbush
Heterotheca grandiflora	telegraph weed
Jaumea carnosa	marsh jaumea
Logfia filaginoides	California cottonrose
Malacothrix californica	California dandelion
Malacothrix incana	**dunedelion**
Pseudognaphalium bioletti	twocolor cudweed
Pseudognaphalium californicum	ladies' cudweed
Psuedognaphalium canescens	Wright's cudweed
Pseudognaphalium ramosissimum	pink cudweed
Senecio blochmaniae	**Blochman's groundsel**
Solidago confinis	Southern goldenrod
**Sonchus asper*	*prickly sow thistle
**Sonchus oleraceus*	*common sow thistle
Stephanomeria virgata	tall stephanomeria
BORAGINACEAE	**Borage Family**
Amsinckia spectabilis var. microcarpa	small fruit seaside fiddleneck
Cryptantha clevelandii	Cleveland's cryptantha
Phacelia ramosissima	branching phacelia
Pholisma arenarium	desert pholisma
Plagiobothrys sp.	popcorn flower
BRASSICACEAE	**Mustard Family**
**Brassica nigra*	*black mustard
**Cakile maritima*	*sea rocket
Erysimum suffrutescens	**suffrutescent wallflower**
CACTACEAE	**Cactus Family**
Opuntia phaeacantha	prickly pear
CAPRIFOLIACEAE	**Honeysuckle Family**
Lonicera involucrata var. ledebourii	twinberry honeysuckle
CARYOPHYLLACEAE	**Pink Family**
Cardionema ramosissimum	sand Mat
Silene laciniata var. laciniata	cardinal catchfly
CONVOLVULACEAE	**Morning Glory Family**
Calystegia soldanella	beach morning glory
CRASSULACEAE	**Stonecrop Family**
Dudleya lanceolata	Southern California dudleya
EUPHORBIACEAE	**Spurge Family**
Croton californicus	California croton

Scientific Name	**Common Name**
FABACEAE	**Legume Family**
Acmispon heermannii var. heermannii	Heerman's lotus
Astragalus nuttallii var. nuttallii	**Nuttall's milkvetch**
Lotus scoparius [Acmispon glaber]	deerweed
Lupinus chamissonis	silver dune lupine
FAGACEAE	**Oak Family**
Quercus agrifolia	coast live oak
GROSSULARIACEAE	**Gooseberry Family**
Ribes divaricatum var. pubiflorum	straggly gooseberry
Ribes sanguineum	flowering currant
LAMIACEAE	**Mint Family**
Monardella undulata* ssp. *crispa	**crisp monardella**
Monardella undulata* ssp. *undulata	**San Luis Obispo monardella**
Salvia mellifera	black sage
Salvia columbariae	chia
NYCTAGINACEAE	
Abronia latifolia	yellow sand verbena
Abronia maritima	**red sand verbena**
Abronia umbellata	pink sand verbena
ONAGRACEAE	**Evening Primrose Family**
Camissoniopsis cheiranthifolia var. *cheiranthifolia*	beach evening primrose
Camissonia strigulosa	contorted primrose
Epilobium ciliatum var. watsonii	Watson's willowherb
OROBANCHACEAE	**Broomrape Family**
Castilleja exserta var. exserta	purple owl's clover
Castilleja latifolia	**Monterey Indian paintbrush**
PAPAVERACEAE	**Poppy Family**
Eschscholzia californica	California poppy
Hesperomecon linearis	Carnival poppy
Linanthus californicus	**fuzzy prickly phlox**
POLYGONACEAE	**Buckwheat Family**
Chorizanthe angustifolia	narrow-leaf spineflower
Eriogonum parvifolium	seacliff buckwheat
Mucronea californica	**California spineflower**

Scientific Name	**Common Name**
RHAMNACEAE	**Buckthorn Family**
Frangula californica ssp. californica	California coffeeberry
ROSACEAE	**Rose Family**
Fragaria chiloensis	beach strawberry
Heteromeles arbutifolia	toyon
Horkelia cuneata var. cuneata	wedge-leaved horkelia
Potentilla anserina var. pacifica	Pacific silverweed
Rubus ursinus	California blackberry
SALICACEAE	**Willow Family**
Populus trichocarpa	black cottonwood
Salix lasiolepis	arroyo willow
SOLANACEAE	**Nightshade Family**
Solanum douglasii	Douglas' nightshade
URTICACEAE	**Nettle Family**
Urtica dioica	stinging nettle
MONOCOTS	
CYPERACEAE	**Sedge Family**
Carex praegracilis	field sedge
Schoenoplectus americanus	American bulrush
Schoenoplectus californicus	California bulrush
JUNCACEAE	**Rush Family**
Juncus effusus var. brunneus	bog rush
Juncus lescurii	dune rush
POACEAE	**Grass Family**
**Ammophila arenaria*	*European beachgrass
**Bromus diandrus*	*ripgut brome
**Bromus madritensis var. rubens*	*red brome
**Cortaderia jubata*	*jubata grass
Distichlis spicata	salt grass
**Ehrharta calycina*	*perennial veldt grass
Elymus glaucus	blue wildrye
**Festuca bromoides*	*brome fescue
Koeleria macrantha	June grass
Leymus [Elymus] condensatus	giant wild rye
Melica imperfecta	California melic
**Polypogon monspeliensis*	*rabbitsfoot grass
TYPHACEAE	**Cattail Family**
Sparganium eurycarpum var. eurycarpum	broadfruit bur-Reed

Scientific Name	**Common Name**
Typha latifolia	broadleaf cattail

*indicates non-native

Bold= Special-status Species

Management History

Perennial veldtgrass at Big Coreopsis Hill was treated by LCLSO in 2007-2008. Following this treatment, there was reduced presence of veldtgrass, but due to the brevity of the treatment and the considerable seedbank remaining the veldtgrass re-invaded the area.

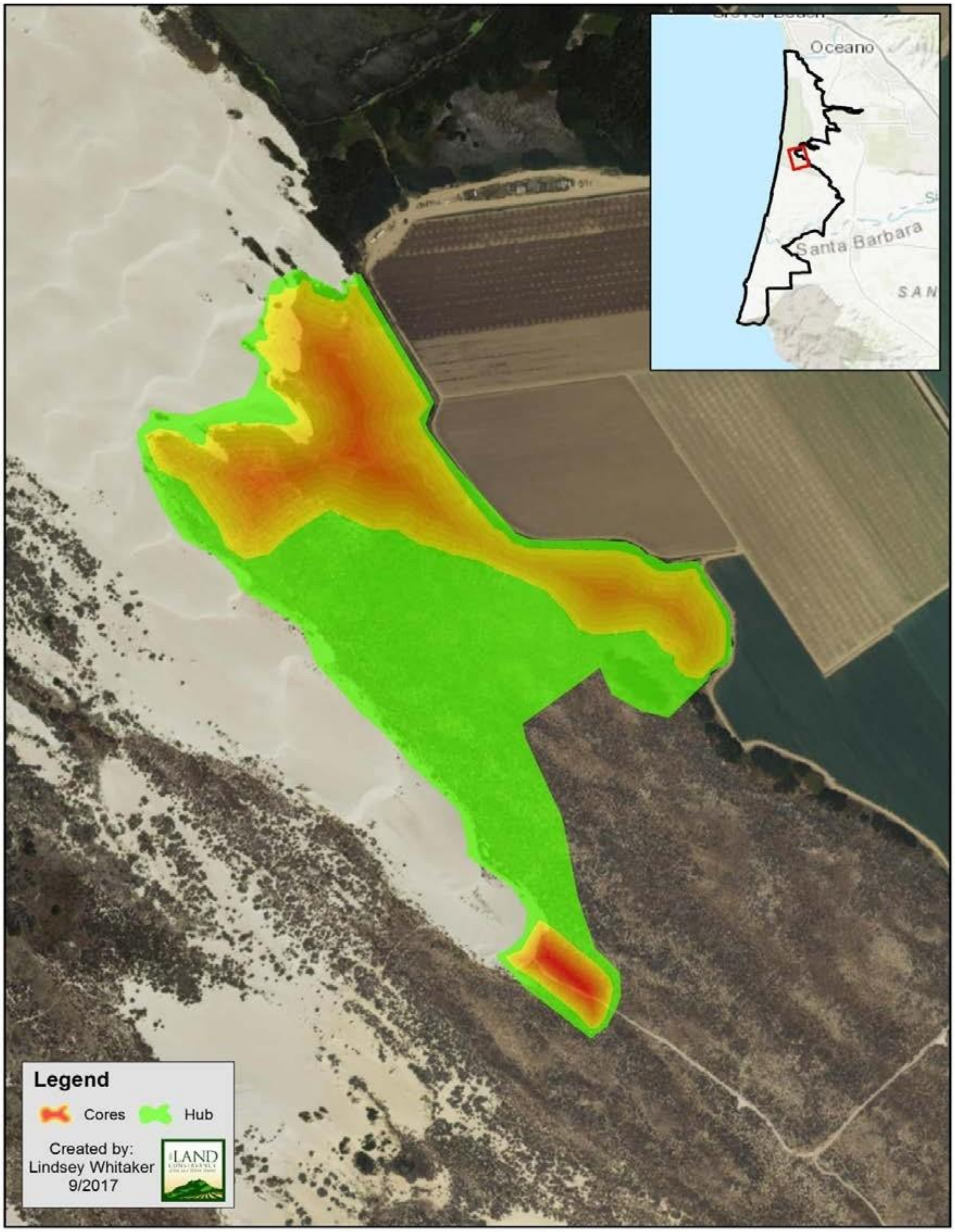


Figure 4: Boundary of the Big Coreopsis Hill DPA with Cores and Hub area.

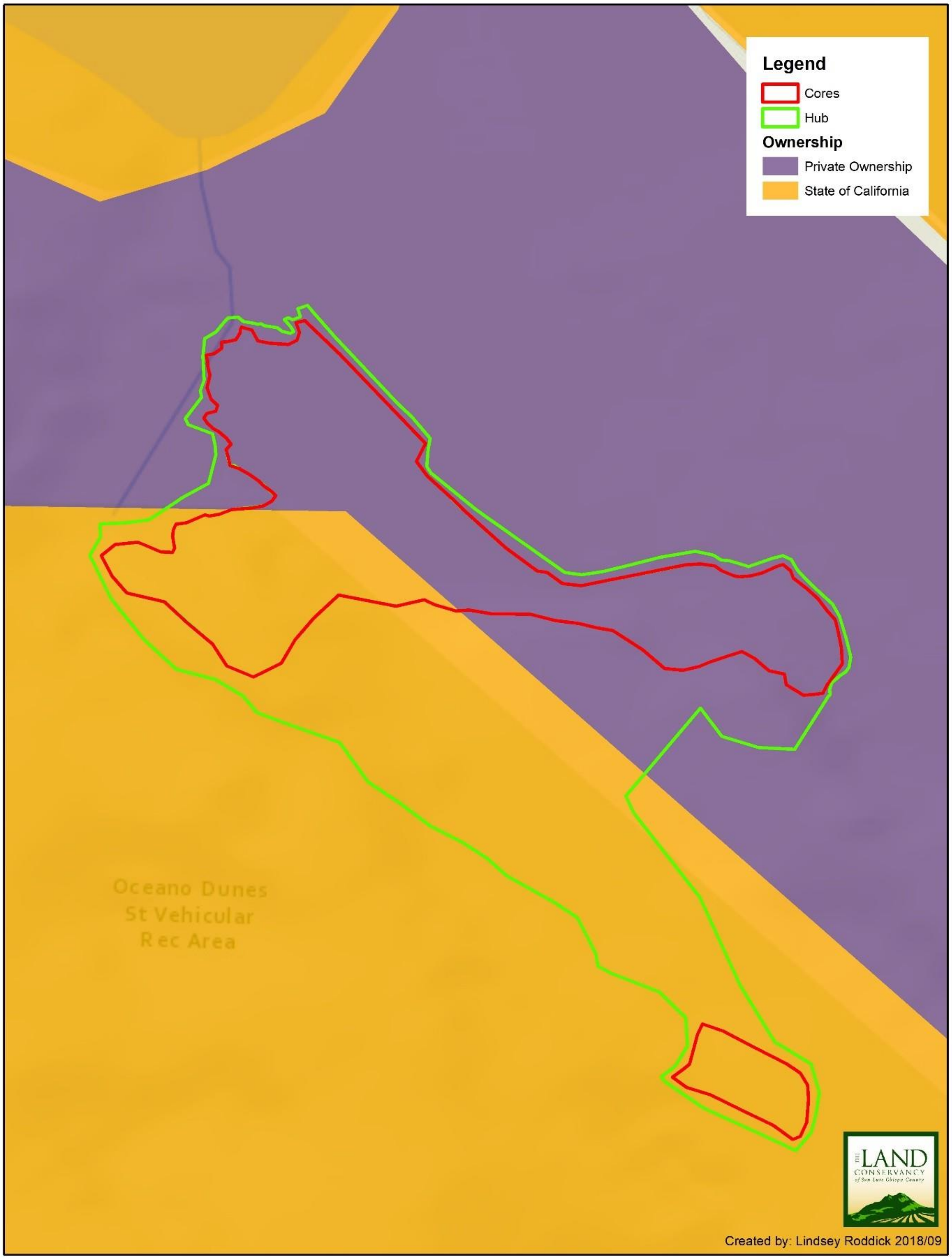


Figure 5: Property boundary/ ownership of the Big Coreopsis Hill DPA.

Site Assessment

The site assessment for Big Coreopsis Hill DPA is a snapshot in time setting representing a baseline of site conditions during the years 2017-2018. This includes a species inventory as well as geospatial data for habitat types, conservation targets, and threats.

Species Inventory

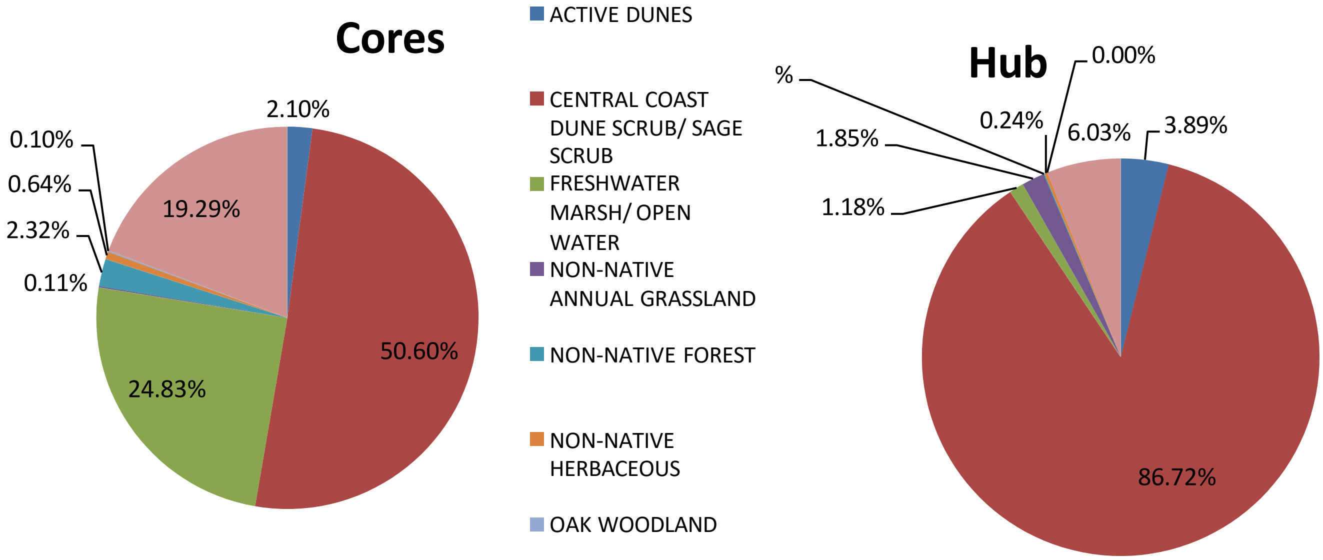
In 2017, a series of meetings were held with technical experts to determine which Conservation Targets were known to, or likely to, occur in the Big Coreopsis Hill DPA. Many of the technical experts were not familiar with this region of the GNDC and were not able to contribute to this DPA site assessment. Those species were known are included in the table below.

Table 31: Conservation targets known or likely to occur at Big Coreopsis Hill DPA.

Bird Fine Filter Species	Flora Fine Filter Species
Unknown	*Astragalus nuttallii* var. *nuttallii* (Nuttall's milkvetch)
	Cirsium scariosum var. *loncholepis* (La graciosa thistle)
Mammal Species	*Cirsium rhothophilum* (surf thistle)
Unknown	*Cladium californicum* (California sawgrass)
	Delphinium parryi var. *blochmaniae* (dune larkspur)
	Erysimum suffrutescens (suffrutescent wallflower)
	Horkelia cuneata ssp. *puberula* (Mesa horkelia)
	Horkelia cuneata ssp. *sericea* (Kellogg's horkelia)
	Juncus acutus ssp. *leopoldii* (Leopold's rush)
	Leptodactylon californicum ssp. *tomentosum* (prickly phlox)
	Leptosyne gigantea (giant coreposis)
	Monardella undulata ssp. *crispa* (dune mint)
	Monardella sinuata ssp. *sinuata* (dune mint)
	Monardella undulata ssp. *undulata* (dune mint)
	Mucronea california (California spineflower)
	Orobanche parishii ssp. *brachyloba* (Parish's broomrape)
	Scrophularia atrata (black flowered figwort)
	Senecio blochmaniae (Blochman's groundsel)

Habitats

The Big Coreopsis Hill DPA (Hubs and Cores) is composed of the following habitat types:



Habitat Type	Core Acres	Core %	Hub Acres	Hub %
ACTIVE DUNES	0.62	2.10%	1.47	3.89%
CENTRAL COAST DUNE SCRUB/ SAGE SCRUB	15.00	50.60%	32.78	86.72%
FRESHWATER MARSH/ OPEN WATER	7.36	24.83%	0.45	1.18%
NON-NATIVE ANNUAL GRASSLAND	0.03	0.11%	0.70	1.85%
NON-NATIVE FOREST	0.69	2.32%	0.03	0.09%
NON-NATIVE HERBACEOUS	0.19	0.64%	0.09	0.24%
OAK WOODLAND	0.03	0.10%	0.00	0.00%
RIPARIAN WOODLAND/ SCRUB	5.72	19.29%	2.28	6.03%
TOTAL	**29.64**		**37.80**	

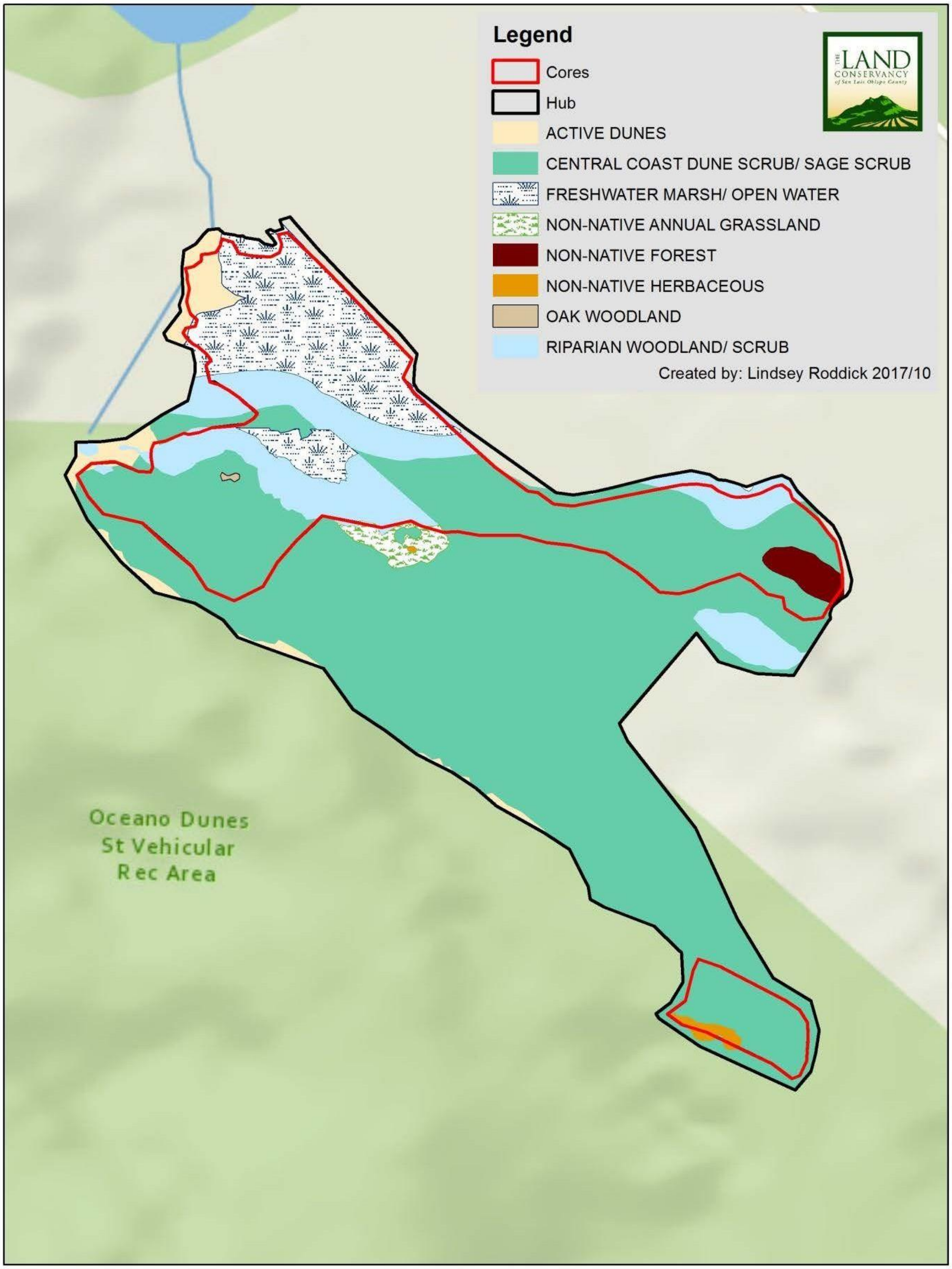


Figure 6: Habitat types within the Big Coreopsis Hill DPA.

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 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 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 has yet to be developed based on site-specific existing conditions.

Table 1: Species list for Monitoring surveys at Nipomo Lupine DPA.

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

Surveys in the Guadalupe Nipomo Dunes Complex collected data 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 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 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 2 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 2 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 3).

Table 2: 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 3: 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).

Preliminary surveys have been conducted for iceplant and perennial veldtgrass in this DPA. The survey results are shown in the maps below.

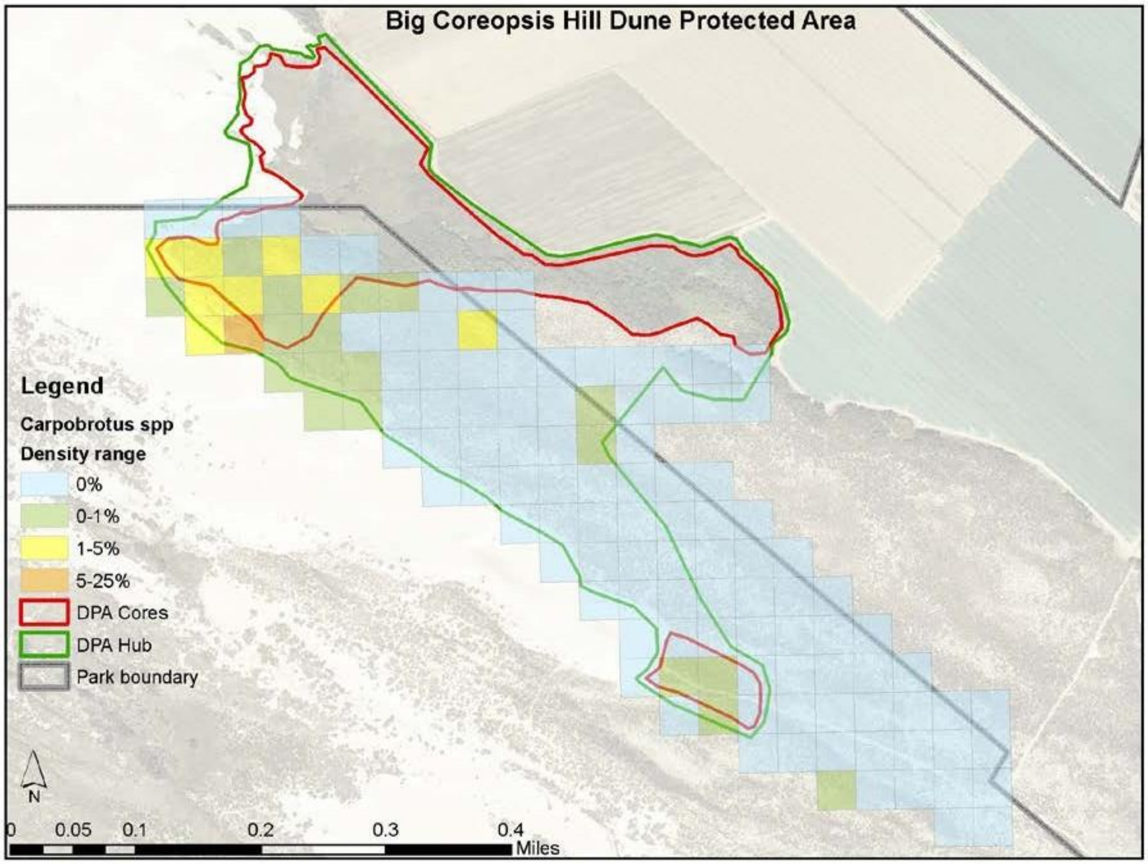


Figure 7: Distribution and abundance maps of iceplant in the Big Coreopsis Hill DPA. It is estimated that iceplant covers approximately 2 acres within the DPA.

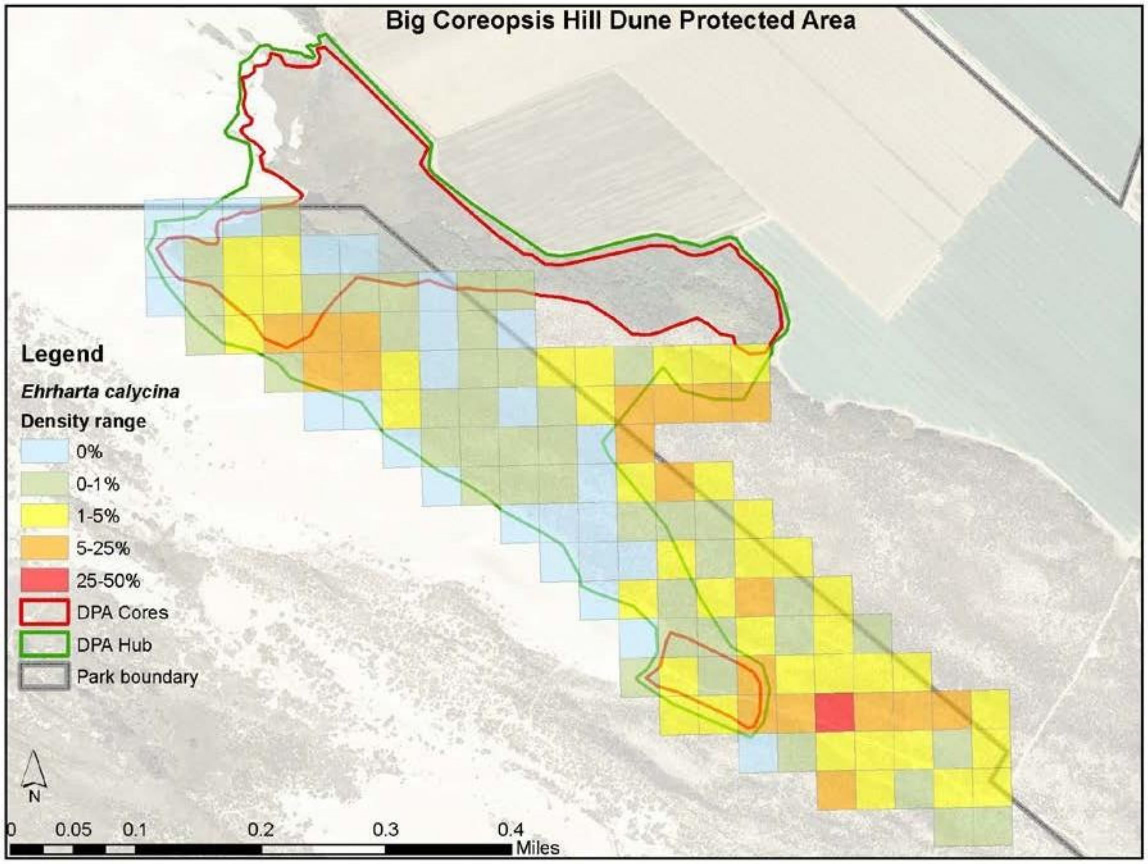


Figure 8: Distribution and abundance maps of perennial veldtgrass in the Big Coreopsis Hill DPA.

Table 4: Net and gross acreages within core and hub areas of perennial veldtgrass in the Big Coreopsis Hill DPA.

	Cores		Hub	
	Net Acres	**Gross Acres**	**Net acres**	**Gross Acres**
Perennial veldtgrass	0.29	8.17	0.79	24.2
Hottentot fig	0.11	6.37	0.14	6.96
Narrow leaved iceplant	0.16	10.25	0.26	30.33
Area not surveyed	-	21.37	-	5.66

Opportunity Prioritization

Based on the assets and threats in the Big Coreopsis Hill 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 veldt grass (*Ehrharta calycina*) control

The Big Coreopsis Hill DPA contains moderate perennial veldtgrass density throughout the DPA, especially within the southern portion of the hub area. Perennial veldtgrass 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 shrub-dominated coastal dune scrub into a grassland. Perennial veldtgrass releases hundreds to thousands of seeds which fall near the parent plant and disperse short distances with wind.

Successful control methods utilize herbicide to kill the plant before it has the opportunity to go to flower or seed. Where appropriate, aerial application of herbicide to control perennial veldtgrass would be most effective, as certain areas are very dense.

It is anticipated that perennial veldt grass can be brought to manageable levels in this DPA, 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.

Priority 2 Opportunities

Iceplant (*Carprobrotus* ssp.) control

Approximately 2 acres of dispersed iceplant can be found in the DPA in low percent cover. Iceplant is perennial and forms dense and deep mats that form extensive monospecific stands, preventing other species from growing. It is a known invader of foredune, dune scrub, coastal bluff scrub, coastal prairie, and maritime chaparral communities, and competes directly with several threatened or endangered plant species for nutrients, water, light, and space (State Resources Agency 1990). Although long-term management is required, the probability of success keeping this species to a low level is considered high.

Priority 3 Opportunities

Fill information gaps

- Marsh habitat: work to better understand hydrology & habitat values of wetland areas, then identify opportunities for restoration
- Non-native eucalyptus grove: assess & research use of grove and the ecosystem services it provides (raptor, monarch, bats habitat)
- Pursue opportunities with surrounding private landownership: foster relationship in support of future easement agreement possibilities
- Explore nexus points with Oso Flaco lake remediation efforts, hydrologic connectivity to the lake
- Develop planning based on existing conditions habitat values

Management Objectives, Actions, Method, Timeline and Budgets

Opportunity 1A: Perennial veldt grass (*Ehrharta calycina*) control
The Big Coreopsis Hill DPA contains moderate density of perennial veldtgrass, especially along the southern hub area. 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. Perennial veldtgrass releases hundreds to thousands of seeds which fall near the parent plant and disperses short distances with wind. This DPA has not yet been treated.

It is anticipated that perennial veldtgrass can be brought to manageable levels in this DPA, 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. State Parks is currently treating perennial veldtgrass in other DPAs and has demonstrated successful control methods using herbicide to kill the plant before it has the opportunity to go to flower. An aerial application of herbicide to control perennial veldtgrass complimented by spray crew treatments will offer the most effective and efficient approach. A summary of actions for Opportunity 1A are summarized below. The map following the summaries will provide further visual clarification.

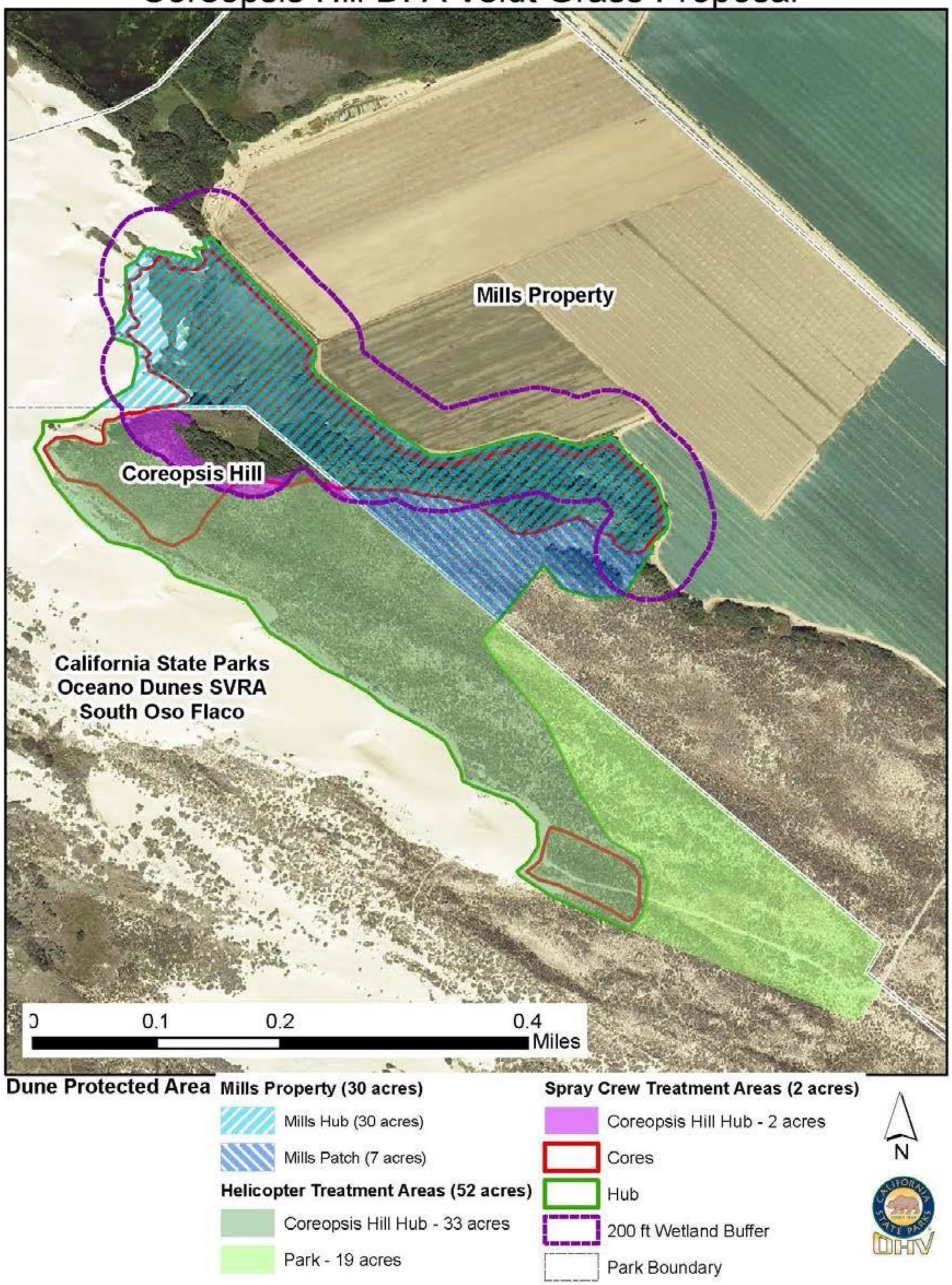
Action 1A.1: Control perennial veldtgrass via helicopter using Sethoxydim (a monocot specific herbicide) within the Big Coreopsis Hill DPA (cores and hub areas) while creating defensible spaces to minimize reintroduction from plant propagules. This approach will occur twice per year for three years across 52 acres (light green, green in southern portion of hub). The first helicopter treatment will occur after monitoring for presence of veldtgrass seedlings after 0.5 inches of rainfall (October-January). The second treatment is one month after the first helicopter treatment.

Action 1A.2: Conduct follow-up control of perennial veldtgrass in areas treated via helicopter in Action 1A.1 via ground spray crew using Sethoxydim (a monocot specific herbicide) within the Big Coreopsis Hill DPA (cores and hub areas) across 52 acres. It is assumed that Action 1A.1 will require follow-up surveys and treatment across all 52 acres due to the known effectiveness of the herbicide being used to be less than Clethodim. This approach will occur once per year for three years across 52 acres with a decreasing cost per acre in years 2-3 due to an assumed reduced level of spraying effort but still including a survey of most of the hub area (light green, dark green in State Parks including hub area). This action will occur one month after helicopter treatment is completed to ensure early detection of resprouts in treated areas.

Action 1A.3: Control perennial veldtgrass via helicopter using Sethoxydim (a monocot specific herbicide) within the Big Coreopsis Hill DPA on private Mills property within DPA (outside of wetland buffer area) while creating defensible spaces to minimize reintroduction from plant propagules. This approach will occur twice per year for three years across 7 acres (dark blue hashed area on Mills' property). This treatment will coincide with Action 1A.1.

Action 1A.4: Conduct follow-up control of perennial veldtgrass in areas treated via helicopter in Action 1A.3 via ground spray crew using Sethoxydim (a monocot specific herbicide) within the Big Coreopsis Hill DPA within Mills' property (hub areas outside of wetland buffer) across 7 acres. It is assumed that Action 1A.3 will require follow-up surveys and treatment across all 7 acres due to the known effectiveness of the herbicide being used to be less than Clethodim. This approach will occur once per year for three years across 7 acres with a decreasing cost per acre in years 2-3 due to an assumed reduced level of spraying effort but still including a survey of most of the hub area (dark blue hashed area on Mills' property). This action will occur one month after helicopter treatment is completed to ensure early detection of resprouts in treated areas.

Coreopsis Hill DPA Veldt Grass Proposal



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. 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.

First treatments are expected to occur between October and January, after the first rain of the season. Follow up treatments in March may overlap with nesting bird season (3/1 or 3/15, variable).

Table 5: 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 Grass -- Life cycle:			Reduced growth			Active growth				Flower		Fruit		
Perennial Veldtgrass (*Ehrharta calycina*)	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 1A Cost Estimate:

Opportunity 1A	Cost/3 years
Complete Per-treatment Survey	$ 2,400.00
Opportunity 1A: Perennial veldtgrass control	$86,140.00
Phase 1 Total	**$ 88,540.00**

Opportunity 2A: Iceplant (*Carprobrotus* ssp.) control
Approximately 2 acres of dispersed iceplant can be found in the DPA in low percent cover. Iceplant is perennial and forms dense and deep mats that form extensive monospecific stands, preventing other species from growing. It is a known invader of foredune, dune scrub, coastal bluff scrub, coastal prairie, and maritime chaparral communities, and competes directly with several threatened or endangered plant species for nutrients, water, light, and space (State Resources Agency 1990). Although long-term management is required, the probability of success keeping this species to a low level is considered high.

This action includes control if iceplant in core and hub areas throughout the DPA with a spray crew or spray rig for 3 years of approximately 2 acres of iceplant treatment.

Schedule:

Iceplant can be treated anytime but is it best to treat iceplant at Big Coreopsis Hill specifically, in Summer/Fall. Treatment should be completed after native wildflowers have senesced and there are only perennials species are left.

Opportunity 2A Cost Estimate:

Opportunity 2A	**Cost/3 years**
Opportunity 2A: Iceplant control	$ 2,500.00
Phase 1 Total	**$ 2,500.00**

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 Big Coreopsis Hill DPA are still being characterized, and at a minimum include: 12 sensitive plant species, intact habitat types including marsh, freshwater, and riparian.

The following practices will be implemented working around these resources.

- Breeding birds- avian resources avoidance. State Parks will closely coordinate with CDFW to ensure helicopter treatments to not affect avian resources.
- Permit measures will be followed.
- Areas containing known sensitive/ rare plant species will be clearly marked in field, and all crews will be educated on sensitivity of foot traffic.
- Impacts will be minimized in areas where intact habitats are present; to the extent feasible, crews will stay on existing paths and trail. Disturbance of existing plants will be minimized, and all crews will reduce spread of weeds via transport of seed on clothing and boots.
- Small wetlands/riparian areas: A 200-ft buffer has been identified within which no herbicide treatment will occur.

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 (PCA) 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 6: 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 7: 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:

1- 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.

2- 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.

3- 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.

Due to the data gaps present in Big Coreopsis Hill DPA, a baseline assessment will be conducted prior to any other workplan activities beginning. It is assumed a small crew can accomplish a survey of the entire DPA and collect information to help evaluate baseline conditions.

Big Coreopsis Hill DPA	**Cost/3 years**
Baseline assessment	$2,400.00
Total	**$2,400.00**

Management Activity Monitoring:

All management activities will be tracked using ESRI ArcGIS.

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 perennial veldtgrass (*Ehrharta calycina*) cover to 10% cover class by year 3 in the Big Coreopsis Hill DPA (Hub and Cores).

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of *E. calycina* maintained at a 10% cover class value throughout the DPA by Year 3. This is considered the “knock down” Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure cover class values are being maintained.

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 (Dunes Collaborative 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 iceplant cover to 0-1% cover class by year 3 in the Big Coreopsis Hill DPA (Hub and Cores).

Performance monitoring will occur in Years 1 and 3 to document progress towards meeting the objective of *E. calycina* maintained at a 10% cover class value throughout the DPA by Year 3. This is considered the "knock down" Phase. Performance monitoring will then switch to long term maintenance and monitoring with a monitoring interval of once every 5 years to ensure cover class values are being maintained.

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 (Dunes Collaborative 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.

Monitoring Cost Estimate:

Big Coreopsis Hill DPA	**Cost/3 years**
Monitoring	$ 9,280.00
Phase 1 Total	**$ 9,280.00**