Native plant associations, reference areas, restoration design, and monitoring design at Fort Ord Dunes Campground, Monterey County, California

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Executive summary and next steps

This report describes vegetation associations, reference areas, restoration design, and monitoring design for the proposed campground development at Fort Ord Dunes State Park (FODSP). The work was completed by students and staff during an 8-week Professional Environmental Science class in the Master of Environmental Science program at California State University Monterey Bay (CSUMB ENVS 660, Fall 2021). The work was completed for the California Department of Parks and Recreation as part of their effort to meet restoration requirements outlined by the California Coastal Commission for a Coastal Development Permit.

The campground site is a 130 acre area roughly in the center of the 990 acre state park. We adopted a 2013 acre study area including all of FODSP, Marina State Beach to the north, a relatively undisturbed area to the east near Marina High School, and some adjacent buffer areas. The state park is within the former Fort Ord, which closed in the early 1990s. The campground restoration site is highly degraded due primarily to previous military activity. Most plant cover is invasive ice plant (*Carpobrotus edulis*), but native species persist at low abundance or in isolated patches.

The revegetation plan for the campground site requires identification of nearby undisturbed **reference areas** with intact native vegetation that can be used to define the vegetation to be achieved at the campground restoration site. To identify potential reference areas, we mapped **soil disturbance** throughout the 2013 acre study area through manual interpretation of historical aerial imagery dating back to 1940 as well as high-resolution LiDAR terrain imagery from 2018. We also incorporated mapping of **previous restoration plantings**, which ideally should not be used as reference areas. This resulted in the identification of patches of land within the study area that have received minimal historical soil disturbance, no previous restoration, and which exhibit generally native vegetation cover at present. We used this information to identify three general reference areas for closer study: (1) southern FODSP in the vicinity of CNPS Reserve 10, (2) northern Marina State Beach, and (3) an area of city land west and southwest of Marina High School. Although not on State Parks land, the Marina High School area exhibits the best remaining example of the ecotone between coastal dune scrub and coast live oak woodland that most likely also occurred at the campground site before European arrival.

The revegetation plan for the campground site requires prescription and monitoring of vegetation "**sub-communities**". In order to have a defensible framework for describing and prescribing vegetation communities, we adopted the National Vegetation Classification Standard (NVCS) which – at its finest scale - describes vegetation "**alliances**" and "**associations**" based on floristic composition. We identified 35 alliances and associations that had some degree of relevance to the campground restoration. We created **vegetation maps** that describe the spatial pattern of these alliances and associations through the campground restoration area and the three reference areas. The mapping was based on manual interpretation of high-resolution aerial imagery validated at 481 "rapid assessment" (RA) field plots where we recorded the relative cover of dominant and prominent plant species. We described the floristic composition of the alliances and associations using the RA plots and individual species point records from over 1800 additional point locations that we recorded using ArcGIS Field Maps and iNaturalist. These floristic descriptions should inform **planting palettes** within the restoration area.

The revegetation plan requires enhancement of **special status species** and their habitat. The most prominent opportunity in this regard is to expand and improve the integrity of stands of *Eriogonum parvifolium* and *E. latifolium*, which are the host plants for the endangered butterfly

Euphilotes enoptes smithi. There is also opportunity to enhance habitat for *Chorizanthe pungens*, *Erysimum ammophillum, Arctostaphylos pumila*, and to a lesser extent, *Arctostaphylos hookeri*. The campground area may not be a particularly favorable location for *Erysimum menziesii* or *Gilia tenuiflora* ssp. *arenaria*. Some *Piperia* were observed during our study within the campground project area; it is uncertain if they are *P. yadonii* (federally endangered), *P. michaelii* (CA rare plant ranked), or *P. elegans* (no special status).

We created a **prescribed vegetation map** that depicts a plausible spatial pattern of 16 vegetation communities that would have existed at the campground site before European arrival and that should be the **restoration target** for the campground revegetation project – in response to the restoration plan requirement for the delineation of "sub-communities". This map was informed by: (1) inference from spatial patterns at reference areas both in plan form and in cross-section form, (2) existing locations of special status species, and (3) spatial patterns of native plants that currently occur at the campground despite the overwhelming dominance of non-native species such as *Carpobrotus edulis, Hesperocyparis macrocarpa*, and *Pinus radiata*. Features of the map include: (1) a belt along the immediate coast with prominent *Eriophyllum staechadifolium*, (2) a belt inland of this with prominent *Eriogonum parvifolium*, *Artemisia pycnocephala*, and *Corethrogyne filaginifolia*, (3) a zone further inland dominated by *Ericameria ericoides* and *Acmispon glaber*, (4) a transition toward inland shrub communities characterized by *Artemisia californica*, (5) an ecotone toward woodland communities including *Heteromeles arbutifolia*, *Quercus agrifolia*, *Garrya elliptica*, and *Arbutus menziesii*, (6) the enhancement of distinct existing patches of *Frangula californica*, *Lupinus chamissonis*, and *Toxicodendron diversilobum*, and (7) some opportunity to explore the viability of establishing stands of *Arctostaphylos pumila* attended by minor *Arctostaphylos tomentosa* and *Arctostaphylos hookeri*.

The revegetation plan details a specific approach to **monitoring** progress toward well-defined **success criteria**. State Parks staff piloted this approach in mid-2021 and we expanded it. We installed five new permanent monitoring plots in addition to the six established by State Parks staff. The new reference plots were located according to a constrained stratified random sampling design – constrained to be in locations with minimal soil disturbance, no prior planting, and predominantly native plant cover, and stratified by mapped vegetation type. We surveyed these for relative abundance along line-intercept transects, as well as for total species composition within a defined plot area. We compared reference and restoration plot data in terms of **non-native cover**, **species richness**, and **species diversity**. As would be expected, the reference areas scored much better than the restoration areas. The comparison illustrates how the reference area scores constitute metrics of success, with success itself defined by the achievement of scores at the restoration plots that equal the scores at reference plots within matching vegetation alliances and associations. The reference plot data also constitute an objective and quantitative planting palette to supplement the more subjective and qualitative palette obtained through the previously mentioned correspondence between mapped vegetation types and species observed at point locations throughout the study area.

Future work should:

- Replace CSUMB's wooden stakes with steel ones
- Establish more permanent plots
- Survey permanent plots in spring
- Survey in spring for species composition within alliances and associations

- Develop and test a quantitative system for objectively determining success, e.g. through formal statistical inference based on comparison of success metrics between restoration and reference pots
- Clarify if the *Piperia* are *yadonii*, *michaelii*, or *elegans*

Future work could:

- Refine the vegetation maps of reference areas
- Refine the prescribed vegetation map for the campground

Table of Contents

1 Introduction

Fort Ord Dunes State Park (FODSP) occupies lands that were part of the former Fort Ord military base. The California Department of Parks and Recreation (commonly known as California State Parks, CSP) has proposed to build a 17-acre development consisting of a campground and beach access facilities on areas previously disturbed by military use (reference: Initial Study and Mitigated Negative Declaration, 2013).

A condition of development approval from the California Coastal Commission (CCC) is the restoration of 90 acres of degraded dune habitat lands within and adjacent to the campground project area (CCC 2017).

A condition of the California Coastal Commission's (CCC) Notice of Intent (NOI) to develop the campground is the creation of a restoration plan for 90 acres of degraded dune habitat within, and adjacent to, the proposed campground project area (CCC 2017). Additionally, CSP must fulfill monitoring, success criteria, and reporting components under Special Condition 7 of the CCC-NOI (CCC 2017).

We assisted CSP by describing and prescribing vegetation communities and contributing to the establishment of a system of reference areas containing permanent plots against which the campground restoration success can be measured (Fig. 1.1). Our scope of work was to meet certain objectives outlined by CSP in Appendix D: Campground and Coastal Dune Revegetation Plan (CCDRP) of the FODSP Campground Project Restoration, Monitoring, and Reporting Plan (CSP 2020). The CCDRP uses the term "sub-communities" as an organizing concept, and we chose to implement this specifically using the National Vegetation Classification Standard (NVCS) framework of floristic alliances and associations as implemented in California through the Manual of California Vegetation (MCV). Thus, reproducing the CCDRP in NVCS terms, our scope of work was:

- **CCDRP Step 1**. Define NVCS plant alliances and associations at nearby and local reference sites. Reference sites extend from Marina State Beach (MSB) south to the Southern boundary of FODSP.
- **CCDRP Step 2**. Define NVCS plant alliances and associations in the proposed campground restoration area.
- **CCDRP Step 3**. Pair restoration and reference areas for permanent monitoring survey plots based on NVCS alliances and standards.

We used the term "map class" to encompass a combination of both alliances and associations. Some vegetation types were mapped and analyzed at the alliance level, and others were addressed at the (more-detailed) association level.

We began by systematically surveying the campground and potential reference sites. CCDRP Step 1 requires plant species composition recommendations at the proposed campground and adjacent areas. These recommendations are important to reach the goals of the NOI Step 7a (Fig 1.1). For CCDRP Step 2, we delineated alliances and associations that currently exist at reference areas. At the campground area, we generated a list of potential map classes based on existing vegetation and we mapped proposed alliances and associations based on inference from reference areas, as well as existing special relevant special status plant species at the campground site, existing native vegetation at the campground site, soil type, and terrain. We

paired restoration and reference areas for permanent survey plots, completing preliminary surveys and analysis toward Step 3 of the CCDRP and NOI steps 7c-d.

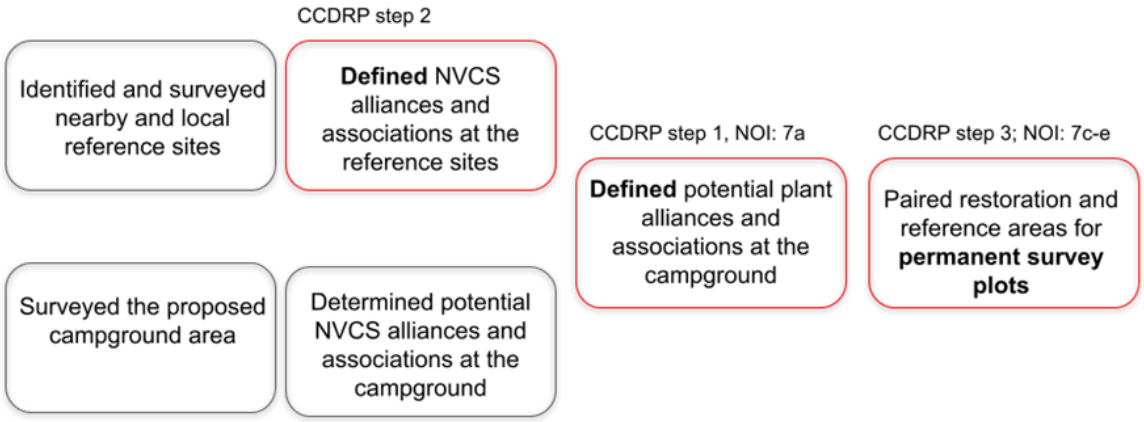

Figure 1.1 Overview of project workflow with required elements highlighted in red.

2 Study area

Our study area encompassed 2030 acres and included Fort Ord Dunes State Park, Marina State Beach, some city land near Marina High School, and some directly adjacent areas (Fig 2.1).

Prior to European arrival, the land that is now known as the Fort Ord Dunes was used by the Rumsen Ohlone people. When Europeans arrived, livestock was introduced, and the land was also used for grazing (CSP 1996). In 1917, the United States Department of War purchased 15,000 acres from the David Jacks Corporation to use as an artillery training field for the U.S. Army. The land was initially called the Gigling Field Artillery Range and eventually became Fort Ord (CSP 1996). *Carpobrotus edulis* (ice plant) was planted by the Army in the 1940s and 1950s following the construction of firing ranges, ammunition supply points, and other facilities to stabilize the dunes. In the 1940s, Army activity and infrastructure on the dunes significantly increased due to World War II (CSP 2004). In the 1970s, dune habitat was excavated to construct Highway 1. *Carpobrotus edulis* was again planted to stabilize the newly filled areas, preventing erosion into urban areas and the new freeway (Caudillo et al. 2019). Fort Ord closed in 1991 and the land was divided among various agencies and jurisdictions. A 1997 base-wide Habitat Management Plan described placed restoration requirements on the land that would eventually become FODSP. Various lead remediation and habitat restoration projects have occurred at FODSP ever since. In 2004, CSP adopted a general plan and environmental impact report (EIR), stating how CSP would fulfill the requirements of the 1997 HMP and in 2007 FODSP was deeded to CSP. The campground project was developed in 2013 and described in a 2013 Initial Study and Mitigated Negative Declaration. A Revegetation Plan for lands around the campground was developed between 2015 and 2020 and in conjunction with this, the California Coastal Commission issued a Notice of Intent to issue a Coastal Development Permit, citing revegetation plan as a condition of permit approval. Initial revegetation and monitoring activity began in 2020 with a pilot study by CSP.

Figure 2.1 Map of study area.

3 Soils and terrain

FODSP contains two main types of dunes: pre-Flandrian and Flandrian (Griffin 1978). Pre-Flandrian dunes are the oldest dunes that formed more than 100,000 years ago. Pre-Flandrian dunes occur throughout most of the former Fort Ord, and generally along the inland edge of FODSP. The Flandrian dunes formed during the Wisconsin Glaciation between 100,000 and 75,000 years ago and can now be found as a narrow strip along the coastline (Thomas Reid Assoc. 1987). The pre-Flandrian terrain is typically more gently sloped than the Flandrian terrain (Fig. 3.1).

Within pre-Flandrian dunes there are two types of soils: Baywood Sand and Oceano Loamy Sand (Fig. 3.1). Baywood Sand soils are characterized as “fine sand” and “excessively drained” with slopes ranging from 2 to 15 percent (USDA 2014; USDA 1978). Oceano Loamy Sand soils have high permeability, are also known to be “excessively drained,” and also have slopes between 2 to 15 percent (USDA 1978). Flandrian dunes contain Dune Land soils that may be found beneath loose sand deposited by wind near the coast (USDA 1978). Dune Land soils form from loose sediment deposits from the Salinas and Pajaro rivers and have rapid permeability and abundant drainage (Dorrell-Canepa 2005; USDA 1978). Within the former Fort Ord region adjacent to FODSP, the Oceano Loamy Sands tend to support oak woodland, whereas the Baywood Sands tend to support shrub communities such as maritime chaparral and coastal sage scrub (our observation, based on aerial photography interpretation).

The MSB study area is primarily located within the Flandrian dune boundary on Dune Land soils (Fig. 3.2). A survey completed in 2005 found 30 native species within the Marina Dunes Preserve, with upwards of 40% vegetative cover (Dorrell-Canepa 2005) within coastal strand, coastal bluff, and coastal scrub vegetation types. Non-native species found on the dunes include ice plant (*Carpobrotus edulis*) and annual grasses. The abundance of non-native species, loss of native species, and orientation of the dunes within MSB historically led to sand erosion and “sand blowouts" in the area (Dorrell-Canepa 2005).

The campground study area contains a narrow belt of Flandrian dunes with frequently steep slopes at the coast, and a comparatively large and relatively flat portion of Pre-Flandrian dune sheet with Oceano Loamy Sand soil further inland (Fig. 3.3). A relatively high-elevation broad wooded ridge characterizes the northeastern portion of the campground study area.

The CNPS Plant Reserve #10 study area primarily contains Flandrian dunes with Dune Land soils, and a small portion of Pre-Flandrian dune sheet with Baywood Sand soils (Fig. 3.4).

The Marina High School study area is inland of FODSP on the Pre-Flandrian dune sheet with Baywood Sand soils (Fig. 3.5).

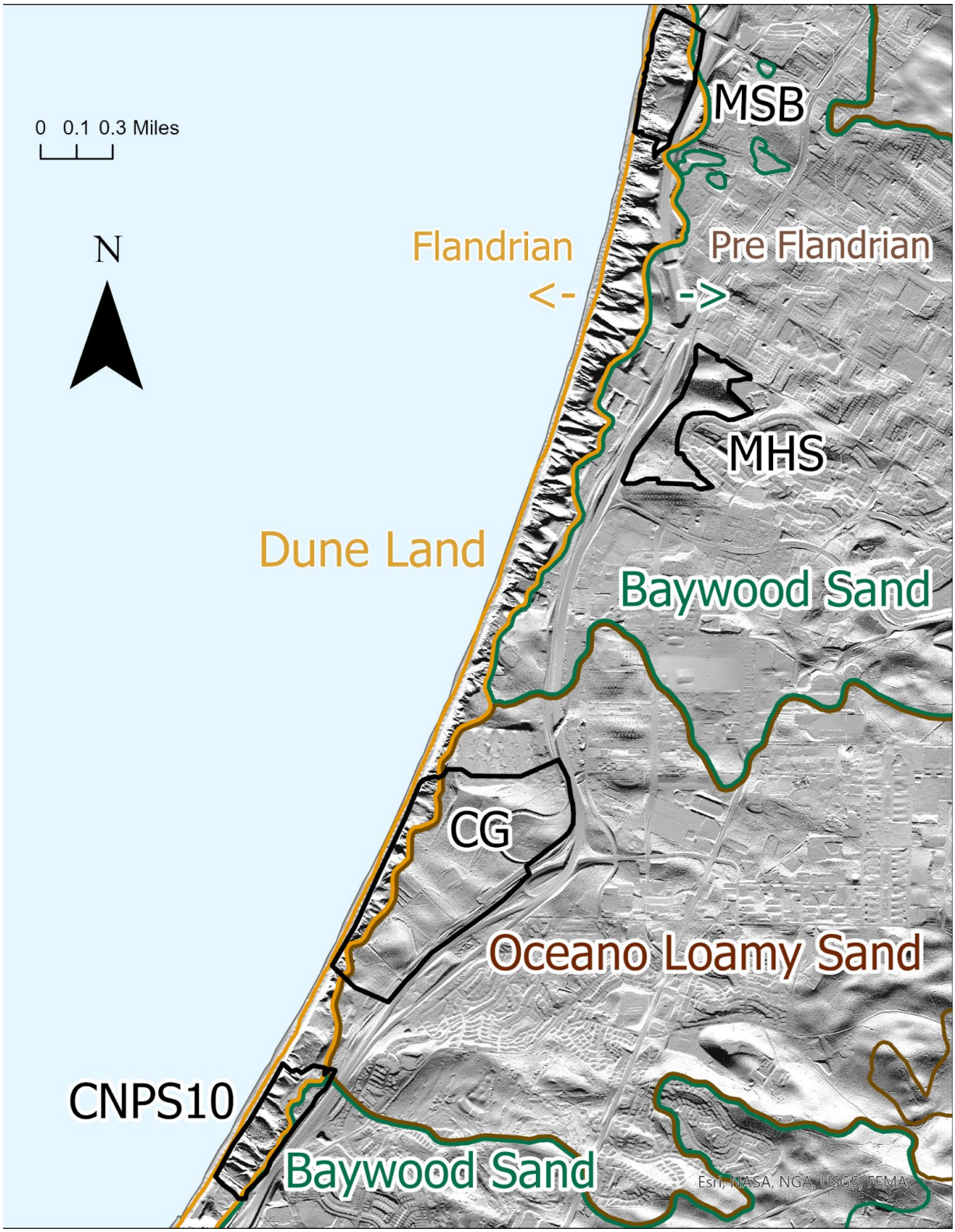

Figure 3.1. Terrain and soil types at FODSP and surrounding areas.

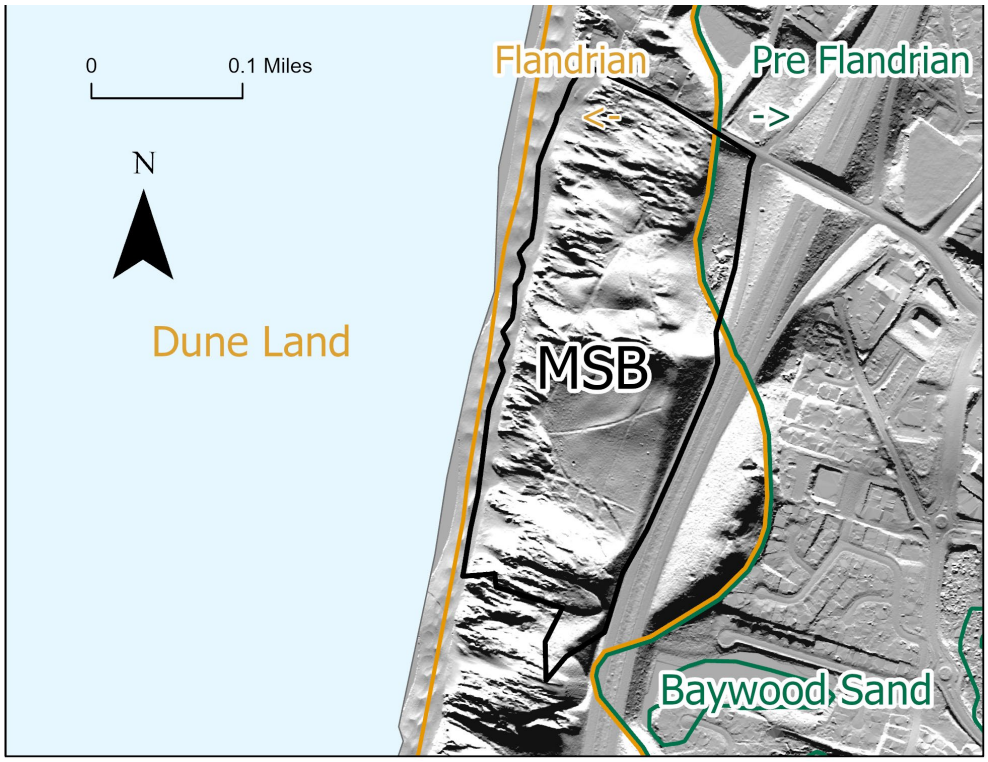

Figure 3.2. Soil types and terrain at the Marina State Beach (MSB) study area.

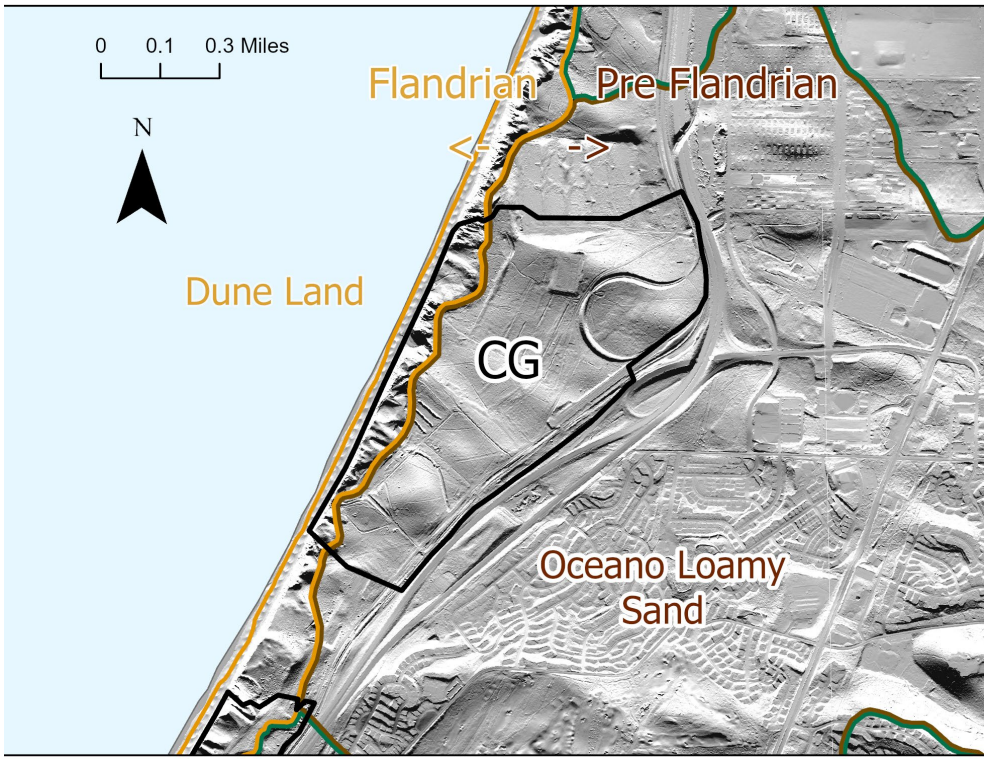

Figure 3.3. Soil types in the campground (CG) study area.

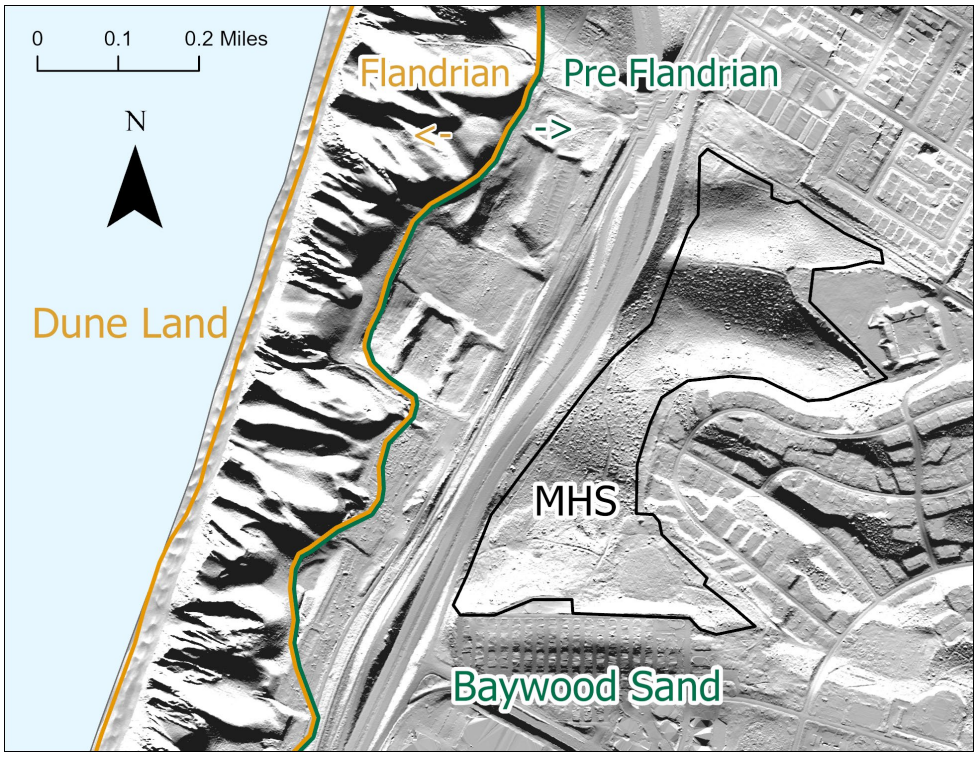

Figure 3.5. Soil types and terrain at the Marina High School (MHS) study area.

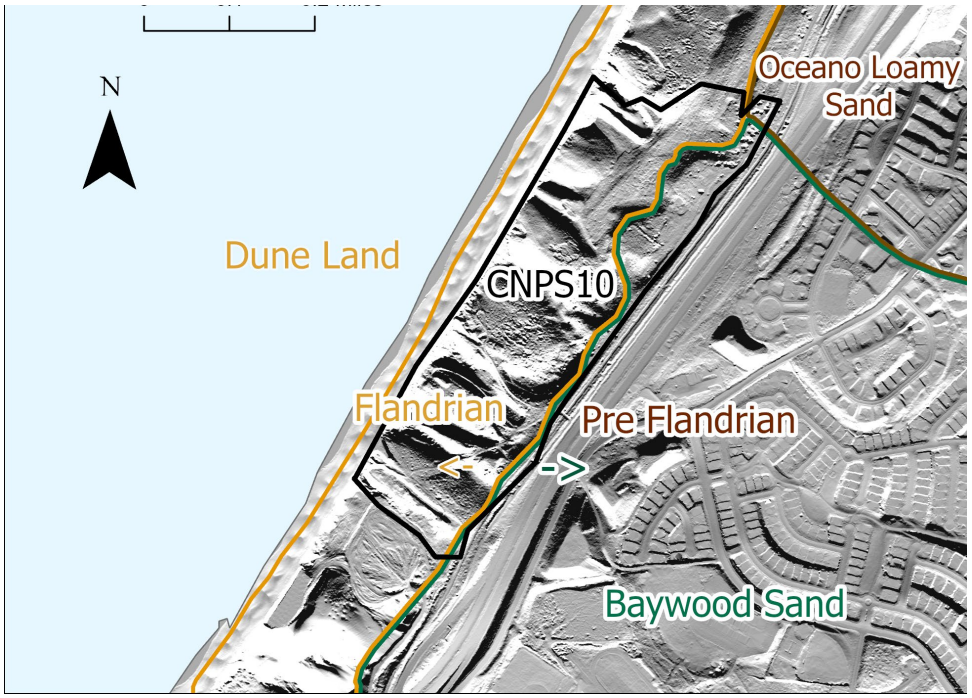

Figure 3.4. Soil types at the CNPS Plant Reserve #10 (CNPS10) reference area.

4 Historical soil disturbance

In selecting reference vegetation sites, we prioritized areas with relatively undisturbed soil. Soil disturbance can have lasting effects on soils, plant communities, and affect the success of restoration (Lovich and Bainbridge 1999; Heneghan et al. 2008).

The United States Army occupied FODSP and the surrounding area for 74 years. During that time, construction projects and training activities disturbed much of the area's soil. These disturbances continued into the early 2000s when lead remediation efforts on old training grounds occurred (CSP 2000). We visualized disturbance patterns using six decades of aerial imagery, lead remediation polygons, and a LiDAR hillshade layer.

We obtained aerial imagery from the University of California (UCSB 2021) and the US Army. We manually interpreted these images to map ground disturbances caused by the construction of roads and buildings, military activity, and sand blowouts. We extended the scope of our search beyond FODSP to include similar dune habitat at the MSB, and around MHS.

We used ArcGIS Pro to georeference images from 1941, 1956, 1961, 1976, 1987, 1988, and 2020 using the National Agriculture Imagery Program (NAIP) high resolution (3m) 2020 imagery (ESRI 2021). Once georeferenced, we digitized polygons on top of the imagery to demarcate ground disturbance.

We also added known lead remediation site polygons provided by the US Army, which verified some of our disturbance digitization (USACE 2021). The last phase of our disturbance mapping used a LiDAR hillshade layer (see Section 3) which allowed us to document soil disturbance that had been covered up by sand and vegetation.

Once we determined the extent of soil disturbance in and around FODSP, we used the inverse of that layer to highlight soil-undisturbed areas. The undisturbed layer was then intersected with a polygon layer of known native vegetation from 2010. We used the resulting map to narrow reference site selection to soil-undisturbed areas with native vegetation.

We documented 5,659 acres of soil disturbance from aerial imagery, 22 acres from the lidar hillshade layer, and 8.6 acres from lead remediation polygons (Fig. 4.1). The acreage of soil disturbance from aerial imagery was much higher than the rest because it was the sum of all decadal polygons. At the MHS and MSB sites, we documented 928 and 3030 acres of disturbance, respectively (Fig. 4.2; Fig. 4.3). Unlike at FODSP, the soil disturbance around MSB was mostly the result of trails, sand blowouts, and urban development, with minimal military activity. The area west of MHS proved to be a relatively undisturbed site with a good example of the ecotone between coastal scrub and more wooded areas inland.

Within FODSP, CNPS Plant Reserve 10 is an area set aside by the military and CNPS to protect native plants, and therefore an important location for reference site consideration. Some disturbance did occur within the reserve, but large patches of undisturbed soils provided appropriate reference areas for this study (Fig. 4.4). We estimated undisturbed soils at and around FODSP to be 465.9 acres.

Much of this undisturbed area is dominated by non-native plants, which further narrowed suitable reference areas to 39 acres of native-dominated land (Fig. 4.5). To best represent native plant communities without anthropogenic impacts, we also removed undisturbed sites in areas with

documented planting or restoration activity from reference site consideration. CSP provided spatial data of prior restoration efforts throughout FODSP and MSB since 1985 (Fig. 4.6). Because restoration efforts tend not to overlap with soil-undisturbed areas, these data support the accuracy of our disturbance analysis.

Improvements to our soil disturbance estimates could be made with additional aerial imagery. Some imagery held at UCSB could not be obtained due to COVID-19 pandemic-related staff shortages. Additionally, the 2010 native plant polygon layer only covered some of the region, therefore we may have missed some soil-undisturbed areas with native plant communities.

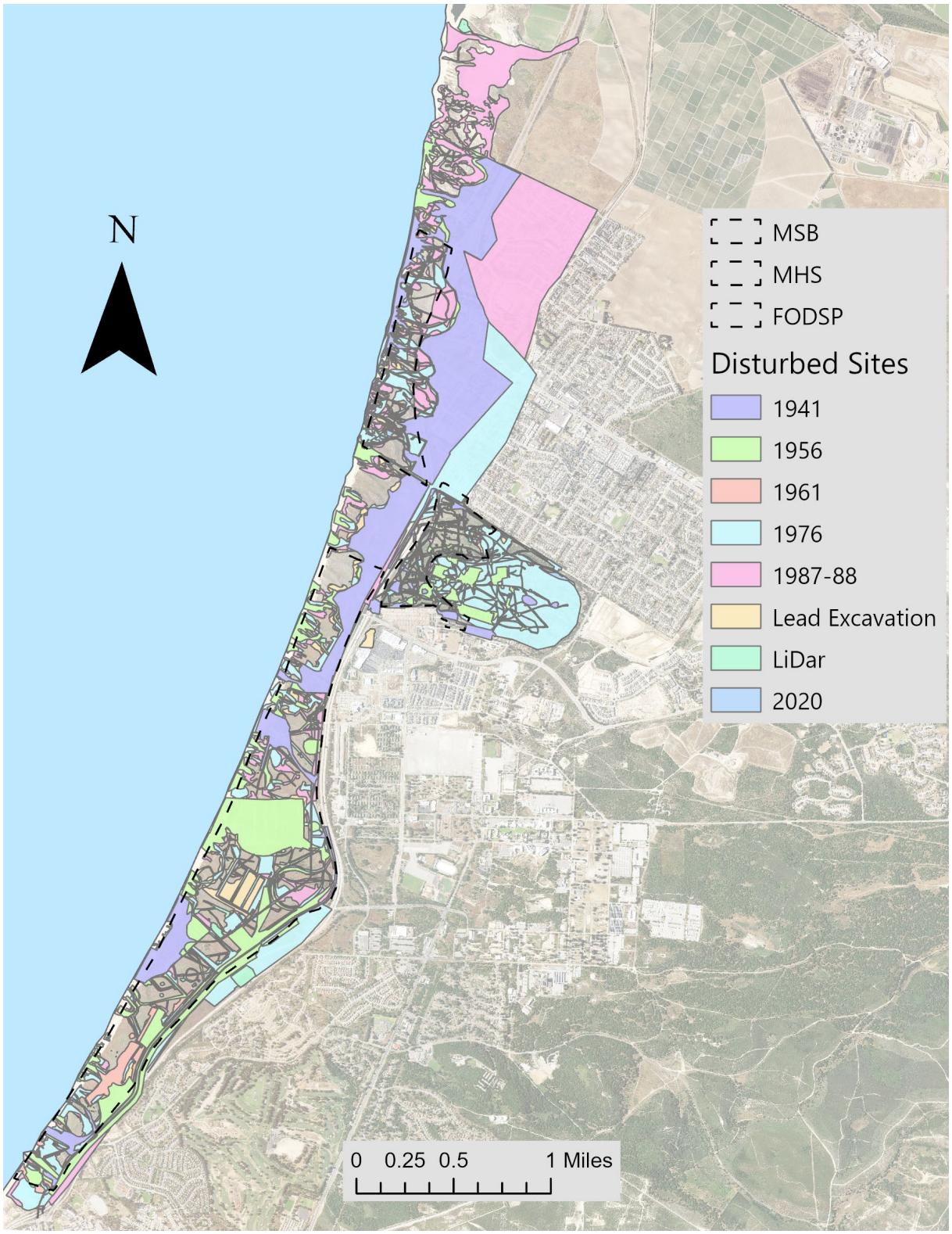

Figure 4.1. Soil disturbance at Fort Ord Dunes State Park, Marina State Beach, and near Marina High School.

Figure 4.2. Soil disturbance at Marina State Beach.

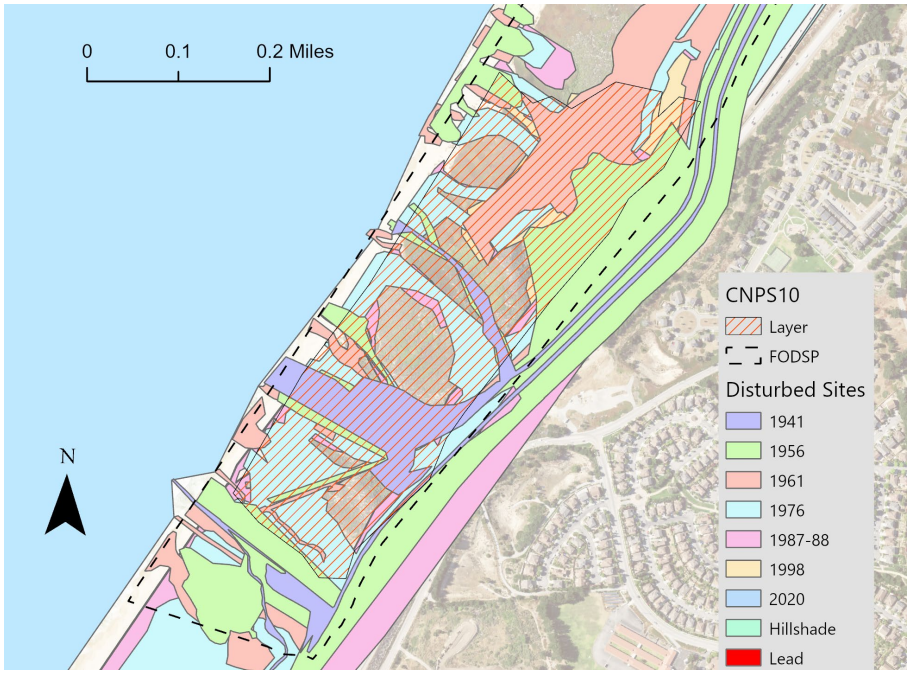

Figure 4.3. Soil disturbance at CNPS Plant Reserve 10 within the southern portion of Fort Ord Dunes State Park.

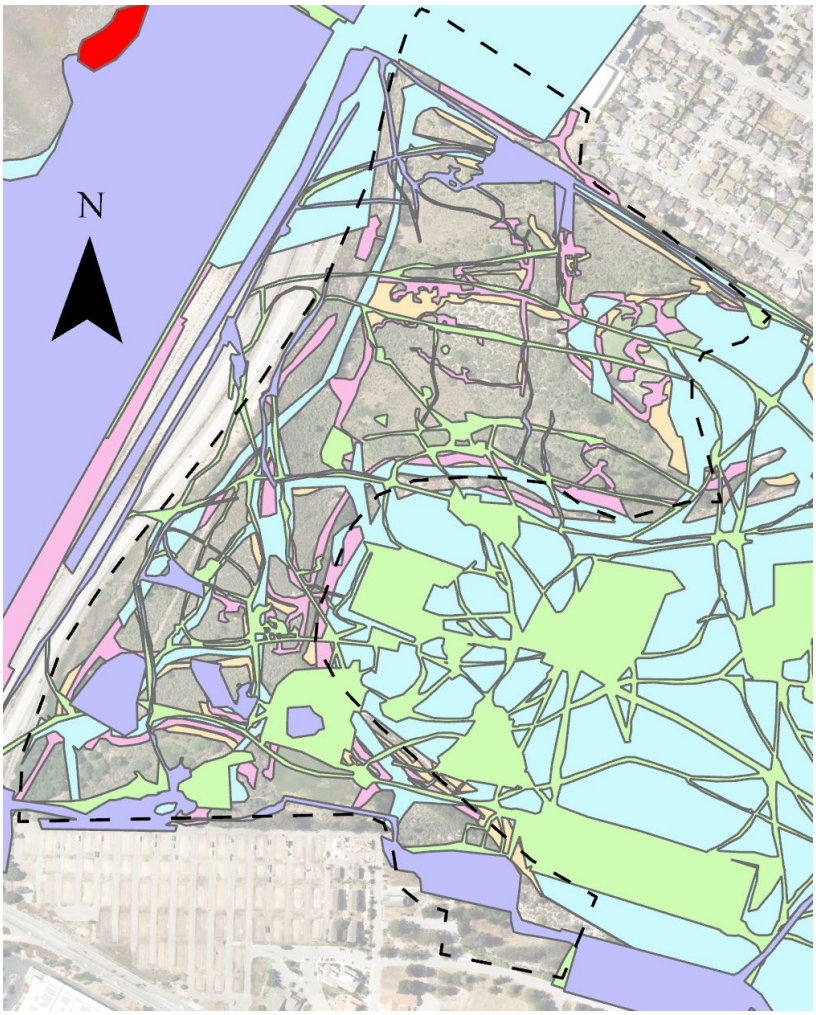

Figure 4.4. Soil disturbance near Marina High School.

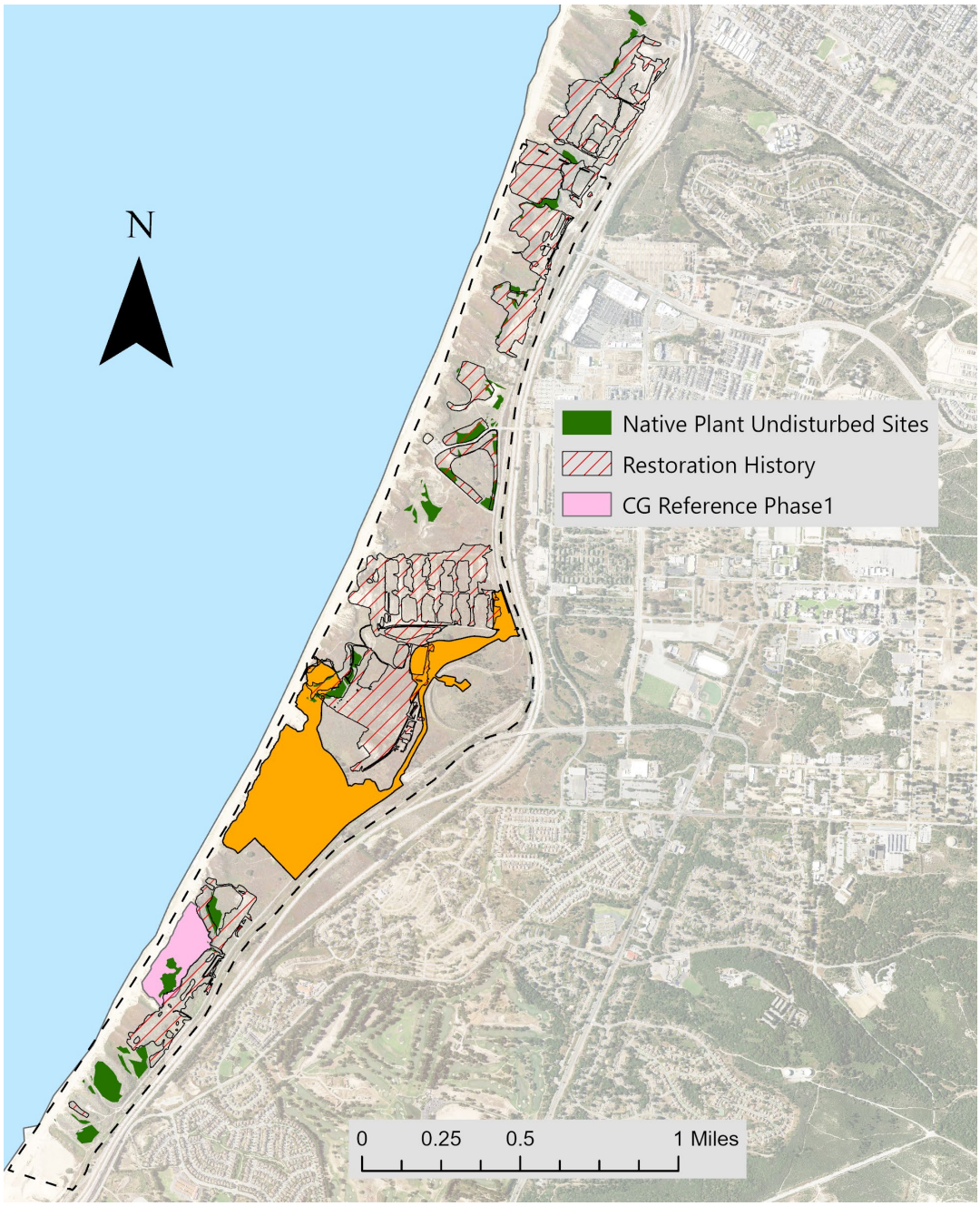

Figure 4.5. Identification of potential reference areas within FODSP.

Green: Areas with both undisturbed soils (mapped from 1940 through 2021) and native vegetation (as mapped in 2010) and undisturbed soils.

Hachured red: Areas with previous restoration planting.

Pink: Reference area used in mid-2021 CSP pilot study.

Figure 4.6. Areas where restoration planting has occurred (diagonal stripes) and where the soil is relatively undisturbed (green solid color).

5 Vegetation alliances, associations, and species

The Fort Ord Dunes State Park Campground & Coastal Dune Revegetation Plan (CCDRP) (2015, revised 2020) requires definition of vegetation "sub-communities" to be restored at the campground site. This requirement is reinforced by reference in the California Coastal Commission Notice of Intent to issue a Coastal Development Permit (NOI-CDP) (2017). We propose that that sub-communities be defined in terms of alliances and associations within the National Vegetation Classification Standard (NVCS) because this is the only applicable standard that has the necessary level of detail for site-specific restoration planning and is the standard adopted by California Department of Fish and Wildlife (CDFW) for vegetation description.

NVCS is a standardized hierarchical system used by the CDFW and CNPS to classify vegetation communities. The CDFW Vegetation Classification and Mapping Program (VegCAMP) continually develops and maintains California's expression of NVCS. This work was originally documented in A Manual of California Vegetation (MCV, Sawyer & Keeler-Wolf, 1995), followed by a second edition (MCV2, Sawyer et al. 2009) and now continually updated in A Manual of California Vegetation Online (MCVO) (https://vegetation.cnps.org/). In contrast to other classification schemes, such as Munz (Munz & Keck 1973) and Holland (Holland & Keil 1986), NVCS is the only standardized classification system used throughout the United States (USNVC 2021). NVCS consists of eight hierarchical levels, with each level requiring a specific level of detail (Fig. 5.1). We defined vegetation subcommunities at the alliance and association levels using MCVO membership rules, which required species-level information such as relative cover. When possible, we defined vegetation subcommunities at the association level. However, if there were no associations in that alliance, we defined that community at the alliance level. We used the term "map class" to describe the lowest level of our implementation of NVCS; thus, a map class could equate to an alliance or an association, depending on the level we used. We also created a small number of additional classes not in MCVO to represent distinct plant communities that we observed but that were not readily apparent in the MCVO system. We created and applied a unique, six letter abbreviation for each map class. For example, we used the abbreviation "ToxDiv" for the "*Toxicodendron diversilobum* Shrubland Alliance" (Table 5.1; Fig. 5.2).

We documented 35 alliances and associations (map classes) relevant to the study area (Table 5.1). In Section 11 of this document, we propose 16 of these alliances and associations to specifically guide revegetation at the campground.

Table 5.2 lists all species and subspecies relevant to the study. This includes about 121 species observed by the authors in the study area during the study period (see Section 7).

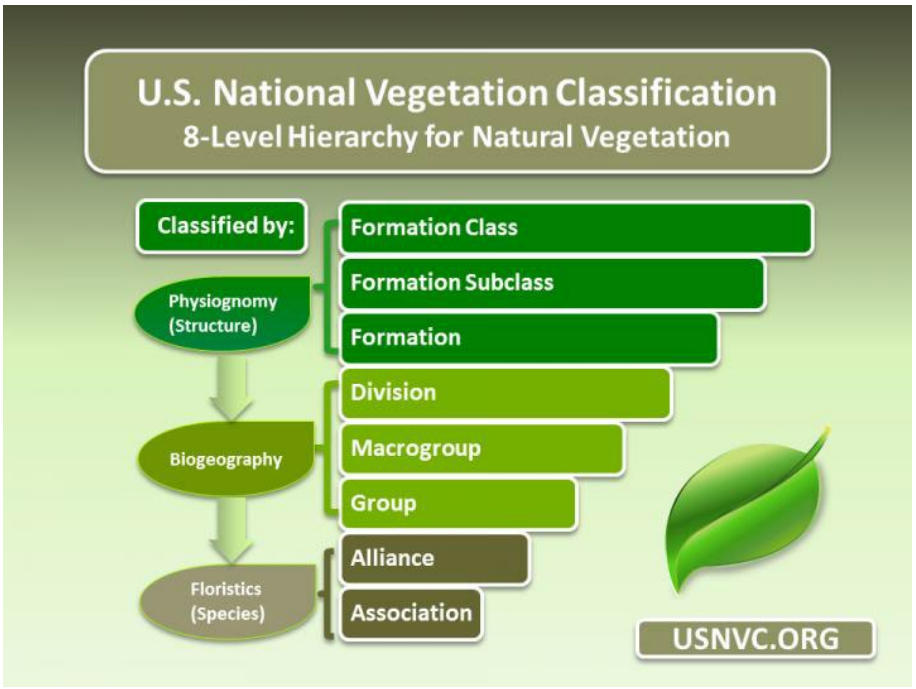

Figure 5.1. The National Vegetation Classification Standard (NVCS) hierarchy.

Table 5.1. Vegetation alliances and associations relevant to this study.

- "CG" indicates class proposed for campground revegetation.
- MCV web pages for each alliance may be visited by entering the MCV Number and the end of web addresses exemplified as follows: https://vegetation.cnps.org/alliance/309
- Note that some alliances or associations here (e.g. LupEri, AdeSal) are never mentioned beyond this table, but are included in the table for completeness because they may be deemed specifically relevant at some point in the future.

Status	Abbreviation used in this study	MCV2 Alliance			MCV2 Association	Characteristic species within study area	CG?
		Scientific name	Common name	No.			
Native	AbrAmb	Abronia latifolia - Ambrosia chamissonis Herbaceous Alliance	Dune mat	309	Undifferentiated in this study	Abronia latifolia, Ambrosia chamissonis	N
Native	EriGla	Eriophyllum staechadifolium - Erigeron glaucus - Eriogonum latifolium Herbaceous Alliance	Seaside woolly-sunflower - seaside daisy - buckwheat patches	583	Erigeron glaucus	Erigeron glaucus	Y
Native	EriSta				Eriophyllum staechadifolium - Eriogonum latifolium	Eriophyllum staechadifolium, Eriogonum latifolium	Y
Native	EriPar				Eriogonum parvifolium	Eriogonum parvifolium	Y
Native	ArtPyc				Artemisia pycnocephala	Artemisia pycnocephala	Y
Native	CorFil	Corethrogyne filaginifolia - Eriogonum (elongatum, nudum) Herbaceous Alliance	Sand-aster and perennial buckwheat fields	505	Undifferentiated in this study	Corethrogyne filaginifolia	Y
Native	AcmGla	Lotus scoparius - Lupinus albifrons - Eriodictyon spp. Shrubland Alliance	Deerweed - silver lupine - yerba santa scrub	567	Undifferentiated in this study	Acmispon glaber	(Y)
Native	EriEri	Lupinus chamissonis - Ericameria ericoides Shrubland Alliance	Silver dune lupine - mock heather scrub	231	Ericameria ericoides	Lupinus chamissonis - Ericameria ericoides	Y
Native	PhaRam				Not defined. Proposed by this study.	Phacelia ramosissima	Y
Native	LupCha				Lupinus chamissonis	Lupinus chamissonis	Y
Native	LupEri				Lupinus chamissonis - Ericameria ericoides	Lupinus chamissonis, Ericameria ericoides	(Y)
Native	RubUrs	Gaultheria shallon - Rubus (ursinus) Shrubland Alliance	Salal - berry brambles	539	Undifferentiated in this study	Rubus ursinus	N
Native	CarPan	Carex (pansa, praegracilis) Herbaceous Alliance	Sand dune sedge swaths	359	Undifferentiated in this study	Carex pansa	N
Native	JunBal	Juncus arcticus (var. balticus, mexicanus) Herbaceous Alliance	Baltic and Mexican rush marshes	405	Undifferentiated in this study	Juncus balticus	N

(continued on next page)

Status	Abbreviation used in this study	MCV2 Alliance			MCV2 Association	
		Scientific name	Common name	No.		Characteristic species within study area
Native	ToxDiv	Toxicodendron diversilobum Shrubland Alliance	Poison oak scrub	301	Undifferentiated in this study	Toxicodendron diversilobum
Native	FraCal	Frangula californica - Rhododendron occidentale - Salix breweri Shrubland Alliance	California coffee berry - western azalea scrub - Brewer's willow	547	Undifferentiated in this study	Frangula californica
Native	BacPil	Baccharis pilularis Shrubland Alliance	Coyote brush scrub	151	Undifferentiated in this study	Baccharis pilularis
Native	LupArb	Lupinus arboreus Shrubland Alliance and Semi-Natural Alliance	Yellow bush lupine scrub	230	Undifferentiated in this study	Lupinus arboreus
Native	ArtCal	Artemisia californica - Salvia mellifera Shrubland Alliance		138	Undifferentiated in this study	Artemisia californica, S. mellifera
Native	ArcPum	Arctostaphylos pumila Provisional Shrubland Alliance	Sandmat manzanita chaparral	129	Undifferentiated in this study	Arctostaphylos pumila
Native	ArcHoo	Arctostaphylos hookeri Provisional Shrubland Alliance	Hooker's manzanita chaparral	118	Undifferentiated in this study	Arctostaphylos hookeri
Native	AdeFas	Adenostoma fasciculatum Shrubland Alliance	Chamise chaparral	102	Undifferentiated in this study	Adenostoma fasciculatum
Native	AdeSal	Adenostoma fasciculatum - Salvia spp. Shrubland Alliance	Chamise - Sage chaparral	586	Undifferentiated in this study	Adenostoma fasciculatum, Salvia mellifera
Native	HetArb	Prunus ilicifolia - Heteromeles arbutifolia - Ceanothus spinosus Shrubland Alliance	Holly leaf cherry - toyon - greenbark ceanothus chaparral	525	Undifferentiated in this study	Heteromeles arbutifolia
Native	GarrEll	Quercus agrifolia Forest & Woodland Alliance	Coast live oak woodland and forest	78	Not defined. Proposed by this study.	Garrya elliptica
Native	QueHetFra				Quercus agrifolia / Frangula	Heteromeles arbutifolia, Frangula californica
Native	QueAgr				Quercus agrifolia	Quercus agrifolia
Native	ArcTom	Arctostaphylos (crustacea, tomentosa) Shrubland Alliance	Brittle leaf - woolly leaf manzanita chaparral	115	Undifferentiated in this study	Arctostaphylos tomentosa
Non-native	CakMar	Cakile (edentula, maritima) Provisional Herbaceous Semi-Natural Alliance	Sea rocket sands	334	Undifferentiated in this study	Cakile maritima
Non-native	AmmAre	Ammophila arenaria Herbaceous Semi-Natural Alliance	European beach grass swards	317	Undifferentiated in this study	Ammophila arenaria
Non-native	CarEdu	Mesembryanthemum spp. - Carpobrotus spp. Herbaceous Semi-Natural Alliance	Ice plant mats	367	Undifferentiated in this study	Carpobrotus edulis
Non-native	AveBro	Avena spp. - Bromus spp. Herbaceous Semi-Natural Alliance	Wild oats and annual brome grasslands	535	Undifferentiated in this study	Avena - Bromus
Non-native	HesMac	Hesperocyparis macrocarpa - Pinus radiata Forest & Woodland Semi-Natural Alliance	Monterey cypress - Monterey pine stands	572		Hesperocyparis macrocarpa
Non-native	PinRad	Hesperocyparis macrocarpa - Pinus radiata Forest & Woodland Semi-Natural Alliance	Monterey cypress - Monterey pine stands	572		Pinus radiata
Non-native	AcaLon	Acacia spp. - Grevillea spp. - Leptospermum laevigatum [pending]	?	?	Undifferentiated in this study	Acacia longifolia
Non-native	Euc	Eucalyptus spp. - Ailanthus altissima - fHer Woodland Semi-Natural Alliance	Eucalyptus - tree of heaven - black locust groves	31	Undifferentiated in this study	Eucalyptus globulus

Table 5.2. Details of all species relevant to the study.

SppAbbr	SciName	ComName	Cat	Origin	Level
AbrLat	Abronia latifolia	Yellow sand-verbena	Living plant	Native	Species
AbrUmb	Abronia umbellata	Pink sand-verbena	Living plant	Native	Species
AcaLon	Acacia longifolia	Wattle	Living plant	Non-native	Species
AcaMel	Acacia melanoxylon	Blackwood	Living plant	Non-native	Species
AcaRet	Acacia retinodes	Silver wattle	Living plant	Non-native	Species
AchMil	Achillea millefolium	Common yarrow	Living plant	Native	Species
AcmGla	Acmispon glaber	Deerweed	Living plant	Native	Species
AcmHee	Acmispon heermannii	Heermann's lotus	Living plant	Native	Species
AdeFas	Adenostoma fasciculatum	Chamise	Living plant	Native	Species
AmbCha	Ambrosia chamissonis	Beach pea	Living plant	Native	Species
AmmAre	Ammophila arenaria	European marram grass	Living plant	Non-native	Species
ArbMen	Arbutus menziesii	Madrone	Living plant	Native	Species
ArcCru	Arctostaphylos crustacea	Brittleleaf manzanita	Living plant	Native	Species
ArcHoo	Arctostaphylos hookeri	Hooker's manzanita	Living plant	Native	Species
ArcPum	Arctostaphylos pumila	Sandmat Manzanita	Living plant	Native	Species
ArcTom	Arctostaphylos tomentosa	Wolllyleaf manzanita	Living plant	Native	Species
ArcTomTom	Arctostaphylos tomentosa tomentosa	Wolllyleaf manzanita	Living plant	Native	Subspecies
ArmMar	Armeria maritima	Sea thrift	Living plant	Native	Species
ArtBie	Artemisia biennis	Biennial wormwood	Living plant	Non-native	Species
ArtCal	Artemisia californica	Coastal sage brush	Living plant	Native	Species
ArtDou	Artemisia douglasiana	California mugwort	Living plant	Native	Species
ArtPyc	Artemisia pycnocephala	Beach wormwood	Living plant	Native	Species
AstNut	Astragalus nuttallii	Nuttall's milkvetch	Living plant	Native	Species
AtrLeu	Atriplex leucophylla	Beach saltbush	Living plant	Native	Species
BacPil	Baccharis pilularis	Coyote brush	Living plant	Native	Species
BliCal	Blitum californicum	California goosefoot	Living plant	Native	Species
BroDia	Bromus diandrus	Ripgut brome	Living plant	Non-native	Species
BroHor	Bromus hordeaceus	Soft chess	Living plant	Non-native	Species
CakMar	Cakile maritima	European searocket	Living plant	Non-native	Species
CalSol	Calystegia soldanella	Sea bindweed	Living plant	Native	Species
CamChe	Camissoniopsis cheiranthifolia	Beach suncup	Living plant	Native	Species
CarRam	Cardionema ramosissimum	Sand mat	Living plant	Native	Species
CarPan	Carex pansa	Sand dune sedge	Living plant	Native	Species
CarEdu	Carpobrotus edulis	Iceplant	Living plant	Non-native	Species
CasAff	Castilleja affinis	Coast paintbrush	Living plant	Native	Species
CasLat	Castilleja latifolia	Monterey paintbrush	Living plant	Native	Species
CeaDen	Ceanothus dentatus	Sandscrub ceanothus	Living plant	Native	Species
CeaRig	Ceanothus rigidus	Monterey ceanothus	Living plant	Native	Species
CeaThy	Ceanothus thyrsiflorus	Blueblossom	Living plant	Native	Species
CenCla	Cenchrus clandestinus	Kikuyu grass	Living plant	Non-native	Species
ChaFlo	Chasmanthe floribunda	African flag	Living plant	Non-native	Species
ChoPun	Chorizanthe pungens	Spineflower	Living plant	Native	Species

CirOcc	Cirsium occidentale	Cobweb thistle	Living plant	Native	Species
CisCre	Cistus creticus	Rock Rose	Living plant	Non-native	Species
ConPug	Conicosia pugioniformis	Narrow-leaved iceplant	Living plant	Non-native	Species
CorFil	Corethrogyne filaginifolia	California aster	Living plant	Native	Species
CotPan	Cotoneaster pannosus	Silverleaf Cotoneaster	Living plant	Non-native	Species
CroCal	Croton californicus	California croton	Living plant	Native	Species
CypEra	Cyperus eragrostis	Tall flatsedge	Living plant	Native	Species
DauPus	Daucus pusillus	Wild carrot	Living plant	Native	Species
DeiCor	Deinandra corymbosa	Coastal tarweed	Living plant	Native	Species
DipAur	Diplacus aurantiacus	Sticky monkey flower	Living plant	Native	Species
DisSpi	Distichlis spicata	Saltgrass	Living plant	Native	Species
DudCae	Dudleya caespitosa	Coast dudleya	Living plant	Native	Species
ElyTra	Elymus trachycaulus	Slender wheat grass	Living plant	Native	Species
EriEri	Ericameria ericoides	California Goldenbush	Living plant	Native	Species
EriCan	Erigeron canadensis	Horseweed	Living plant	Native	Species
EriGla	Erigeron glaucus	Seaside daisy	Living plant	Native	Species
EriGig	Eriogonum giganteum	St Catherine's lace	Living plant	Non-native	Species
EriLat	Eriogonum latifolium	Seaside buckwheat	Living plant	Native	Species
EriPar	Eriogonum parvifolium	Seacliff wild buckwheat	Living plant	Native	Species
EriSta	Eriophyllum staechadifolium	Seaside wooly sunflower/ Lizard Tail	Living plant	Native	Species
EroCic	Erodium cicutarium	Redstem stork's-bill	Living plant	Non-native	Species
EryAmm	Erysimum ammophilum	Coast wallflower	Living plant	Native	Species
EryMen	Erysimum menziesii	Menzies' wallflower	Living plant	Native	Species
EscCal	Eschscholzia californica	California poppy	Living plant	Native	Species
EucGlo	Eucalyptus globulus	Blue Gum	Living plant	Non-native	Species
ExtCal	Extriplex californica	California orache	Living plant	Native	Species
FraCal	Frangula californica	California coffeeberry	Living plant	Native	Species
FraSal	Frankenia salina	Alkali heath	Living plant	Native	Species
GalApa	Galium aparine	Catchweed bedstraw	Living plant	Native	Species
GamUst	Gamochaeta ustulata	Pacific cudweed	Living plant	Native	Species
GarEll	Garrya elliptica	Coast Silk Tassel	Living plant	Native	Species
GenMon	Genista monspessulana	French broom	Living plant	Non-native	Species
GilTenAre	Gilia tenuiflora arenaria	Sand Gilia	Living plant	Native	Subspecies
GriStr	Grindelia stricta	Oregon gum plant	Living plant	Native	Species
GriStrPla	Grindelia stricta platyphylla	Coastal gum plant	Living plant	Native	Variety
HelLut	Helichrysum luteoalbum	Jersey cudweed	Living plant	Non-native	Species
HesMac	Hesperocyparis macrocarpa	Monterey cypress	Living plant	Non-native	Species
HetArb	Heteromeles arbutifolia	Toyon	Living plant	Native	Species
HetGra	Heterotheca grandiflora	Telegraphweed	Living plant	Native	Species
HirInc	Hirschfeldia incana	Shortpod Mustard	Living plant	Non-native	Species
HypRad	Hypochaeris radicata	Common cat's ear	Living plant	Non-native	Species
HorCun	Horkelia cuneata	Wedgeleaf horkelia	Living plant	Native	Species
IsoMen	Isocoma menziesii	Coastal goldenbush	Living plant	Native	Species
JunBal	Juncus balticus	Baltic rush	Living plant	Native	Species
LepLae	Leptospermum laevigatum	Australian tea tree	Living plant	Non-native	Species

LesGla	Lessingia glandulifera	Valley lessingia	Living plant	Native	Species
LeyMol	Leymus mollis	Beach grass	Living plant	Native	Species
LimSin	Limonium sinuatum	Blue Stattice	Living plant	Non-native	Species
LonHis	Lonicera hispidula	Pink honeysuckle	Living plant	Native	Species
LupArb	Lupinus arboreus	Coastal bush lupine/Yellow bush lupin	Living plant	Native	Species
LupCha	Lupinus chamissonis	Silver dune lupine	Living plant	Native	Species
LysArv	Lysimachia arvensis	Scarlet pimpernel	Living plant	Non-native	Species
MarFab	Marah fabacea	California manroot	Living plant	Native	Species
MatInc	Matthiola incana	Hoary stock	Living plant	Non-native	Species
NasCer	Nassella cernua	Nodding needlegrass	Living plant	Native	Species
OxaPes	Oxalis pes-caprae	Bermuda Buttercup	Living plant	Non-native	Species
PhaRam	Phacelia ramosissima	Branching phacelia	Living plant	Native	Species
PinMur	Pinus muricata	Bishop pine	Living plant	Unknown	Species
PinRad	Pinus radiata	Monterey pine	Living plant	Non-native	Species
PinTor	Pinus torreyana	Torrey Pine	Living plant	Non-native	Species
PlaCor	Plantago coronopus	Cutleaf plantain	Living plant	Non-native	Species
PlaMar	Plantago maritima	Sea plantain	Living plant	Native	Species
PoaDou	Poa douglasii	Bluegrass	Living plant	Native	Species
PolPar	Polygonum paronychia	Beach Knotweed	Living plant	Native	Species
PseCal	Pseudognaphalium californicum	California cudweed	Living plant	Native	Species
PseBen	Pseudognaphalium beneolens	Fragrant Everlasting	Living plant	Native	Species
PseBio	Pseudognaphalium biolettii	Two-color rabbit tobacco	Living plant	Native	Species
PteAquPub	Pteridium aquilinum pubescens	Hairy brackenfern	Living plant	Native	Variety
PyrKoi	Pyracantha koidzumii	Taiwan firethorn	Living plant	Non-native	Species
QueAgr	Quercus agrifolia	Coast live oak	Living plant	Native	Species
RosCal	Rosa californica	California wild rose	Living plant	Native	Species
RubUrs	Rubus ursinus	Pacific Blackberry	Living plant	Native	Species
RubUrsMac	Rubus ursinus macropetalus	California blackberry	Living plant	Native	Subspecies
RumAce	Rumex acetosella	Sheep sorrel	Living plant	Non-native	Species
RumCri	Rumex crispus	Curled dock	Living plant	Non-native	Species
SalPac	Salicornia pacifica	Pacific glasswort	Living plant	Native	Species
SalTra	Salsola tragus	Prickly Russian Thistle	Living plant	Non-native	Species
SalMel	Salvia mellifera	Black sage	Living plant	Native	Species
SolDou	Solanum douglasii	Greenspot nightshade	Living plant	Native	Species
SolUmb	Solanum umbelliferum	Blue witch	Living plant	Native	Species
SteEla	Stephanomeria elata	Santa Barbara wirelettuce	Living plant	Native	Species
SynRur	Syntrichia ruralis	Twisted Moss	Living plant	Native	Species
TetTet	Tetragonia tetragonoides	New Zealand Spinach	Living plant	Non-native	Species
ToxDiv	Toxicodendron diversilobum	Poison oak	Living plant	Native	Species
UlmMin	Ulmus minor	Field Elm	Living plant	Non-native	Species
AcaSpp	Acacia	Wattle	Living plant	Non-native	Genus
AgaSpp	Agave	Agave	Living plant	Non-native	Genus
AbrSpp	Abronia	Sand-verbena	Living plant	Native	Genus
AcmSpp	Acmispon	Lotus	Living plant	Native	Genus
ArcSpp	Arctostaphylos	Manzanita	Living plant	Native	Genus

ArtSpp	Artemisia	Sage	Living plant	Native	Genus
CakSpp	Cakile	Searocket	Living plant	Non-native	Genus
CarSpp	Carpobrotus	Iceplant	Living plant	Non-native	Genus
ChoSpp	Chorizanthe	Spineflower	Living plant	Native	Genus
CorSpp	Cortaderia	Pampas grasses	Living plant	Non-native	Genus
DudSpp	Dudleya	Dudleya	Living plant	Native	Genus
ErySpp	Erysimum	Wallflower	Living plant	Native	Genus
EscSpp	Eschscholzia	Poppy	Living plant	Native	Genus
EucSpp	Eucalyptus	Eucalyptus	Living plant	Non-native	Genus
LupSpp	Lupinus	Lupine	Living plant	Native	Genus
PipSpp	Piperia	Rein-Orchid	Living plant	Native	Genus
PlaSpp	Plantago	Plantain	Living plant	Undifferentiated	Genus
PoaSpp	Poa	Bluegrass	Living plant	Undifferentiated	Genus
PseSpp	Pseudognaphalium	Cudweed	Living plant	Undifferentiated	Genus
PyrSpp	Pyracantha	Firethorn	Living plant	Non-native	Genus
RumSpp	Rumex	Sheep's sorrel	Living plant	Undifferentiated	Genus
SteSpp	Stephanomeria	Wire lettuce	Living plant	Undifferentiated	Genus
NasSpp	Nassella	Needle grass	Living plant	Native	Genus
YucSpp	Yucca	Yucca	Living plant	Non-native	Genus
Braciceae	Brassiceae	Mustard	Living plant	Non-native	Tribe
Gnaphalieae	Gnaphalieae	Gnaphalieae	Living plant	Undifferentiated	Tribe
Poaceae	Poaceae	Grasses	Living plant	Undifferentiated	Family
Apiaceae	Apiaceae	Carrot family	Living plant	Undifferentiated	Family
Asteraceae	Asteraceae	Sunflowers, daisies, asters, and allies	Living plant	Undifferentiated	Family
Poales	Poales	Grasses, sedges, cattails, and allies	Living plant	Undifferentiated	Order
Magnoliopsida	Magnoliopsida	Dicots	Living plant	Undifferentiated	Class
Apiaceae	Angiospermae	Flowering plants	Living plant	Undifferentiated	Subphylum
Bryophyta	Bryophyta	Moss	Living plant	Undifferentiated	Phylum
Marchantiophyta	Marchantiophyta	Liverwort	Living plant	Undifferentiated	Phylum
Nonvascular	Nonvascular	Nonvascular	Living plant	Undifferentiated	Other
Lecanoromycetes	Lecanoromycetes	Lichen	Lichen	Undifferentiated	Other
Lichen/Moss	Lichen/Moss	Lichen/Moss	Lichen/Moss	Undifferentiated	Other
Annual grasses	Annual grasses	Annual grasses	Functional group	Undifferentiated	Other
Bunch grasses	Bunch grasses	Bunch grasses	Functional group	Undifferentiated	Other
Annual herbs	Annual herbs	Annual herbs	Functional group	Undifferentiated	Other
Bare	Bare	Bare	Bare etc.	Non-Living	Non-Living
Road	Road	Road	Bare etc.	Non-Living	Non-Living
None		Bare or Litter or Road	Bare etc.	Non-Living	Non-Living
Unk	_Unknown	Unknown	Living plant	Undifferentiated	Unknown

6 Special status species

The campground revegetation plan offers an excellent opportunity to protect and expand special status species occurrences at Fort Ord Dunes. We defined special status species as those which met one or more of the following criteria:

- Federally listed as threatened or endangered
- State listed as threatened or endangered
- Ranked by the California Native Plant Society as California Rare Plant Rank 1B (plants that are rare, threatened, or endangered in California and elsewhere)
- Is a host plant for the federally endangered Smith's blue butterfly, *Euphilotes enoptes smithi*

To understand which SSS are specifically relevant to the campground area (i.e. could potentially exist there), we compiled a list of species that either: (a) we encountered in FODSP or MSB, (b) State Parks employees previously encountered in FODSP, (c) were listed in the CCDRP, (d) were listed in the Fort Ord Habitat Management Plan (USACE 1997; Table 6.1), and/or (e) were mapped by Styer (2019) as occurring at FODSP.

We used CSP survey data, CSUMB observations, and our previous data (Watson, unpublished data) to illustrate the current presence and historical extents of SSS within the FODSP restoration area (Fig. 6.1), CNPS10 (Fig. 6.2), and MSB (Fig. 6.3).

For the public version of this report, we obscured the locations of particularly localized special status species.

The general occurrence of special status species in the study area was observed as follows:

- ***Euphilotes enoptes smithi*, *Eriogonum parvifolium*, and *Eriogonum latifolium***. The two *Eriogonum* species are the host plants for the endangered butterfly *E. e. smithi*. We did not survey for the butterfly. The host plants have been extensively mapped in the campground area through previous work by State Parks. We also encountered them in our various field observations (see Section 7). *E. parvifolium* occurred in a wide range of vegetation alliances and associations (see Section 9) and most prominently in the *ArtPyc*, *EriSta*, *EriPar*, and *EriEri* map classes in the southern portion of FODSP. *E. latifolium* occurred in similar map classes but more in the northern portion of the study area i.e. Marina State Beach.
- ***Chorizanthe pungens* var. *pungens***. is an annual and was barely detected by our study. It has been extensively mapped throughout FODSP by State Parks. We did not quantitatively analyze its spatial relationship to defined vegetation associations and alliances, but qualitatively we note that is strongly associated with what we mapped (see Section 8) as the *ArtPyc* and *EriEri* map classes.
- ***Gilia tenuiflora* ssp. *arenaria*** is another annual that we did not detect during the study period but that has been extensively surveyed for in the study area by F. Watson and A. Palkovic (unpublished data) and prior workers. It is closely associated with *ArtPyc* and *CorFil* map classes at MSB and with *EriEri* and *ArtPyc* map classes in the vicinity of CNPS Reserve 10. There are no known present or historic occurrences near the campground site, and it is uncertain and perhaps even unlikely that it would have been native to the campground site given the very narrow Flandrian dunes there and the soils of the Pre-

Flandrian dunes there that are more loamy than Pre-Flandrian soils to the south and north where *G. t. arenaria* does occur.

- ***Erysimum menziesii*** occurs at Marina State Beach at a fairly specific distance from the ocean in a linear zone that we mapped as encompassing a complex of *AbrAmb*, *CorFil*, *ArtPyc*, *EriSta*, *EriPar* map classes. Ideal *E. menziesii* habitat may be closer to the beach and ocean than any substantial area within the campground revegetation project.
- ***Erysimum ammophilum*** occurs both at MSB and in the vicinity of CNPS reserve 10 typically close to the leeward edge of the Flandrian dunes in *CorFil*, *ArtPyc*, and *EriEri* map classes.
- ***Arctostaphylos pumila*** is the most coastward of the *Arctostaphylos* of the former Fort Ord. It grows in large dense and relatively undisturbed stands near Marina High School. In FODSP it is much more limited but appears to have a relatively even but sparse distribution on Pre-Flandrian soils (particularly in the areas of FODSP and the railroad right of way that are west of MHS, west of Eighth Street, west of Lightfighter Drive, and northwest of Seaside High School). It is probable that *Arctostaphylos pumila* was once substantially more abundant on what is now FODSP.
- ***Arctostaphylos hookeri*** is widely distributed throughout the chaparral of the central area of the former Fort Ord. We observed two individuals in the vicinity of the campground site in close proximity to other more inland species, such as *Quercus agrifolia* and *Arctostaphylos tomentosa*, and several individuals west of the railroad tunnel north of Divarty Street. *A. hookeri* was probably a minor component of what we argue was a native oak woodland and maritime chaparral in the northeasternmost portion of the campground site.
- ***Piperia sp***. This genus occurs beneath *Pinus radiata* within the campground project area (F. Watson, obs. 12/30/21). The species is mostly likely either *yadonii* (federally endangered), *michaelii* (CA Rare Plant Ranked), or *elegans* (no special status). *Yadonii* is plausible, because the location and habitat are not particularly different to where *P. yadonii* has been documented near Marina High School and in the area just east of FODSP known as “Main Gate”. *P. michaelii* and *P. elegans* are plausible because Styer (2019) documented them in FODSP. At the same location as 12/30/21 observation, a single “Piperia sp.” data point with a “Count” attribute value of “0” shows up in a CSP shapefile produced during the IS-MND for the campground in around 2013. This observation was not reported in the IS-MND, which suggests that either the observation was not identified to species, or that it was not legally protected (i.e. not *yadonii*).

Table 6.1. Special status species relevant to the FOD campground area.

Scientific Name	Common Name	Status: USFWS / CDFW / CRPR	Encountered during ENVS660 F21 study
*Eriogonum parvifolium**	Sea Cliff Buckwheat*	-- / -- / --	Y
*Eriogonum latifolium**	Seaside Buckwheat*	-- / -- / --	Y
Chorizanthe pungens var. *pungens*	Monterey Spineflower	FT / -- / 1B.2	Y
Erysimum menziesii	Menzies' Wallflower	FE / CE / 1B.1	Y
Erysimum ammophilum	Coast Wallflower	-- / -- / 1B.2	Y
Arctostaphylos pumila	Sandmat Manzanita	-- / -- / 1B.2	Y
Arctostaphylos hookeri	Hooker's Manzanita	-- / -- / 1B.2	Y
Gilia tenuiflora ssp. *arenaria*	Monterey Gilia	FE / CT / 1B.2	N
Piperia michaelii	Michael's Rein-Orchid	-- / -- / 4.2	?
Piperia yadonii	Yadon's Rein-Orchid	FE / -- / 1B.1	

*Special status as host plant to the federally endangered Smith's Blue Butterfly, *Euphilotes enoptes smithi*

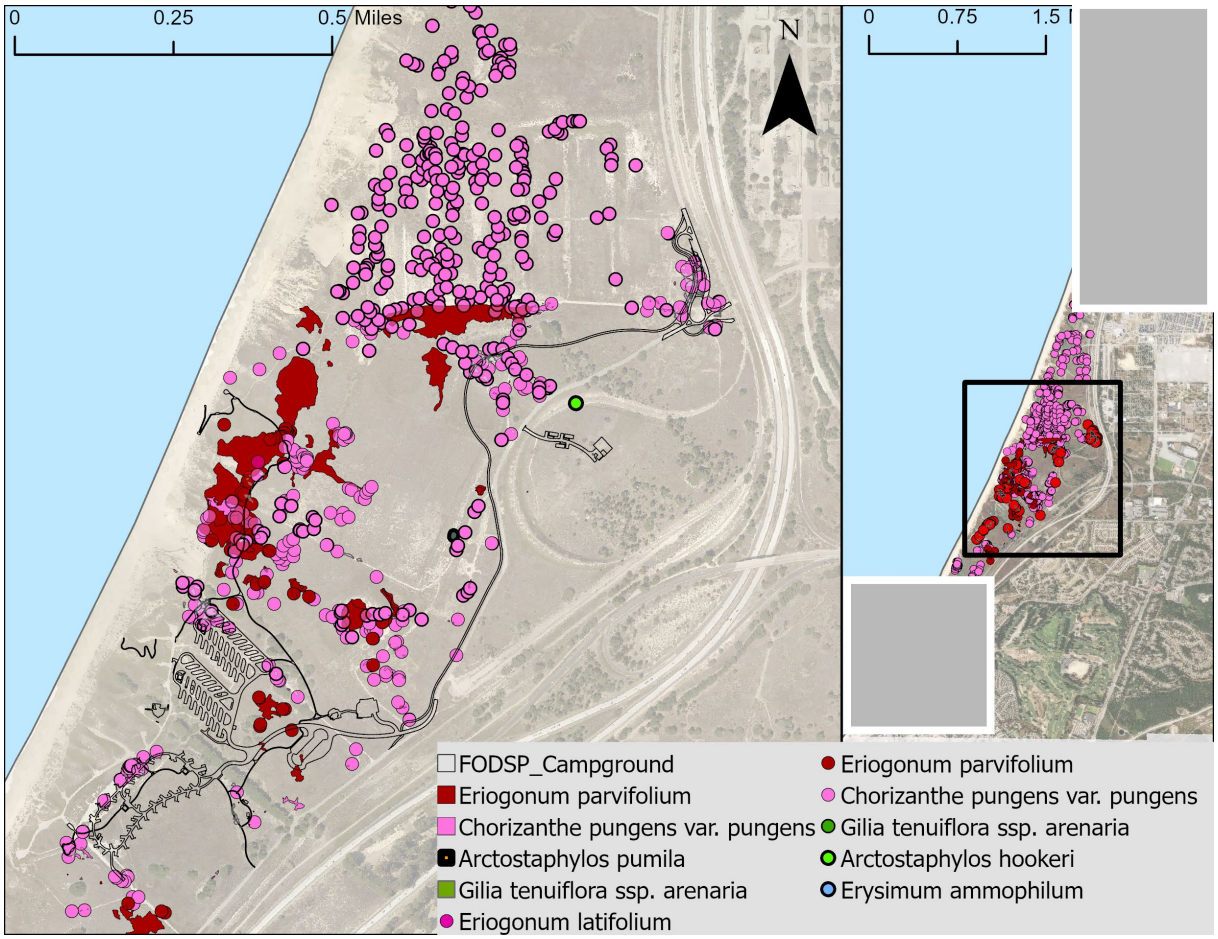

Figure 6.1. SSS at the FODSP campground restoration area.
(Redacted in public version. Non-redacted versions available to CSP staff.)
(Some A. pumila and A. hookeri locations are missing from this map because they were discovered late in the project.)

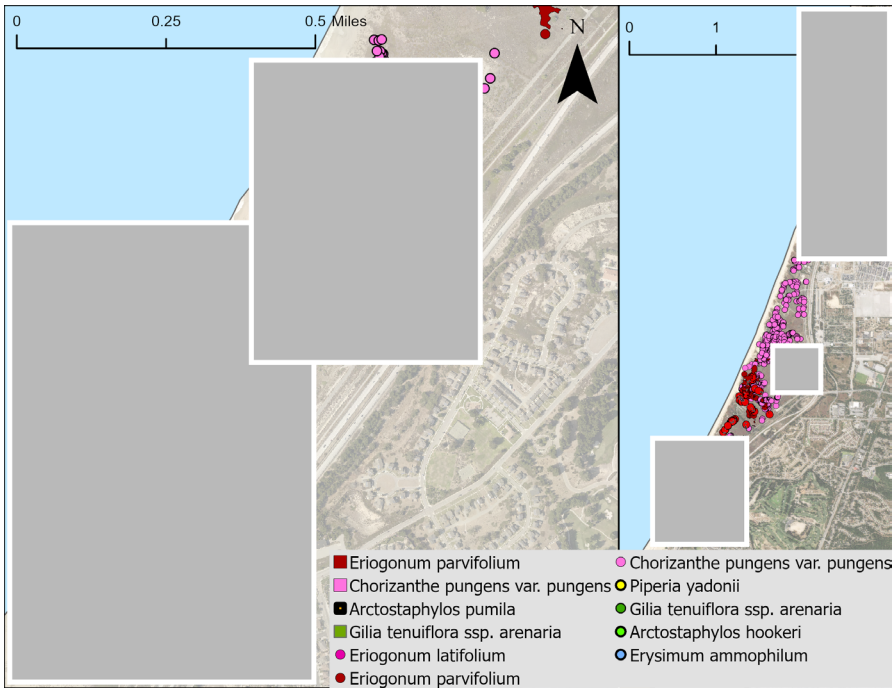

Figure 6.2. SSS at the CNPS10 reference area.
(Redacted in public version. Non-redacted versions available to CSP staff.)

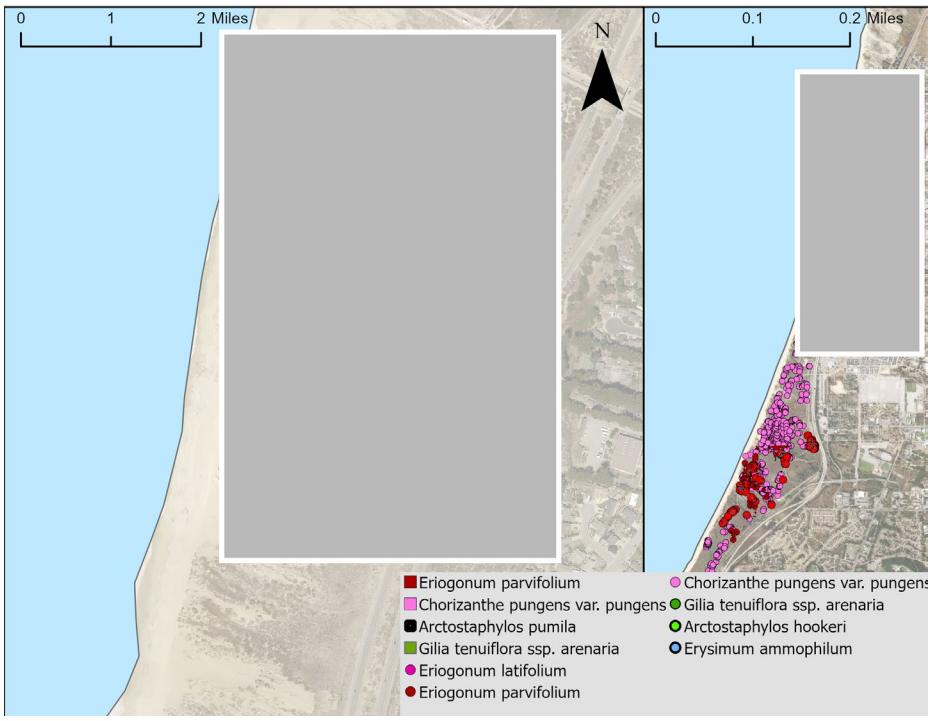

Figure 6.3. SSS at the MSB reference area.
(Redacted in public version. Non-redacted versions available to CSP staff.)

7 Field observations

We collected field observations of plants in the study area for a variety of purposes including:

- Rapid assessment of **percent cover** of different plant species in order to determine vegetation alliances and associations.
- Recording the location and size of individual plants of species that we determined to be indicators of the **woodland/scrubland ecotone**.
- Recording point locations of at least one individual of all species within selected areas in order to estimate **species composition.**
- Recording all locations of **locally rare species** e.g. *Erysimum* spp., *Arctostaphylos* spp.
- Establishment of **permanent monitoring plots** for tracking the progress of restoration at the campground relative to reference areas.

Each of these is described in more detail below, except the permanent monitoring plots which are described in Section 12.

7.1 Rapid assessment of relative cover

We made rapid assessments (RAs) of the percent cover of the most abundant plant species at each of 481 50 m × 50 m plots located throughout the study area. These provided observational support for the mapping of vegetation associations and alliances (see Section 8). We used an abbreviated form of the CNPS Rapid Assessment protocol (CNPS 2007). Percent cover was estimated by eye.

We determined the alliance or association (i.e. map class) of each RA point using membership rules from MCV Online (Fig. 7.3). Most of the campground area is occupied by the *CarEdu* map class because it is dominated by non-native *Carpobrotus* spp. Most of the reference areas (MSB, CNPS10, MHS) are occupied by a range of map classes dominated by native plants.

In plots dominated by non-native species, in addition to recording the percent cover of those non-native species, we also recorded the percent cover of the most abundant native species, even if their percentages were very low. We then determined what we referred to as the "**potential** map class" of those plots using relative cover among just the native species (Fig. 7.4). Most of the potential vegetation of the campground thus determined was classified as *EriEri* (dominated by *Ericameria ericoides*), but there are also several large areas where other map classes prevail in a distinct pattern – e.g. *EriSta* near the coast (*Eriophyllum staechadifolium*) and *QueAgr* more inland (*Quercus agrifolia*).

We also examined the RA data on a per-species basis for native species in the campground area in order to elucidate the spatial patterns of individual sub-dominant species that may be obscured by the spatial patterns of dominant ones (Fig 7.5). For example, *LupCha* (*Lupinus chamissonis*) was never expressed as a potential map class, but as a species *Lupinus chamissonis* exhibited a clear spatial pattern as a secondary species in area where the dominant native plant was either *Artemisia pycnocephala* or *Ericameria ericoides*.

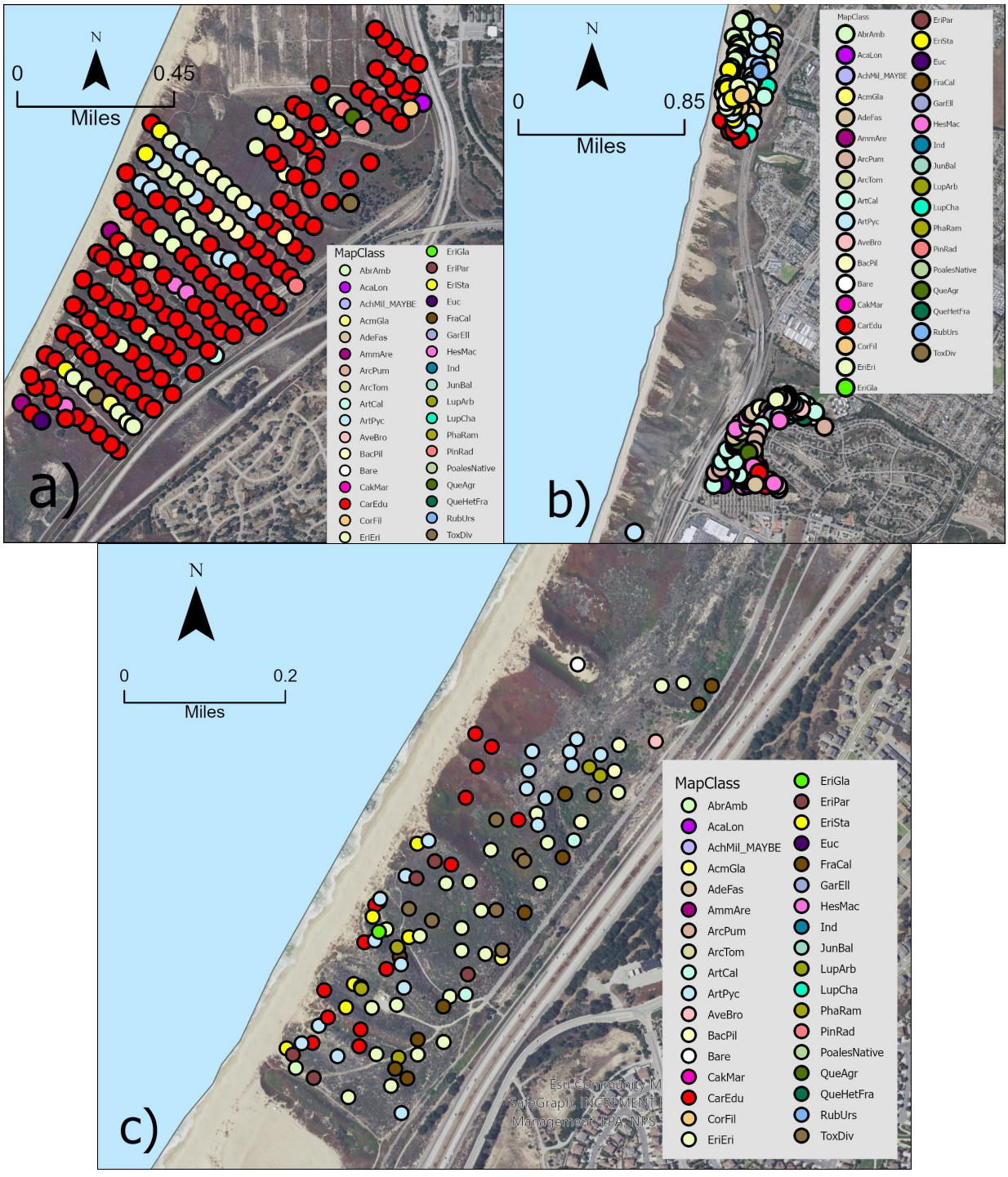

Figure 7.1. Vegetation alliances and associations recorded at rapid assessment (RA) field survey points in: (a) the campground area, (b) MSB and MHS, and (c) near CNPS Reserve 10.

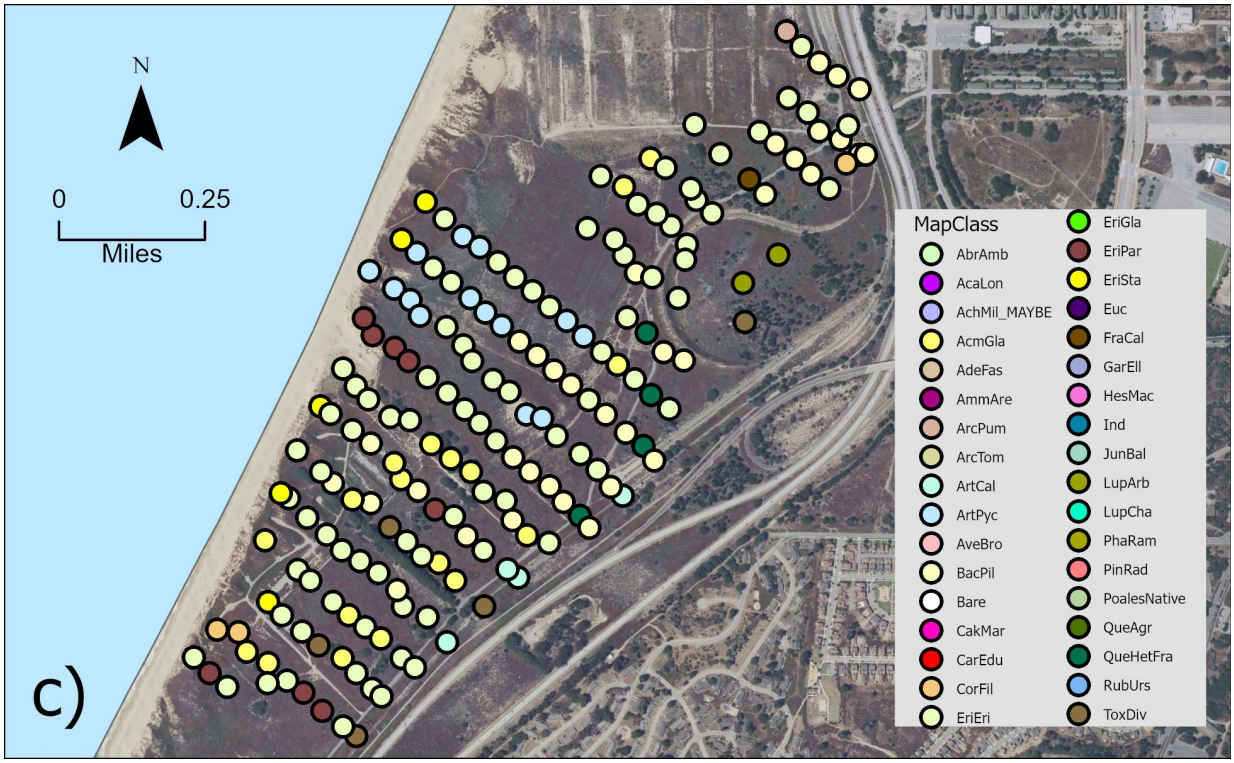

Figure 7.2. Potential native alliances and associations inferred from the native component of rapid assessment (RA) field data in the campground area.

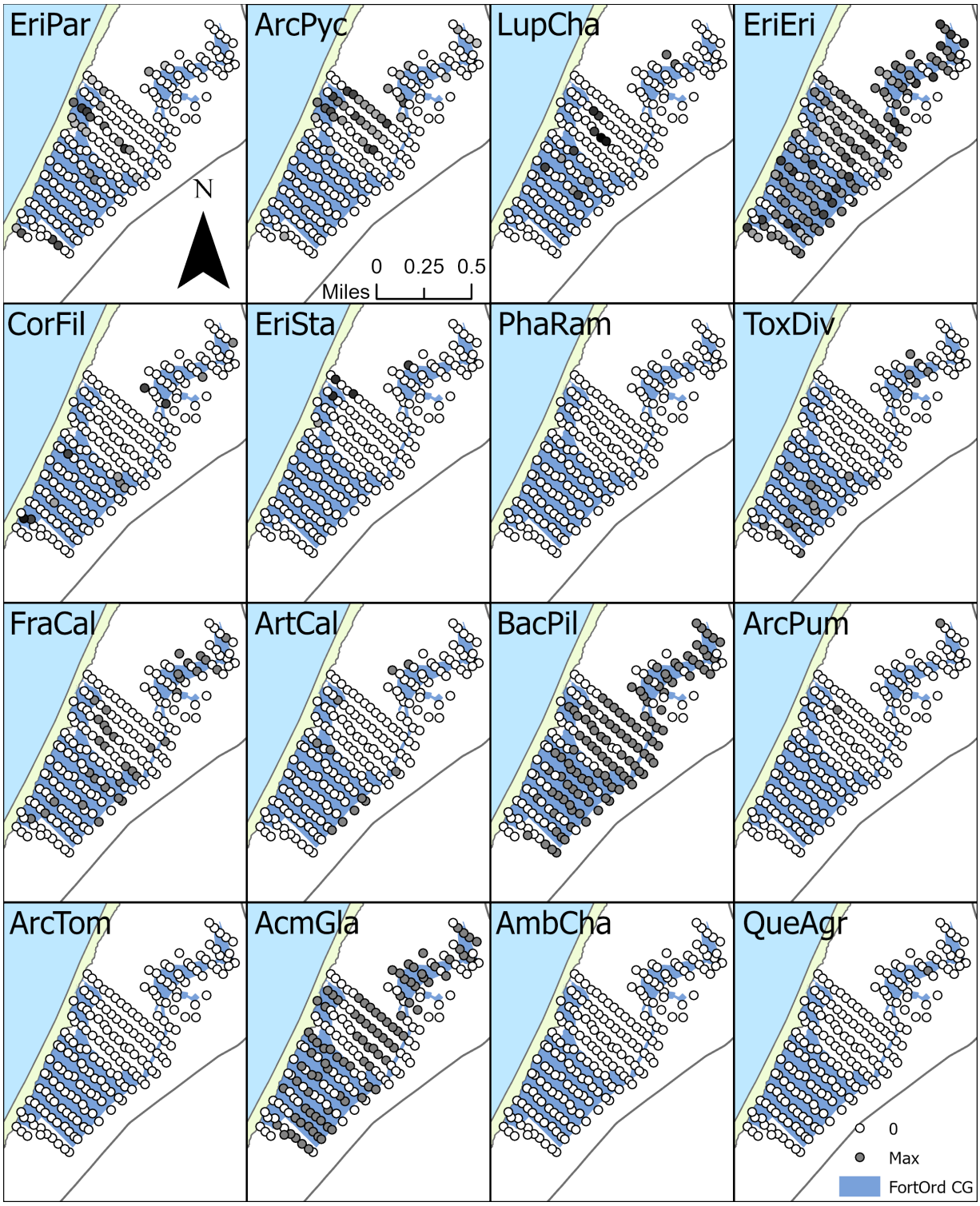

Figure 7.3. Percent cover of native species within the FODSP campground restoration area. shading for each species is relative to the maximum achieved for that species in the study area.

7.2 Woodland/scrubland ecotone indicator species

The woodland/scrubland ecotone on the former Fort Ord is largely obscured by Highway 1 and the surrounding military and urban infrastructure. The ecotone represents the transition between the shrub- and herb-dominated ecosystems of the immediate coast and the oak woodland that occupies much of the interior of the former Fort Ord. Most of FODSP is probably on the scrubland side of where this ecotone occurred just before European arrival. But several lines of evidence indicate that the near the campground the ecotone extended substantially westward of the highway into FODSP. Firstly, numerous native species occur densely here that are indicative of either woodland or the transition to woodland. Secondly, the soils differ from elsewhere in the Pre-Flandrian portions of FODSP; they are the Oceano Loamy Sands that exhibit a strong association oak woodland elsewhere on the former Fort Ord (see maps in Section 3). Thirdly, the area is approximately the same distance inland as the only remaining substantially intact example of the woodland/scrubland ecotone on the former Fort Ord – this being the area immediately west and southwest of Marina High School. Native trees in this area exhibit a somewhat prostrate wind-pruned habit – often growing 40 feet wide and only 10 feet high. The same wind-shaped growth forms occur at FODSP near the campground in *Quercus agrifolia* and *Heteromeles arbutifolia*, and in *Arbutus menziesii* directly adjacent to FODSP.

To document the woodland/scrubland ecotone, we searched for and estimated the dimensions of every individual of an ecotone indicator species within 281 50 m × 50 m plots (174 acres) – a total of 1732 individual plants. The species that were considered to be native woodland/scrubland ecotone indicators were *Quercus agrifolia*, *Heteromeles arbutifolia*, *Garrya elliptica*, *Arbutus menziesii*, and *Frangula californica*.

We also recorded non-native trees, as indicators of the potential for trees of any kind to grow. These included *Pinus radiata*, *Pinus torreyana*, *Hesperocyparis macrocarpa*, *Acacia longifolia*, *Acacia dealbata*, *Leptospermum laevigatum*, and *Eucalyptus globulus*.

Pinus muricata may or may not be present. In stands of *Pinus radiata*, we documented 17 trees with predominantly two needles per fascicle (indicative of *Pinus muricata*) but smooth cone scales (indicative of *Pinus radiata*). We referred to them as *Pinus muricata* mainly as a means of identifying them as something of note. If they are *Pinus muricata*, there's perhaps a small chance that they are native.

The survey encompassed individuals of any size, from seedlings to trees. For each one, we estimated height and canopy width.

The resulting spatial pattern clearly indicates abundant native woodland/scrubland indicator species in the most inland portions of the campground site (Fig. 7.6). *Quercus agrifolia* tended to occur the farthest inland, often in the shadow of Pinus radiata but also with some notably large examples emergent from more open scrubland dominated by *Carpobrotus* and *Ericameria*. *Heteromeles arbutifolia* tended to occur just coastward of the *Quercus*. *Frangula californica* tended to occur in distinct patches, often close to the *Quercus* and *Heteromeles*, but sometimes in patches where it was the largest species, surrounded by other large shrubs such as *Artemisia californica*. Garrya elliptica was essentially dominant at the MHS site in the ecotone between *Quercus* and *Arctostaphylos*, but almost absent from the campground area; the only two *Garrya* we found near the campground were 400 feet from FODSP near the Lightfighter overpass. In contrast, *Heteromeles* were much less abundant at MHS in comparison to the campground area. These differences between the woodland/shrubland ecotone at the campground and MHS areas

may be due to differences in soil type (MHS is more sandy) or perhaps disturbance history. The MHS site is much less disturbed than the campground, and this may favor late-successional species over pioneer species, with the *Arctostaphylos* species, *Garrya*, and *Heteromeles* perhaps differentiating in this respect.

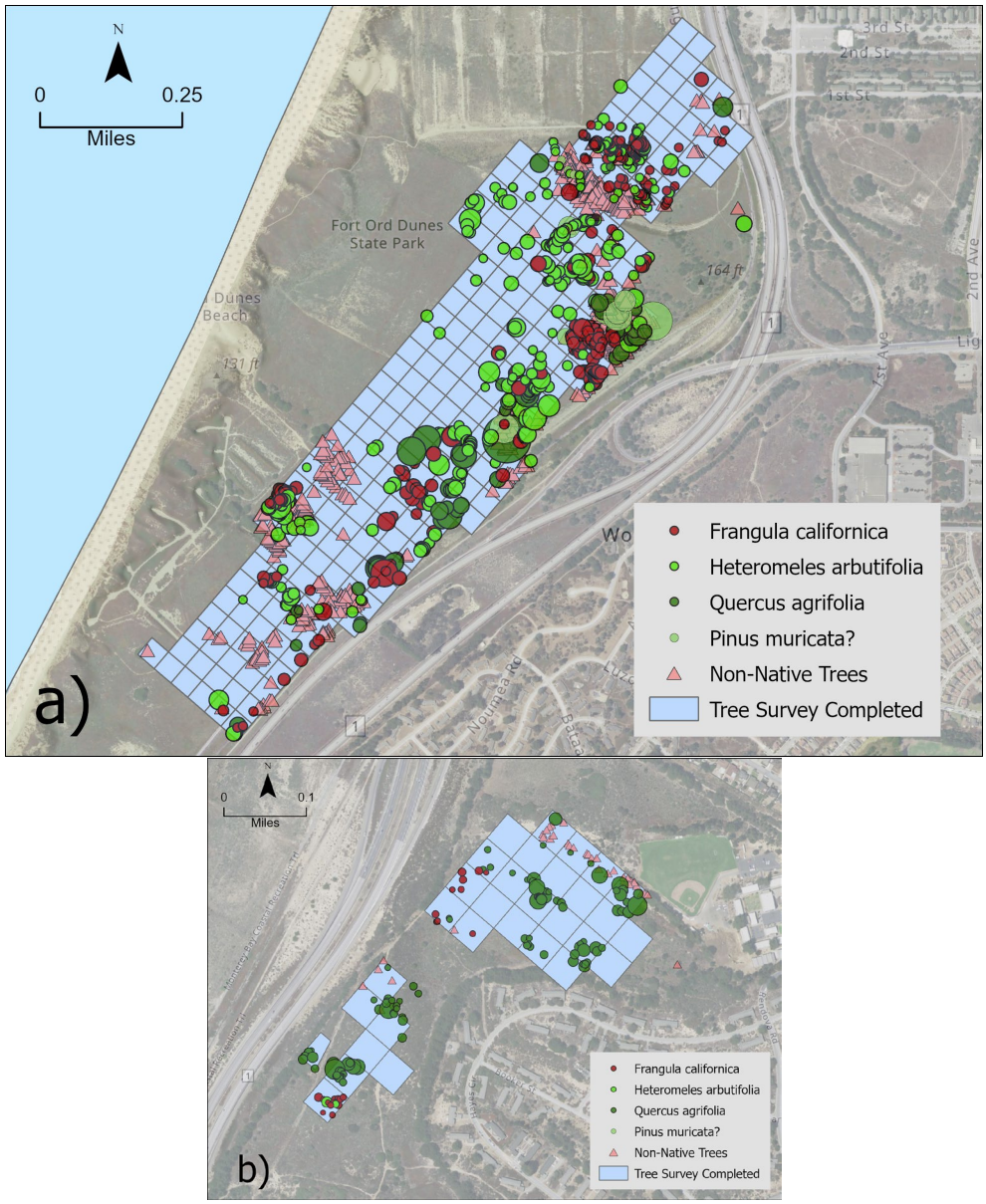

Figure 7.4. Indicator species for the woodland/scrubland ecotone at (a) FODSP and (b)

7.3 Species composition of alliances and associations

We documented the species composition of alliances and associations in order to more precisely define the alliances and associates in the context of the former Fort Ord, and as a partial basis for the planting palettes to be used in the restoration of native alliances and associations at the campground site.

We walked through about two hundred 50 m × 50 m grid cells and used ArcGIS Field Maps to record the first instance of every species we saw in each cell (Fig. 7.7). We also recorded instances of notable species we encountered outside the grid-based survey – e.g. *Erysimum*. This resulted in 1325 point records of the occurrence of individual taxa.

We conducted this effort early in the project so that we could also use it as means of training all team members in plant identification on Fort Ord Dunes.

We also used iNaturalist throughout the project to record notable occurrences and take advantage of the way in which iNaturalist facilitates plant identification and confirmation by multiple individuals. Team members and the broader community with more extensive plant identification experience validated iNaturalist observations. This resulted in 571 iNaturalist observations, some of which overlapped with the point records made using ArcGIS Field Maps.

The results of this effort are presented in Section 9, in the context of the vegetation alliances and associations mapped in Section 8.

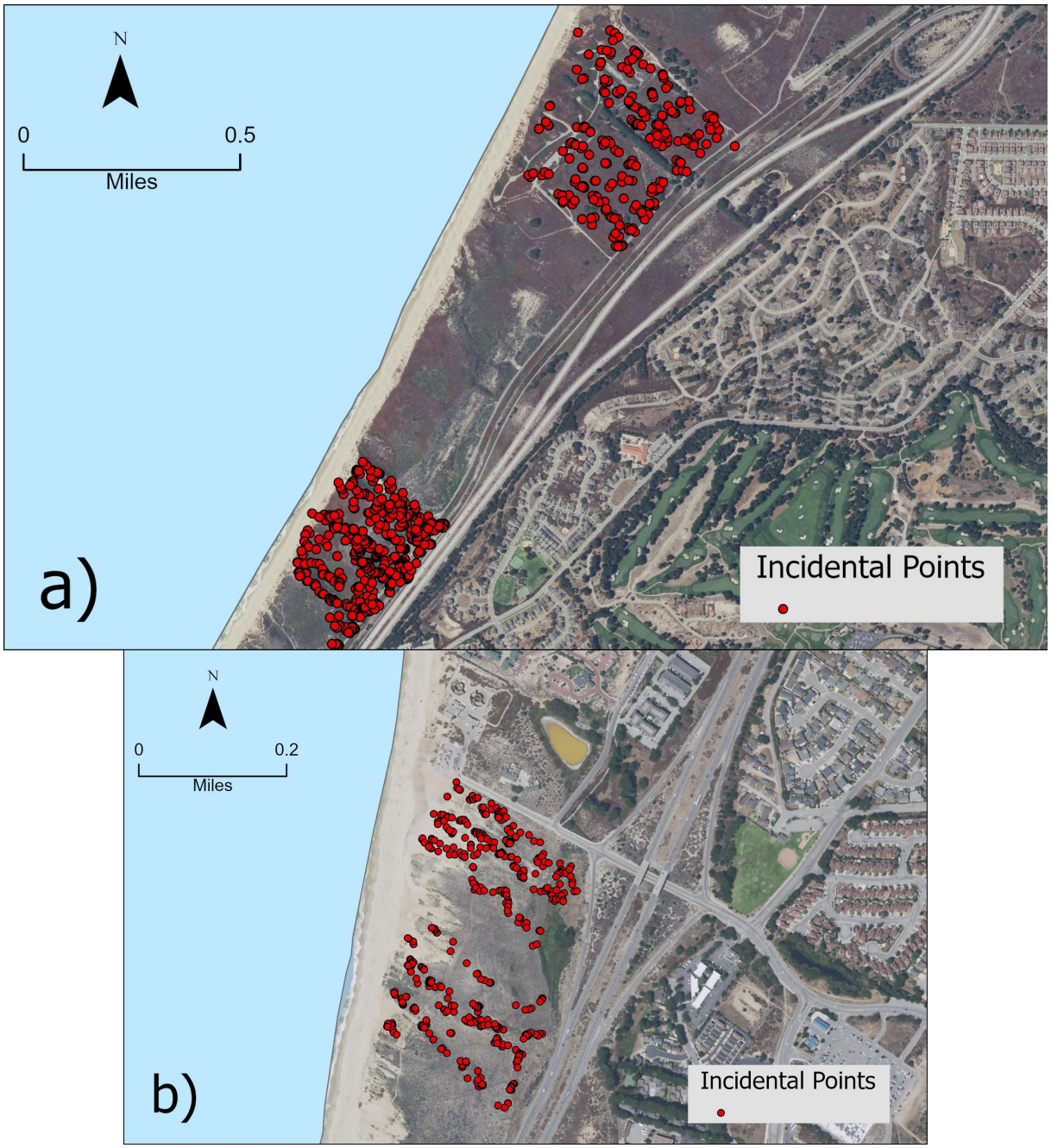

Figure 7.5. Locations at which individual species occurrences were documented using ArcGIS Field Maps as a component of the documentation of the species composition of vegetation alliances and associations.

8 Vegetation maps

We created maps of the vegetation alliances and associations in order to understand their spatial pattern and to use this understanding to design a prescribed restoration pattern at the campground site (Section 11) that plausibly reflects the pre-European situation. We also used vegetation maps to document the species composition of each alliance and association (Section 9), using the field observations described in Section 7.

To map the vegetation, we hand drew polygons in ArcGIS Pro while simultaneously viewing multiple sources of information, including the rapid assessment (RA) map classes from Section 7, NAIP Color Infrared (CIR) imagery from 2020, high-resolution Hexagon CIR imagery from 2018, high-resolution true-color imagery from 2016, Google Earth 3D perspectives of aerial imagery and LiDAR data, and elevation contours based on LiDAR data from 2018.

The native plant communities at CNPS Reserve 10 (Fig 8.1) are dominated by the *EriEri* association (*Ericameria ericoides*). Coastward areas are characterized by intact patches of *EriSta*, *EriPar*, and *EriGla* - dominated respectively by *Eriophyllum staechadifolium*, *Eriogonum parvifolium*, and *Erigeron glaucus*. Protected inland slopes tend to exhibit *FraCal* and *ArtCal* associations – dominated respectively by *Frangula californica* and *Artemisia californica*. There are some large stands of *Toxicodendron diversilobum* in broad elevated areas between the windward and leeward slopes. The bluffs are dominated by *Carpobrotus* and while it is never far away, this genus only constitutes a minor component of the native-dominated alliances and associations.

The northern portion of Marina State Beach (Fig. 8.2) has perhaps the lowest non-native cover of any part of the study area. The most widespread vegetation associations are *ArtPyc* and *CorFil* – respectively dominated by *Artemisia pycnocephala* and *Corethrogyne filaginifolia*. Coastward areas exhibit *EriSta* and *EriPar*– as at CNPS10 – and also large stretches of *AbrAmb* – characterized by an array of species including *Abronia latifolia*, *Ambrosia chamissonis*, *Calystegia soldanella*, *Poa douglasii*, and *Camissoniopsis cheiranthifolia*. Protected inland slopes exhibit *ArtCal* – as at CNPS10 – and also *LupCha* – with prominent *Lupinus chamissonis*. The northeastern corner contains a dune swale on Pre-Flandrian soil with distinctly localized wetland patches of *CarPan*, *JunBal*, and *RubUrs* associations – dominated respectively by *Carex pansa*, *Juncus balticus*, and *Rubus ursinus*. Although dune swale wetlands occur throughout the coastal Monterey Bay dunes, we did not note any evidence that one may have existed in the campground area.

The area near Marina High School (Fig. 8.3) exhibits the only substantial and relatively undisturbed example on the former Fort Ord of the ecotone between inland wooded areas and the scrublands that are immediately adjacent to the coast. It also exhibits a larger amount of relatively undisturbed shrubland un Pre-Flandrian soil than anywhere on State Parks land. The southern part of the area exhibits a large stand of *ArtCal* alliance; it's occurrence here is consistent with it being found on the inland margins of the reference sites at CNPS10 and Marina State Beach. There is a large swale with *EriEri* association – also consistent with the prominence of *EriEri* at CNPS10. But unlike the other two reference areas, the Marina High School area exhibits large stands of *ArcPum* and *AdeFas* alliances – dominated respectively by *Arctostaphylos pumila* and *Adenostoma fasciculatum*. Of these, the ArcPum may be most useful as an indicator of pre-European vegetation at the campground site. *Arctostaphylos pumila* forms small patches near the campground area within FODSP and *Arctostaphylos hookeri* forms a 0.14 acre stand just

north of the campground area within FODSP. *Arctostaphylos tomentosa* also occurs near the campground in and adjacent to FODSP at low density. These observations suggest the viability of *Arctostaphylos* species as an important component of the flora in and near the campground area, and perhaps one that has been disproportionately impeded by the extensive soil disturbance and non-native competition at FODSP.

Native woodland indicator species directly intermingle with shrub and scrub species in the MHS area. *Quercus agrifolia* in particular forms copses emergent from *ArtCal* and *ArtPyc* shrubland – often with one or two larger, central, wind-pruned trees extending over 30 feet laterally but only about 10 feet vertically. The same is true to a lesser extent of the small-tree/large-shrub species *Heteromeles arbutifolia*, *Frangula californica*, and *Garrya elliptica*. Collectively, these co-occurrences provide a reference point for the spatial configuration of the woodland ecotone that may have existed in the more inland areas near the campground site.

Non-native trees also occur at MHS, but not substantially. There are isolated *Acacia longifolia*, *Eucalyptus globulus*, *Leptospermum laevigatum*, and *Hesperocyparis macrocarpa* among the native alliances and associations, and a dense border of *Hesperocyparis* and some *Pinus radiata* around the perimeter of the entire area. *Carpobrotus* is also somewhat limited in comparison to, say, the CNPS10 reference area at FODSP.

At the campground site itself (Fig. 8.4), the vast majority of the vegetation is classified under the non-native *CarEdu* alliance – dominated by *Carpobrotus edulis*. Native species occur at low percent cover in almost all of the areas dominated by *Carpobrotus* (see Figures 7.4 & 7.5). Large rows of planted *Hesperocyparis macrocarpa* are also dominant – outcompeting almost all other plants.

The most coastal natives in the campground area are occasionally expressed at densities that determine the map class – primarily in areas to the immediate north of the campground site where substantial prior restoration has occurred. This includes patches of *EriSta* and *ArtPyc* associations co-dominated by *Eriophyllum staechadifolium*, *Artemisia pycnocephala*, and *Eriogonum parvifolium*. Slightly inland, *EriEri* and *BacPil* associations prevail in restored areas – dominated by *Ericameria ericoides* and *Baccharis pilularis*. The *ArtCal* alliance also occurs as a map class at the most inland areas, often close to embankments that line the railroad. In the inland half of the campground area, woodland indicator species become prominent, including *Heteromeles arbutifolia* and *Frangula californica* at densities that determine the map class in a few places. *Quercus agrifolia* individuals are dense in places but rarely if ever to the point of determining the map class. They are almost always dominated in percent cover by *Carpobrotus* or *Pinus radiata*. There is perhaps one patch of *Arctostaphylos pumila* that is large enough to form a map unit in the vegetation map of the campground area; this patch is at the far northern edge of the campground vegetation map, just beyond the formal campground project area.

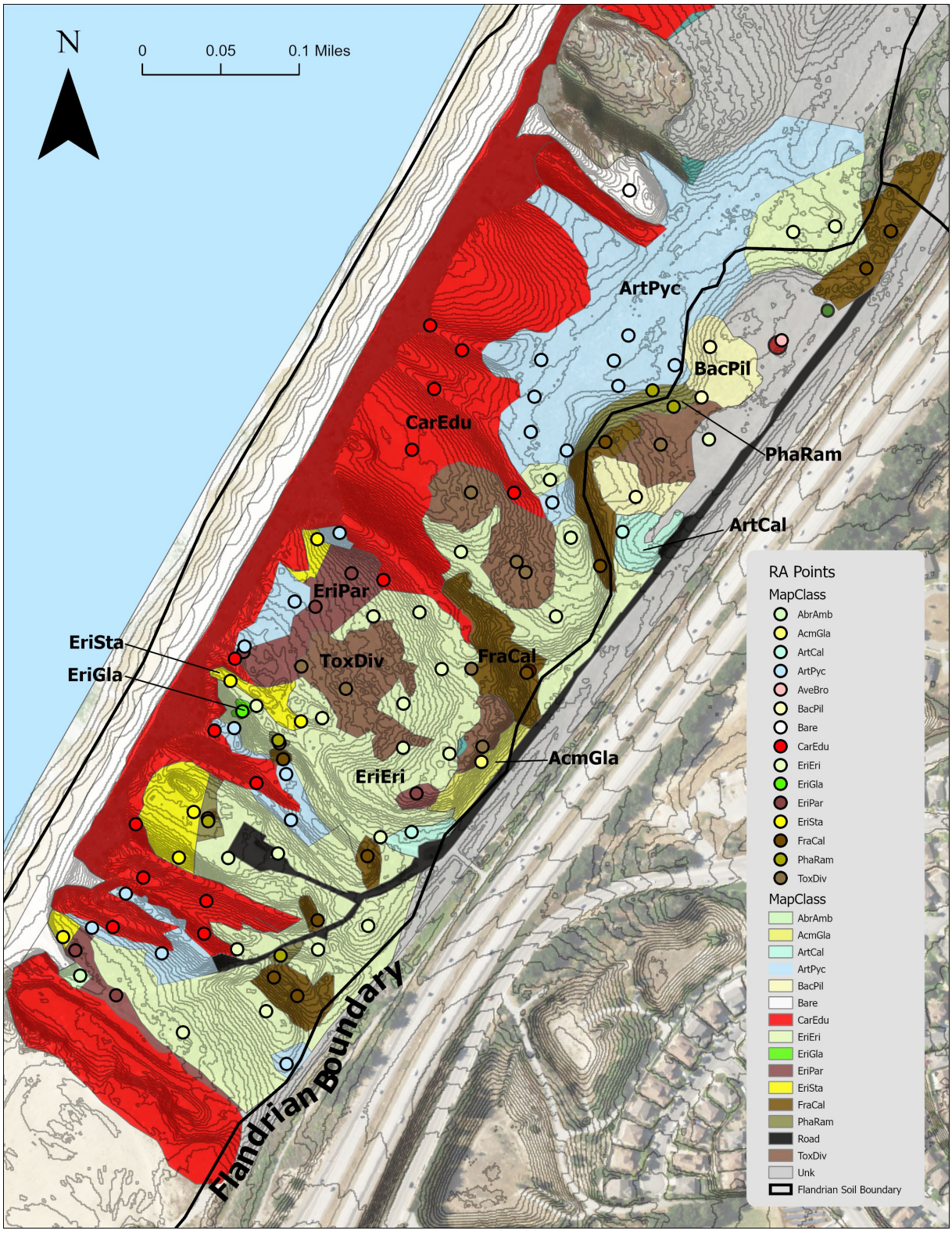

Figure 8.1. Vegetation map for CNPS Plant Reserve 10 in the southern end of FODSP.

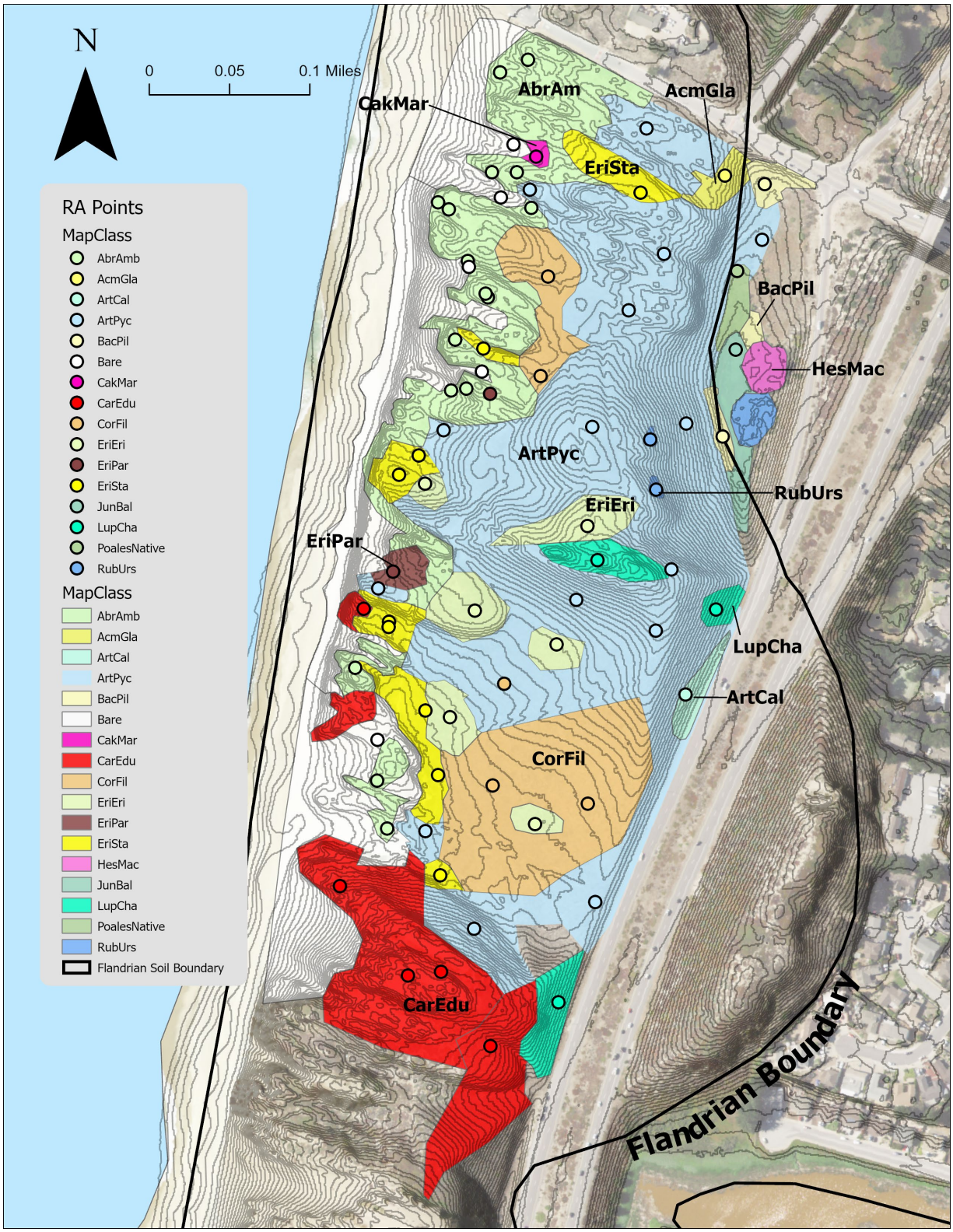

Figure 8.2. Vegetation map for the northern portion of Marina State Beach.

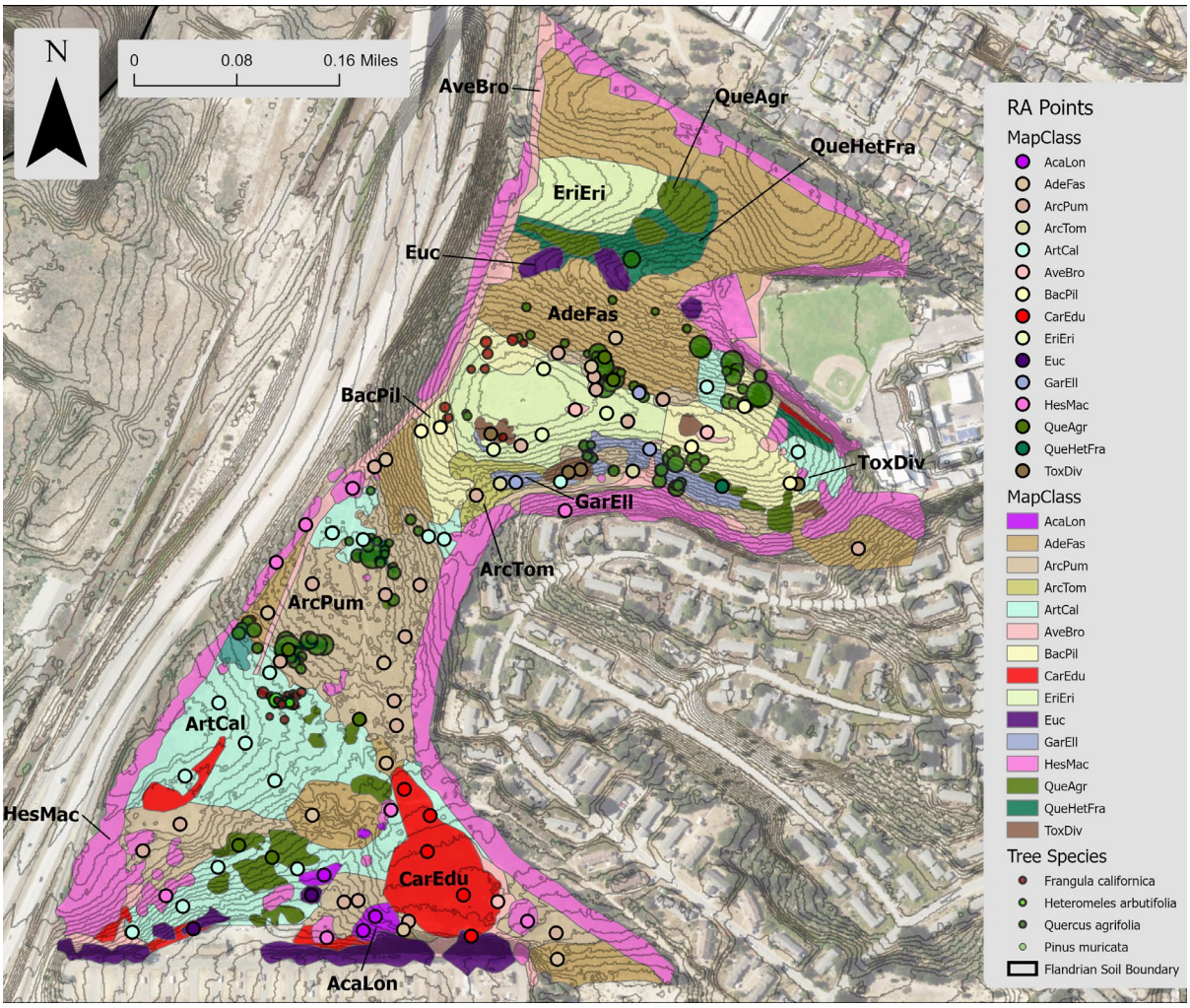

Figure 8.3. Vegetation map for the area west and southwest of Marina High School.

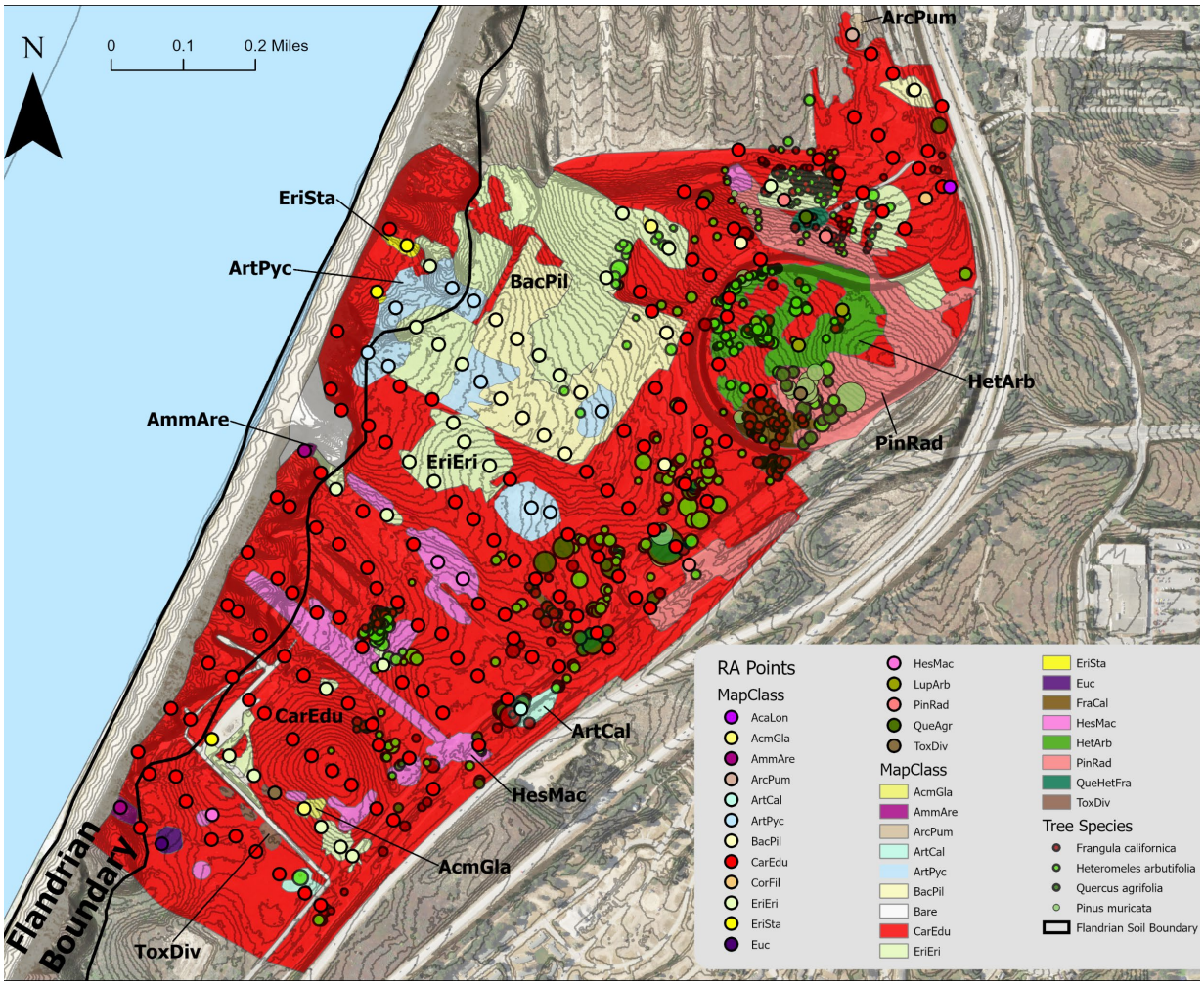

Figure 8.4. Map of present vegetation at the Fort Ord Dunes campground site.

9 Species composition of alliances and associations

We evaluated species composition within each map class in order to clarify what each alliance and association encompasses in the context of the former Fort Ord, and to inform planting palettes for restoration of native alliances and associations at the campground site.

We documented species composition by combining the polygon-scale information in the maps of alliances and associations (Section 8) with the point-scale information (Section 7) from the rapid assessments (RAs), surveys of woodland ecotone indicator species, and species composition survey points.

This resulted in a sequence of species/map-class matrices assembled both manually for the whole study (Table 9.1) and automatically (using software) for specific data sets and a combined data set (Figures 9.1 through 9.5).

The matrices were organized along a coastal gradient, with the most coastal species and map classes typically located at the top-left and the most inland instances located more toward the bottom-right. This gradient encompasses a sequence from beach and beach bluff areas, across the Flandrian dunes from windward to crest to leeward sides, across the Pre-Flandrian dune scrubland, including dune swales, eventually reaching the woodland/scrubland ecotone, and finally, woodland.

There was bias against spring annuals, almost none of which are reflected in the data we were able to assemble during our fall study period.

The manually created matrix (Table 9.1) was also constrained to emphasize native species. Invasive and non-native plants were not included unless they were associated with the map class definition or were of particular interest to include. For example, *Hesperocyparis macrocarpa* and *Pinus radiata* were kept, while *Carpobrotus spp*. was removed.

The matrices reveal that some alliances and associations have a relatively narrow and well-defined species composition while others may exhibit a wide variety of species, and that some species are restricted to occurrence in a relatively small number of vegetation communities while others are more cosmopolitan, occurring almost anywhere within the study area. Note that the content of the matrices is dependent on how the vegetation polygons were manually drawn. If the polygons were re-drawn more accurately, the species composition matrices would be expected to improve in precision; map classes would contain fewer species, and each species would occur in fewer map classes.

Specific alliances and associations are addressed as follows:

- **AbrAmb alliance**. Relatively well-defined species composition comprised of species that are somewhat confined to this alliance and others very near it, including *Abronia latifolia*, *Ambrosia chamissonis*, *Calystegia soldanella*, *Poa douglasii*, *Erigeron glaucus*.
- **EriGla association.** Very limited occurrence. Incudes *Erigeron glaucus*, *Castilleja latifolia*, *Eriophyllum staechadifolium*.

- **EriSta association**. Prominent behind coastal bluffs. Species composition includes typical species of dense coastal scrub including *Eriophyllum staechadifolium*, *Artemisia pycnocephala*, *Eriogonum parvifolium*, and *Eriogonum latifolium*.
- **EriPar** association. Similar to **EriSta** but less widespread and with *Eriogonum parvifolium* or *Eriogonum latifolium* dominant.
- **CorFil association**. Species composition very similar to the widespread *ArtPyc* Association but with *Corethrogyne filaginifolia* more dominant.
- **ArtPyc association.** Widespread. Includes a wide range of dune scrub species typical of more open areas including *Artemisia pycnocephala*, *Corethrogyne filaginifolia*, *Camissoniopsis cheiranthifolia*, *Dudleya* spp., *Cardionema ramosissimum*, and *Eriogonum parvifolium*, as well as more inland and widely distributed species such as *Ericameria ericoides*, *Acmispon glaber*, and *Phacelia ramosissima*.
- **AcmGla alliance**. While *Acmispon glaber* as a species is very widely distributed throughout the study area, it rarely is sufficiently dominant to determine the map class. This result may be seasonally dependent, as the species is much more visible at times of year other than when we surveyed.
- **EriEri association.** One of the most widely distributed and all-encompassing map classes. Dominated by *Ericameria ericoides* but can also include almost any species encountered in the study except the most beach-associated ones (e.g. *Erysimum menziesii*) or the most inland ones (e.g. *Quercus agrifolia*).
- **LupCha association.** While *Lupinus chamissonis* as a species is widely distributed in the study area, it only becomes dominant in a few areas. Observed associates include *Artemisia pycnocephala*, *Polygonum paronychia*, and *Acmispon glaber*.
- **RubUrs alliance.** Very limited in the study area. *Rubus ursinus* dominates only near the dune swale at Marina State Beach, but also occurs at low density along the bike path just east of the campground site.
- **CarPan alliance.** Also very limited in the study area, occurring only at the MSB dune swale. Defined by *Carex pansa* and also includes *Elymus trachycaulus* and some minor species with an apparent local affinity to wetland margins, including *Deinandra corymbosa* and *Erigeron canadensis*.
- **JunBal alliance.** Also very limited in the study area, occurring only at the MSB dune swale. Defined by *Juncus balticus* and also includes other wetland species such as *Cyperus eragrostis*, and *Salicornia pacifica*.
- **PhaRam association.** Not previously defined in the Manual of California Vegetation. We found stands where *Phacelia ramosissima* was clearly dominant with species composition that was otherwise indicative of the broader *Lupinus Chamissonis - Ericameria ericoides* alliance (represented in this study by map classes *EriEri*, *LupCha*, and *LupEri*).
- **ToxDiv alliance.** Dominated by *Toxicodendron diversilobum*. Occurs in large patches particularly in the region of CNPS Reserve 10. When dominant, is often almost exclusively so, but interfingered with widespread prominent shrub species such as *Frangula California*, *Artemisia californica*, and *Ericameria ericoides*.

- **FraCal alliance.** Dominated by *Frangula californica*, often somewhat exclusively so, but also with other species of dense shrubland such as *Toxicodendron diversilobum* and *Eriogonum parvifolium*.
- **BacPil alliance.** Dominated by *Baccharis pilularis* but with a wide range of co-dominants that are often typical of ruderal or early successional communities, including *Acmispon glaber* as well as non-native annual grasses and *Carpobrotus*. Co-dominates with *Arctostaphylos tomentosa* in a large stand near Marina High School.
- **ArtCal alliance.** Strongly dominated by *Artemisia californica*. Usually not far from other widely distributed prominent shrubs such as *Ericameria ericoides* and *Baccharis pilularis*.
- **ArcPum alliance.** Dominated by *Arctostaphylos pumila*. Species composition data entirely based on occurrences near Marina High School, where it includes and grades into *Adenostoma fasciculatum*. *Salvia mellifera* also prominent.
- **ArcHoo alliance**. One 0.14 acre stand occurs just north of the campground area, almost entirely comprised of *Arctostaphylos hookeri*, also with *Ceanothus thyrsiflorus*.
- **AdeFas alliance.** Not closely studied for this project. A large stand occurs in the northern part of the Marina High School reference area and contains, and this stand includes one of the largest somewhat coastal populations of *Gilia tenuiflora* ssp. *arenaria*. Grades into *Arctostaphylos pumila*. Includes *Salvia mellifera*.
- **GarEll association.** Not well defined and not previously defined in the Manual of California Vegetation. The Marina High School area includes substantial stands where *Garrya elliptica* is dominant or nearly so. These stands appear to occur ecologically between *Quercus agrifolia* stands and *Arctostaphylos pumila* stands and contain substantial cover of both of these associated species as well as *Adenostoma fasciculatum* and *Ericameria ericoides*.
- **QueHetFra association.** Not yet well defined or mapped. Encompasses the transition from *Quercus agrifolia* woodland coastward to include prominent *Heteromeles arbutifolia* and *Frangula californica* in a more open context.
- **QueAgr alliance.** Widespread in the interior of the former Fort Ord and reaching its coastward margins within the study area. Dominated by *Quercus agrifolia* and also including *Lupinus arboreus*, *Arctostaphylos pumila*, *Diplacus aurantiacus*, *Frangula California* etc.
- **ArcTom alliance.** Widespread on the generally coastal side of the former Fort Ord except in the immediately coastal areas. Reaches its coastward margins within the study area. *Arctostaphylos tomentosa* is fairly common as a prominent species in the Marina High School reference area, and a few individuals also occur within 400 ft of the campground site beneath *Pinus radiata* woodland that originally may have been *Quercus agrifolia* woodland. In the very few areas within the study area where *Arctostaphylos tomentosa* dominates, associated species include *Adenostoma fasciculatum* and *Baccharis pilularis*.
- **Map classes dominated by non-natives** are not discussed in detail because their species composition is of relatively little interest to the prescription of restoration planting palettes. But for the record, non-native species that determine map classes within the study area include *Cakile maritima*, *Ammophila arenaria*, *Carpobrotus edulis*, annual

grasses (e.g. *Avena* and *Bromus*), *Hesperocyparis macrocarpa*, *Pinus radiata*, *Acacia longifolia*, and *Eucalyptus globulus*.

Table 9.1 Species composition matrix for classified vegetation communities relevant to restoration at the FOD campground site – manual version encompassing multiple data sources. Due to the limited time frame of the study, some map classes were not able to be included in this table (e.g. *EriGla*, *HetArb*, *LupArb*, *QueAgr, CarPan*).

Abbrv.	Veg. Composition
1	Present / 1-25%
2	Dominant / 26-100%

			Coastal Flandrian Dunes <----------> Pre Flandrian <----------> Woodland													
			Map Classes													
Scientific Name	Common Name		EriSta	EriPar	CorFil	ArtPyc	LupCha	AcmGla	EriEri	ToxDiv	PhaRam	PinRad	FraCal	BacPil	ArtCal	QueHetFr
Ambrosia chamissonis	Beach bur	Native	1		1											
Bromus diandrus	Ripgut brome	Invasive			1											
Abronia latifolia	Yellow sand-verbena	Native		1												
Erigeron glaucus	Seaside daisy	Native	1	1		1			1							
Agoseris sp.	Mountain dandelion		1	1		1										
Eschschlozia californica	California poppy	Native	1		1	1			1							
Daucus pusillus	Wild carrot	Native	1	1		1										
Poa douglasii	Bluegrass	Native	1	1		1	1	1	1							
Armeria maritima	Sea thrift	Native	1	1		1	1	1	1							
Eriogonum latifolium	Seaside buckwheat	Native	2	1	1	1	1	1	2				1			
Camissonia cheiranthifoliia	Beach suncup	Native	1	1	1	1										
Abronia umbellata	Pink sand-verbena	Native			1	1	1									
Astragalus nuttallii	Nuttall's milkvetch	Native	1			1										
Calystegia soldanella	Sea bindweed	Native				1										
Erysimum menziesii	Menzies' wallflower	Native		1	1	1										
Lathyrus littoralis	Beach pea	Native				1										
Heteromeles arbutifolia	Toyon	Native						1	1	1		1	1			
Castilleja latifolia	Paintbrush/ painted cup	Native	1			1										
Festuca microstachys	Pacific fescue	Native														
Cortaderia sp.	Pampas grasses	Invasive				1										
Ammophila arenaria	European marram grass	Invasive														
Cakile maritima	European searocket	Non-native				1				1						
Oxalis pes-caprae	Bermuda Buttercup	Non-Native				1										
Polygonum paronychia	Beach Knotweed	Native				1	1						1			
Pseudognaphalium beneolens	Fragrant Everlasting	Native				1										
Rubus ursinus	Pacific Blackberry	Native				1										
Syntrichia ruralis	Twisted Moss					1										
Cardionema ramosissimum	Sand mat	Native	1	1	1	1	1		1							
Dudleya caespitosa/ farinosa	Coast dudleya	Native	1	1	2	1	1	1	1							
Gilia tenuiflora	Sand Gilia	Native			1	1	1		1	1					1	1
Tetragonia tetragonoides	New Zealand Spinach		1			1			1							
Lupinus chamissonis	Silver dune lupine	Native	1		1	1	2		2				1			
Croton californicus	California croton	Native					1		1				1			
Lupinus arboreus	Coastal bush lupine/Yellow b	Native	1	1	1	1	1		1					1		
Eriogonum parvifolium	Seacliff wild buckwheat	Native	1	2		2	1	1	2	1			1		1	
Artemisia pycnocephala	Beach wormwood	Native	2	1	1	2	2	2	2		1		1	2		
Eriophyllum staechadifolium	Seaside wooly sunflower	Native	2	2		2	1							1		
Corethrogyne filaginifolia	California aster	Native	1		2	1	1	1	1						1	
Pseudognaphalium sp.	Cudweed	Both	1	1		1			1					1		
Hirschfeldia Incana	Shortpod Mustard	Invasive				1							1			
Achillea millefolium	Common yarrow	Native	1	1		1			1				1	1		
Acmispon glaber	Deerweed	Native	1	1	1	2	1	2	2	1			1	1		
Heterotheca grandiflora	Telegraphweed	Native		1		1								1		
Juncus balticus	Baltic rush	Native	1			2										
Phacelia ramosissima	Branching phacelia	Native	1			1			1		2		1	1		
Atriplex leucophylla	Beach saltbush	Native	1											1		
Chorizanthe pungens	Spineflower	Native	1	1		1		1	1				1	1		
Toxicodendron diversilobum	Poison oak	Native				1	1	1	1	2			2	1		
Plantago sp.	Plantain	Both				1								1		
Erigeron canadensis	Horseweed	Native	1												1	
Carpobrotus spp.	Iceplant	Invasive				2	1			1			1	2		
Ericameria ericoides	California Goldenbush	Native	1	1	1	1	2	2	2	1	2		2	1	1	
Baccharis pilularis	Coyote brush	Native	1	1	1	1		1	2	1	1	1	1	2	1	
Frangula californica	California coffeeberry	Native				1		1	2	1			2	2	1	
Artemisia californica	Coastal sage brush	Native	1	1		1	1	1	1	2			1	1	2	
Solanum umbelliferus	Blue witch	Native				1				1				1	1	
Diplacus aurianticaitus	Sticky monkey flower	Native							1					1	1	
Salvia mellifera	Black sage	Native				1									2	
Arctostaphylos crustacea	Wooly leaf manzanita	Native								1						1
Hesperocyparis macrocarpa	Monterey cypress	Non-native				1			1	1						1
Pinus radiata	Monterey pine	Non-native							1	1		2				1
Pinus Torreyana	Torry Pine	Non-native										1				
Garrya elliptica	Coast Silk Tassel	Native												2	1	1
Adenostoma fasciculatum	Chamise	Native								1				1	1	1
Arctostaphylos pumila	Sandmat Manzanita	Native														1

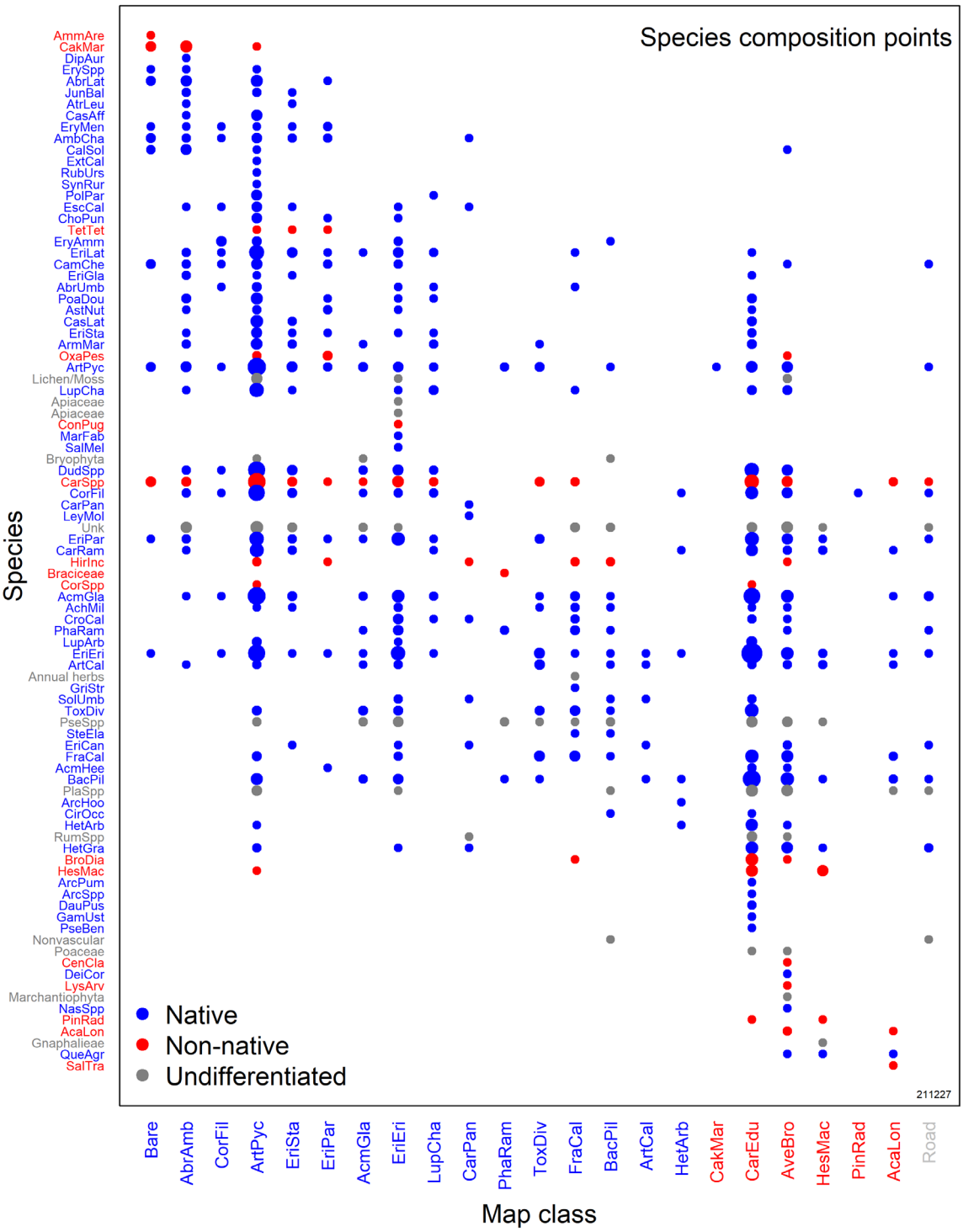

Figure 9.2. Species composition matrix for classified vegetation communities – automatic version based on **species composition survey point data recorded using ArcGIS Field Maps in a somewhat systematic manner**.

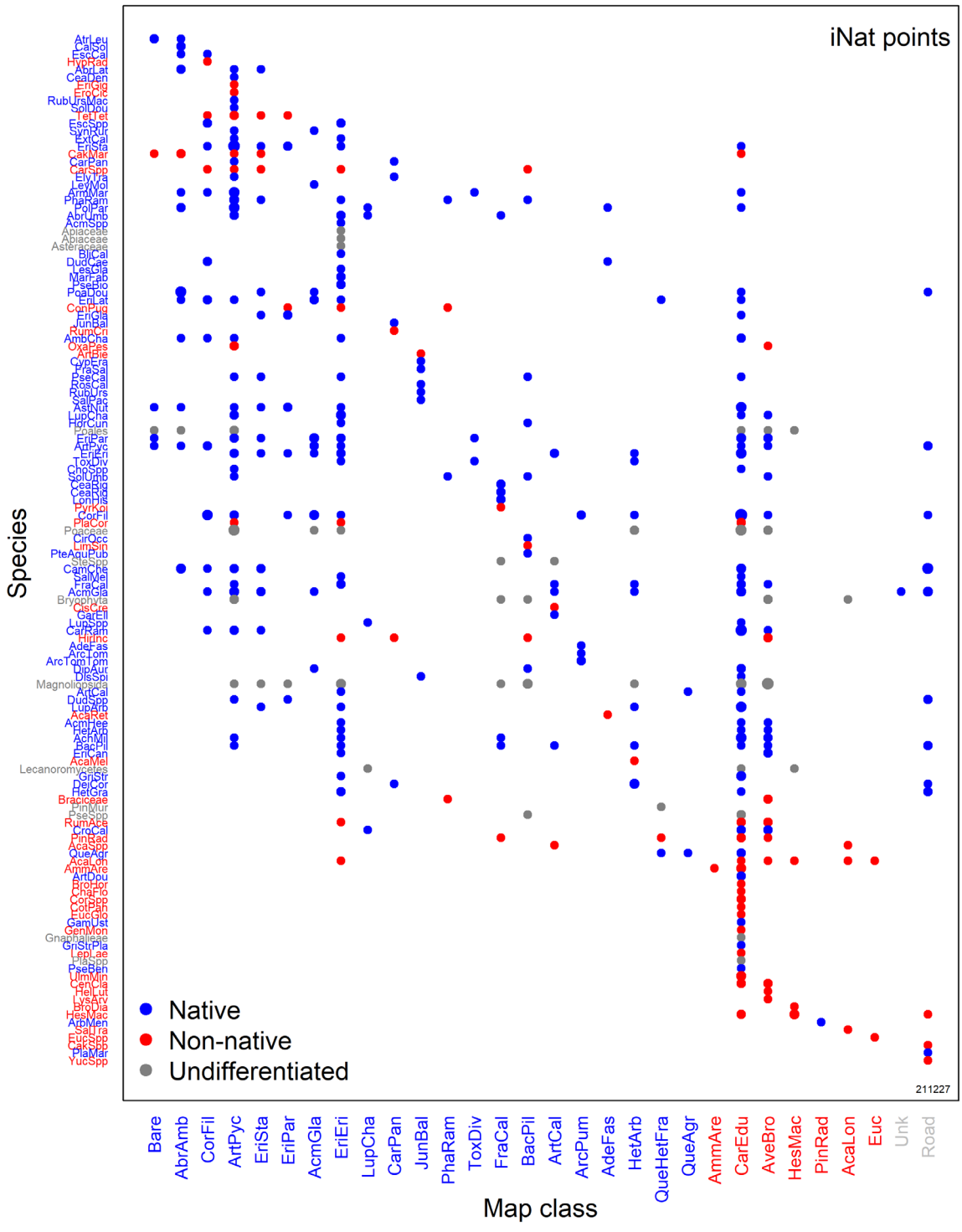

Figure 9.3. Species composition matrix for classified vegetation communities – automatic version based on **species composition survey point data recorded using iNaturalist in a somewhat *ad hoc* manner (only including iNaturalist observations made by the authors during fall 2021).**

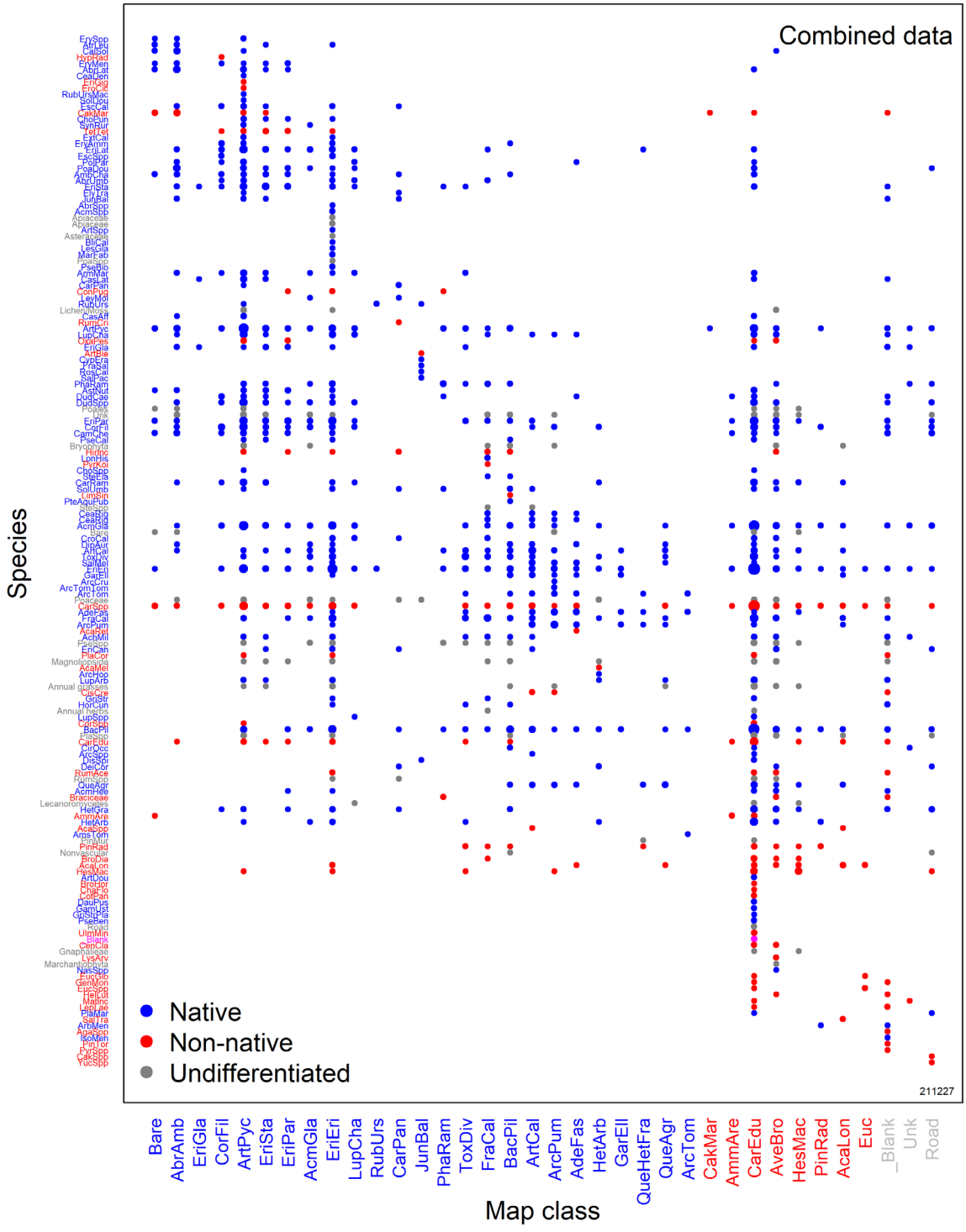

Figure 9.4. Species composition matrix for classified vegetation communities – automatic version based on a **combination of data sources incuding RA points and species composition points recorded in both ArcGIS Field Maps and iNaturalist.**

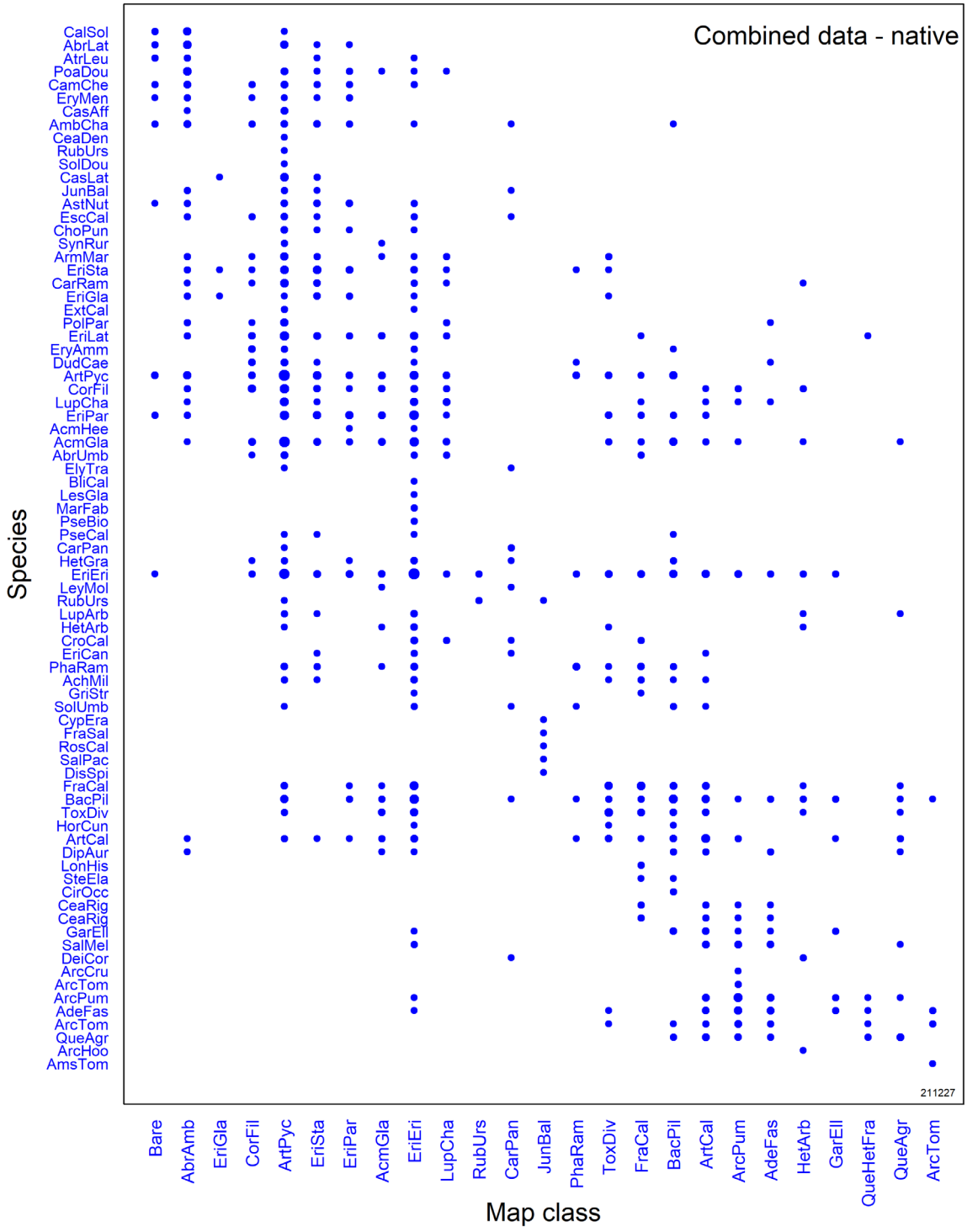

Figure 9.5. Species composition matrix for classified vegetation communities – automatic version **emphasizing native species only** and based on a **combination of data sources incuding RA points and species composition points recorded in both ArcGIS Field Maps and iNaturalist.**

10 Vegetation-terrain cross-sections

We examined the spatial pattern of vegetation communities and terrain along elevation cross-sections in order to compare the various project sub areas in terms of distance from the coast and relationship to the Flandrian/Pre-Flandrian dune boundary. The terrain data were taken from a 2018 LiDAR survey and the vegetation data were based on the maps in Section 8. Figure 10.1 shows the locations of cross-sections depicted in Figure 10.2.

The cross-sections illustrate how the northern portion of the campground extends much farther inland than any other part of FODSP or MSB, and underscores the value of including reference sites beyond State Park boundaries. The Marina High School reference area is a similar distance inland, although on sandier soil than the campground.

The northern campground area is also substantially higher in elevation than other parts of FODSP and MSB, which potentially distinguishes this site in terms of microclimate due to variations in wind exposure, rainfall, and incidence of fog.

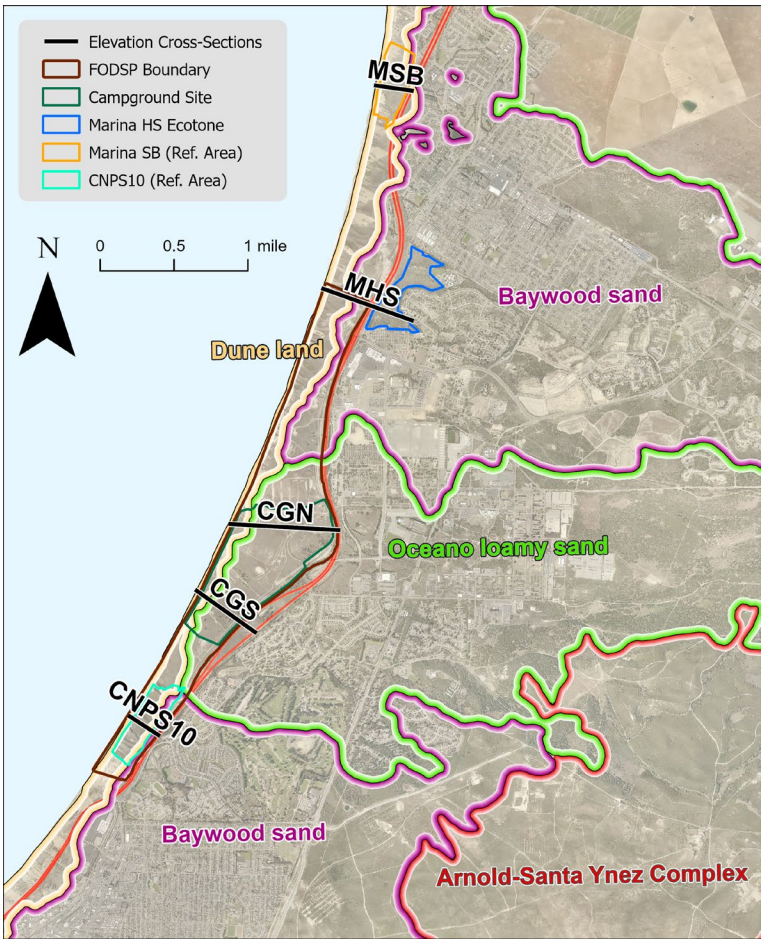

Figure 10.1. Location of vegetation-terrain cross-sections.

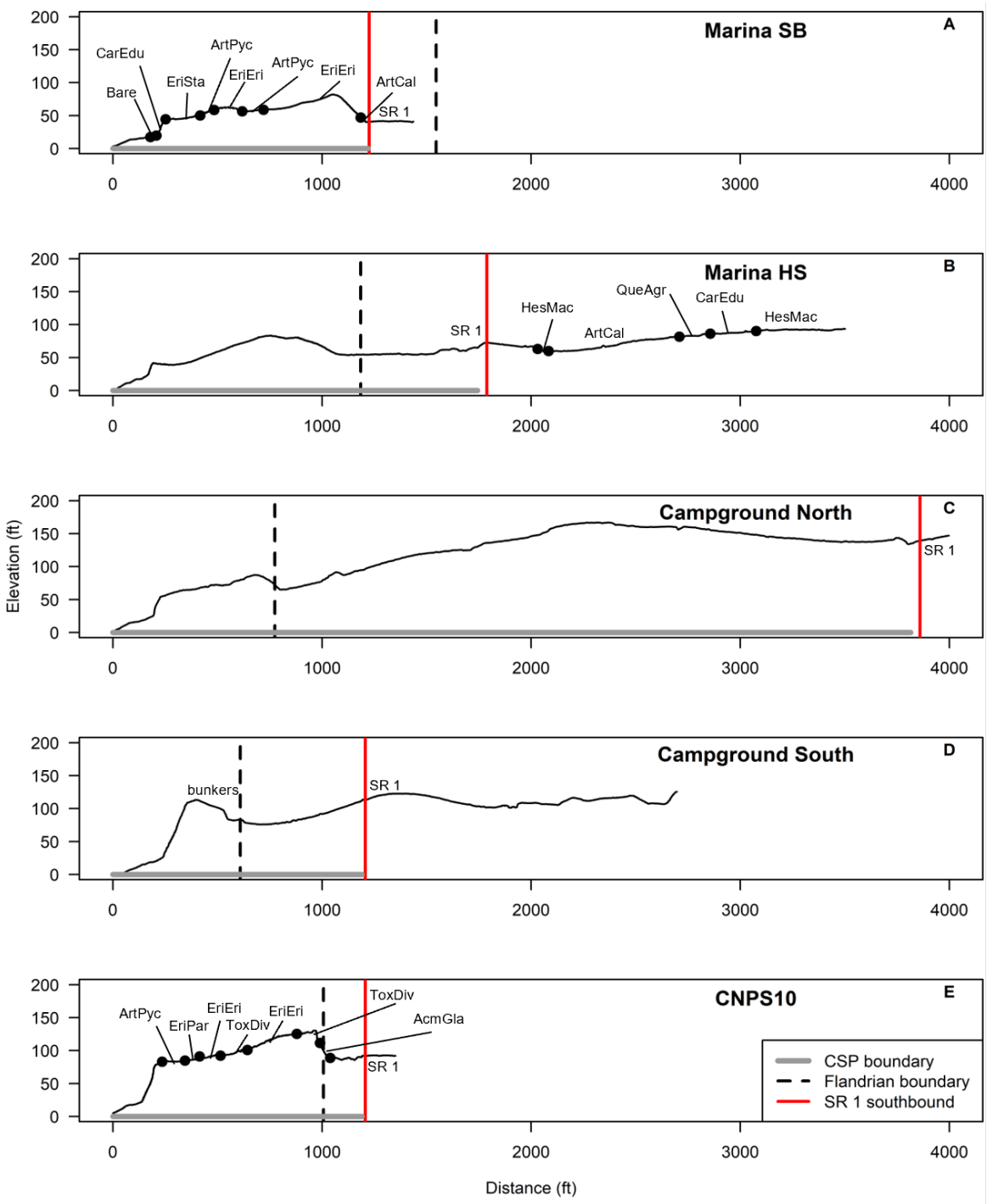

Figure 10.2. Vegetation-terrain cross-section plots. Colored vertical lines not listed in the legend indicate the respective study area boundaries. Map Classes at Campground North (CGN) and South (CGS) are not shown due to proposed restoration efforts.

11 Proposed vegetation at campground site

The campground revegetation plan and notice of intent to issue a coastal development permit require identification of the spatial pattern of plant communities to be restored at the campground site. We responded to this requirement by proposing a map of the vegetation communities to be restored.

We developed the proposed vegetation map in several stages, based on all the information thus far presented in this report. The map conceptually aims to plausibly reproduce the natural configuration of plant communities that would have existed at the site before European arrival. More practically, it aims to enhance and expand habitat for special status species and to provide opportunities for the public to experience and understand the natural diversity of California dune ecosystems.

The final map is shown in Figure 11.1, and Figures 11.2 through 11.8 show its relationship to key sources of information upon which it is based. These are discussed as follows:

- **Relationship to special status species (Fig 11.2)**.
    - To expand and enhance protection for *Euphilotes enoptes smithi*, we prescribed large polygons of the ***EriPar*** association around any areas that currently exhibit *Eriogonum parvifolium* or *Eriogonum latifolium* according to detailed CSP survey data.
    - To expand and enhance protection for *Chorizanthe pungens* var. *pungens*, we prescribed large polygons of the vegetation associations that support this subspecies (see Section 6), including ***EriPar ArtPyc***, and ***CorFil***.
- **Relationship to indicators of the woodland/scrubland ecotone (also Fig 11.2)**.
    - We prescribed a large area of the ***QueAgr*** alliance in the most inland portions of the region encompassing the campground – corresponding with locations on Oceano soil where *Quercus agrifolia* is either currently abundant or indicated by the presence of non-native *Pinus radiata* as being potentially abundant after restoration.
    - Just inland of the *QueAgr*, we prescribed a large area of ***HetArb*** in a zone where *Heteromeles arbutifolia* is currently abundant over a carpet of dense Carpobrotus. This could also be designated for the ***HetQueFra*** association of the ***QueAgr*** alliance, because of the even prominence of both *Heteromeles arbutifolia*, *Frangula californica*, and *Quercus agrifolia* in this area. But the ***HetArb*** designation provides more specificity and can be supported by the point data we collected (see Section 7.2) on where *Heteromeles arbutifolia* is currently the dominant native plant.
    - We prescribed patches of the ***FraCal*** alliance in any areas where *Frangula californica* is the dominant native shrub (usually above a carpet of *Carpobrotus*).
- **Relationship to existing patches of other native species**
    - We prescribed patches of the ***ToxDiv*** alliance wherever *Toxicodendron diversilobum* was the dominant native shrub.
    - We prescribed patches of the ***LupCha*** alliance wherever *Lupinus chamissonis* was the dominant native shrub.
    - We prescribed patches of the ***LupArb*** alliance wherever *Lupinus arboreus* was the dominant native shrub.

- **Relationship to inference from reference areas about species with localized distributions along the coastal gradient**
    - We prescribed a long belt of the ***EriSta*** alliance along and just inland of the coastal bluffs within the Flandrian dune zone – in correlation with the spatial pattern of this map class at both the CNPS Reserve 10 and Marina State Beach (see Section 8) reference areas, and with the current location of *E. staechadifolium* near the campground (Fig. 11.3).
    - We prescribed small patches of ***FraCal***, ***EriGla***, ***PhaRam***, and ***ToxDiv*** alliances within the *EriSta* belt. The FraCal patches are in north-facing leeward dune slopes – in correlation with their spatial pattern in the CNPS Reserve 10 area (see Section 8).
    - We prescribed a belt of the ***CorFil*** association on the Pre-Flandrian dune belt just inland of the ***EriSta*** belt (Fig. 11.4) – in correlation with the distribution of *CorFil* at MSB just inland of the *EriSta* belt (see Section 8).
    - We prescribed a long belt of the ***ArtCal*** alliance along the inland margin of the main portion of the campground site (Fig. 11.5) – both at the location of current patches of *ArtCal* and in correlation with the relatively inland location of a large stand of *ArtCal* expressed near Marina High School, and smaller patches expressed at CNPS Reserve 10 and Marina State Beach (see Section 8).
    - We prescribed large areas of the ***EriEri*** and ***ArtPyc*** associations anywhere not otherwise designated – in correlation with their present distribution as the dominant and most expansive native shrubs in the campground area (Figs 11.6 and 11.7), and them being the dominant native shrubs throughout large relatively flat portions of the CNPS Reserve 10 and MSB reference areas (see Section 8). The *ArtPyc* association in reference areas often occurred in flat dune areas subject to heavy wind influence, and we attempted to reflect this in the prescribed locations of this map class.

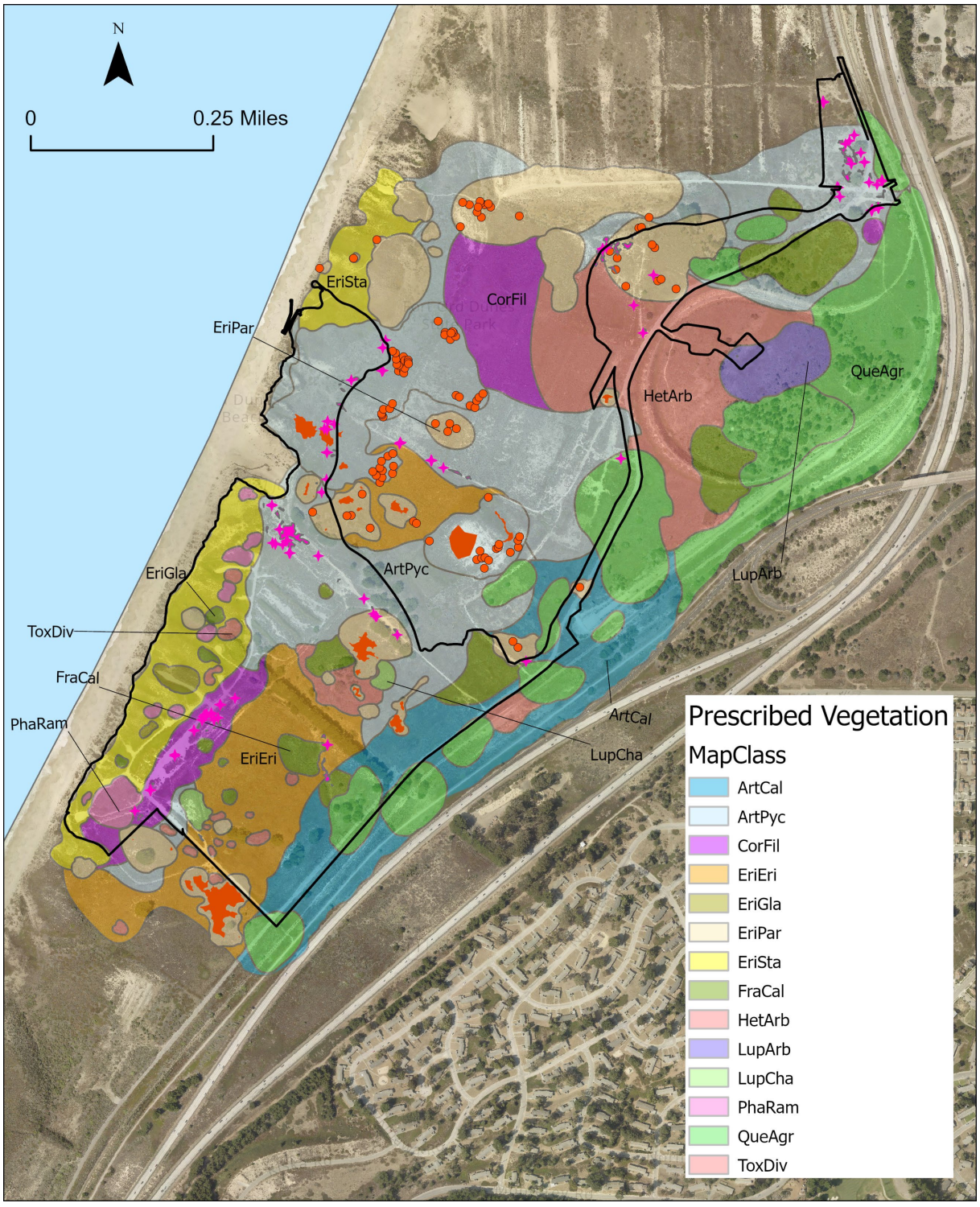

Figure 11.1. Proposed map of vegetation alliances and associations at the FOD Campground.

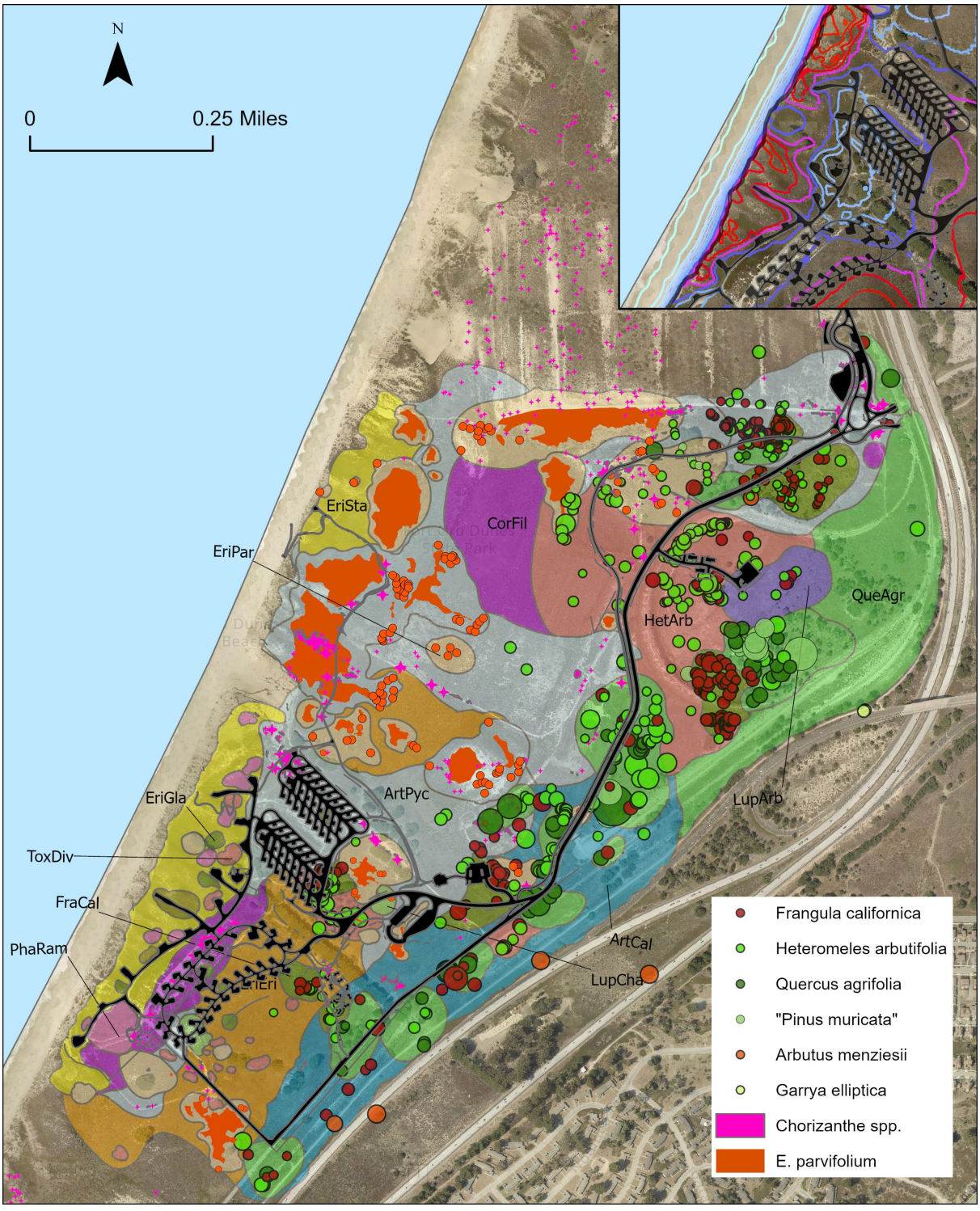

Figure 11.2. Relationship of spatial status species to proposed map of vegetation alliances and associations at the FOD Campground.

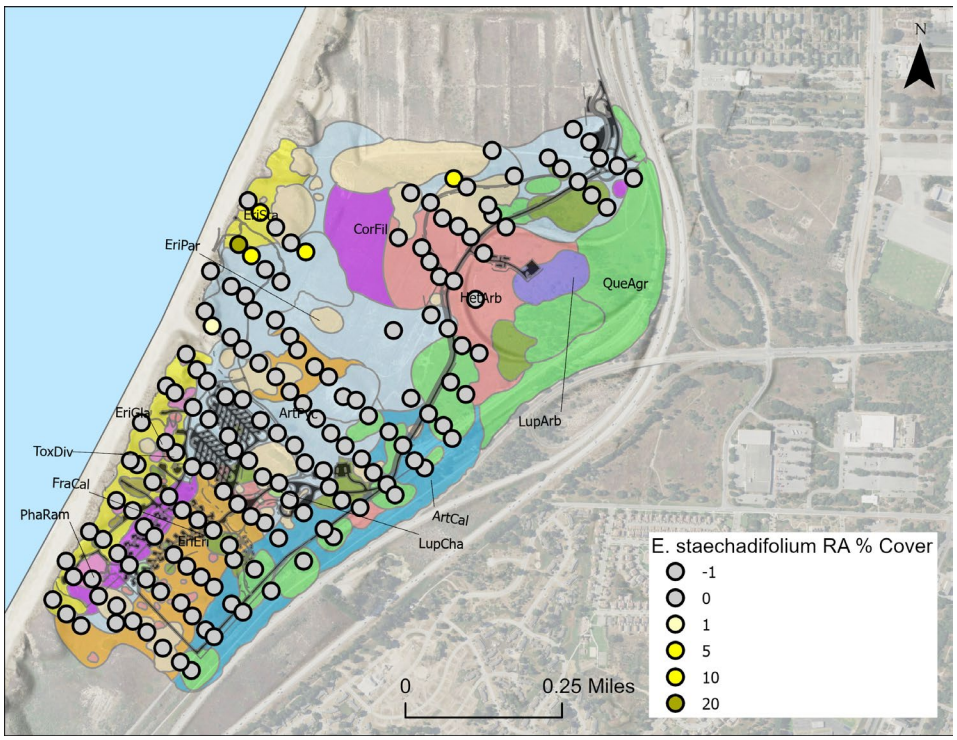

Figure 11.3. Relationship of current locations of *Eriophyllum staechadifolium* to proposed map of vegetation alliances and associations at the FOD Campground.

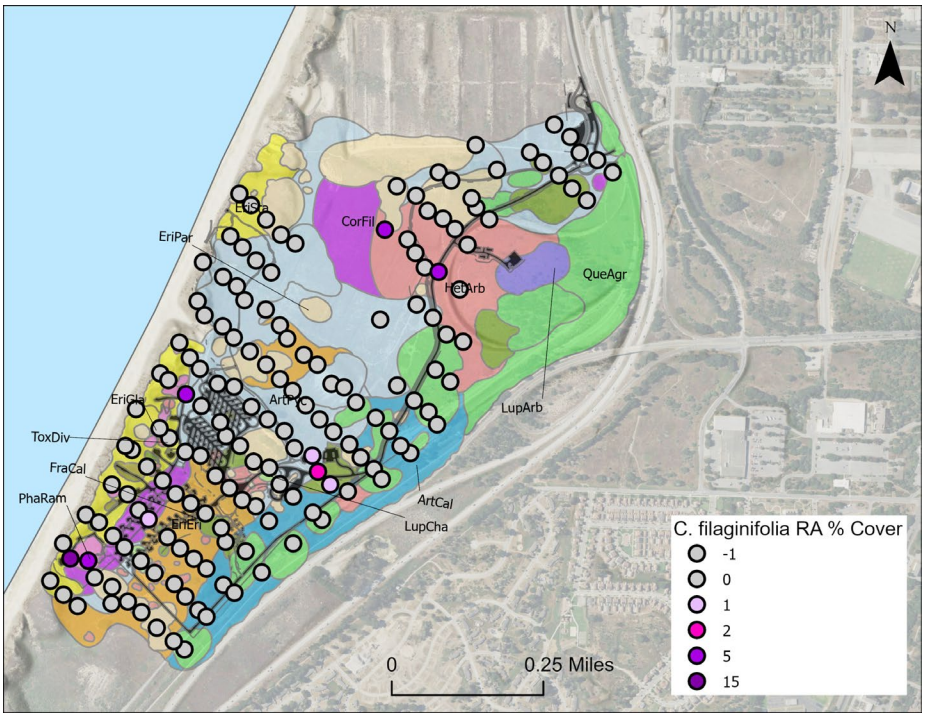

Figure 11.4. Relationship of current locations of *Corethrogyne filaginifolia* to proposed map of vegetation alliances and associations at the FOD Campground.

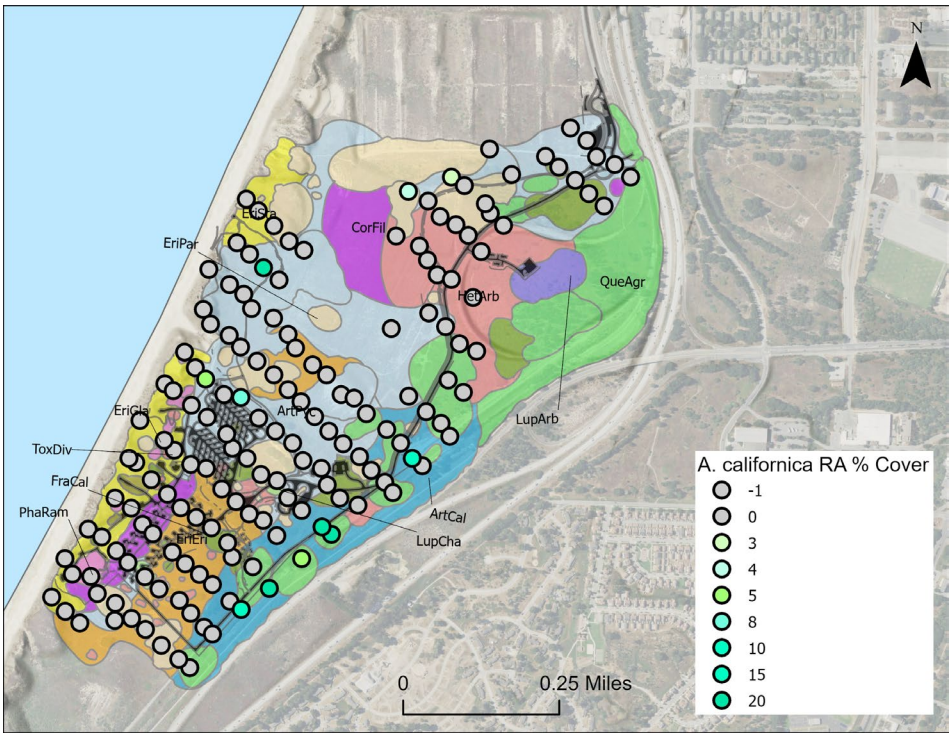

Figure 11.5. Relationship of current locations of *Artemisia californica* to proposed map of vegetation alliances and associations at the FOD Campground.

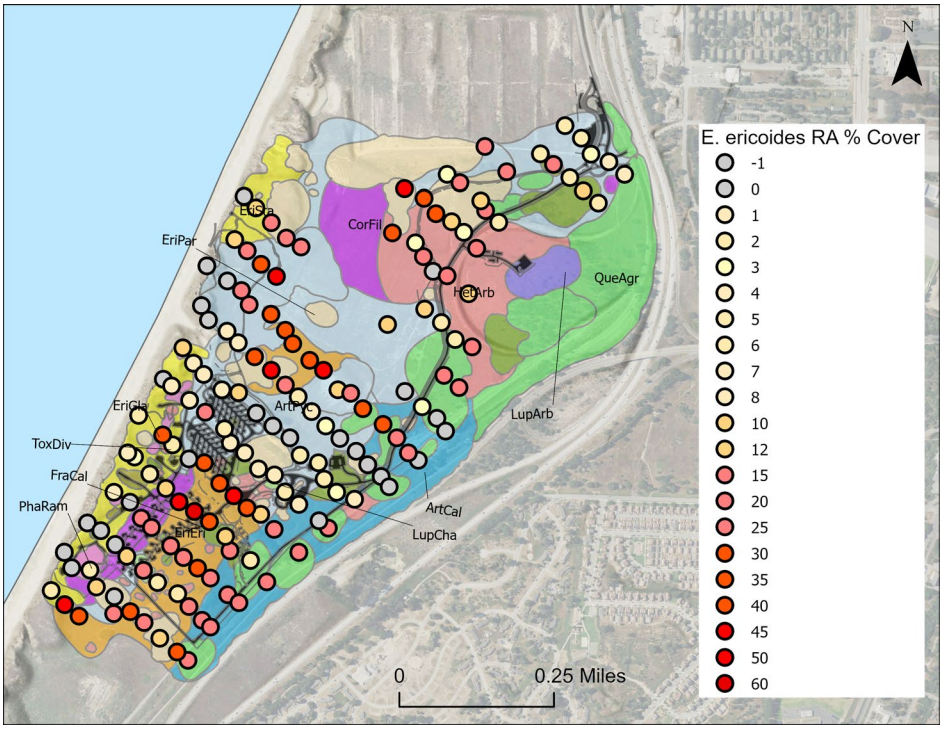

Figure 11.6. Relationship of current locations of *Ericameria ericoides* to proposed map of vegetation alliances and associations at the FOD Campground.

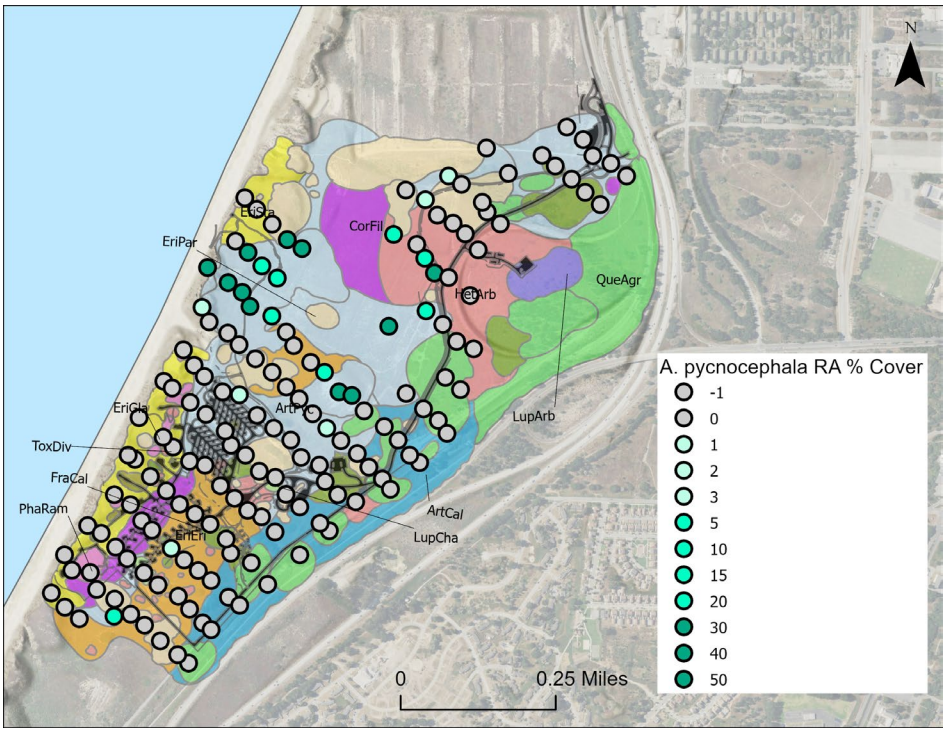

Figure 11.7. Relationship of current locations of *Artemisia pycnocephala* to proposed map of vegetation alliances and associations at the FOD Campground.

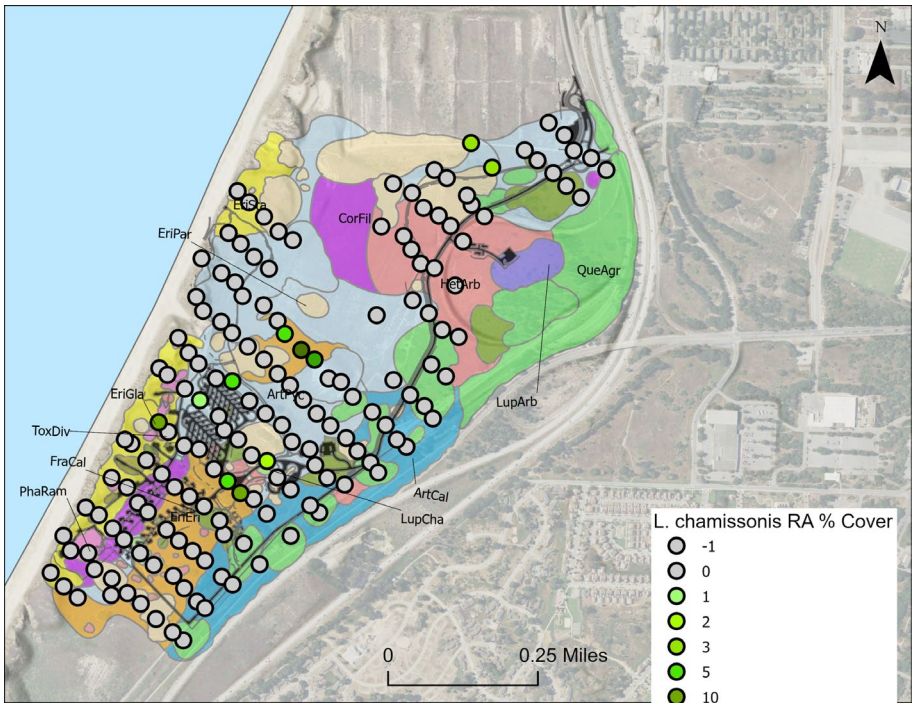

Figure 11.8. Relationship of current locations of *Lupinus chamissonis* to proposed map of vegetation alliances and associations at the FOD Campground.

12 Permanent Monitoring Plots

Under the CCDRP and NOI-CDP, permanent monitoring plots must be established at sites both within the restoration area and at sites within reference areas that exhibit vegetation communities that match the target restoration communities (CSP 2017, 2020). Data from the reference plots must be used to define restoration success criteria, and data from the restoration pots must be used to measure restoration progress against these criteria.

CSP established six plots in mid-2021 – three in the restoration area and three in reference areas. We established a further five plots in reference areas. More remain to be established.

The layout of each plot is prescribed under the CCDRP. It should be a 5 m × 50 m rectangle oriented along the slope, i.e. somewhat parallel to terrain contours. Total species composition should be listed within the plot. A 50 m transect should be located within the plot, and the abundance of plant species should be quantified along this transect using standard line-intercept methodology. We only quantified abundance in this way. CSP's pilot work also quantified abundance using quadrats within the plot.

To locate our reference plots, we used a stratified random sampling design (Figs 12.1 and 12.2). Plot centers were created within ArcGIS Pro randomly within each map class, subject to a constraint that no two plot centers should be within 15 m of each other, and that a point would be excluded if it fell in an area of prior soil disturbance or prior restoration planting (see Section 4). Starting at the plot centers, we used ArcGIS Pro to orient transects along contours within the constraints of the disturbance patterns and mapped vegetation communities. Plot corners and transect end points were also determined using GIS. In the field, metal (CSP) or wooden (CSUMB) stakes were used to mark plot corners and transect end points (Fig. 12.3).

We conducted line intercept surveys and species composition surveys at the five plots we established and at three of the pots previously established by CSP. Native species richness was calculated from the total number of native species within the 5 m × 50 m plot. Native species diversity H′ was calculated as the Shannon index:

$$H' = -\Sigma(p_i \cdot \ln p_i), \quad p_i = \frac{\Sigma_j L_{i,j}}{\Sigma_{i,j} L_{i,j}}$$

where p_i is the total abundance of species *i* along a transect expressed as a proportion of the total abundance of all species along the transect, and $L_{i,j}$ is the length of the transect occupied by species *i* along a specific transect segment, *j*. Calculations were only based on living plants.

Combined survey results are shown in Figures 12.4 and 12.5. As would be expected, non-native cover was very high in the restoration plots and low in the CSUMB reference plots (Fig. 12.5a). Non-native cover at the CSP pilot reference plots was intermediate, Although the CSP reference plots have the advantage of being close to the campground area, they are more impacted by non-native species. Reference plots exhibited between 7 and 13 native species, depending on the vegetation type, while restoration plots only exhibited 0 to 5 native species – as would be expected (Fig. 12.5b). Native species diversity was markedly higher in reference plots compared to restoration plots (Fig. 12.5c).

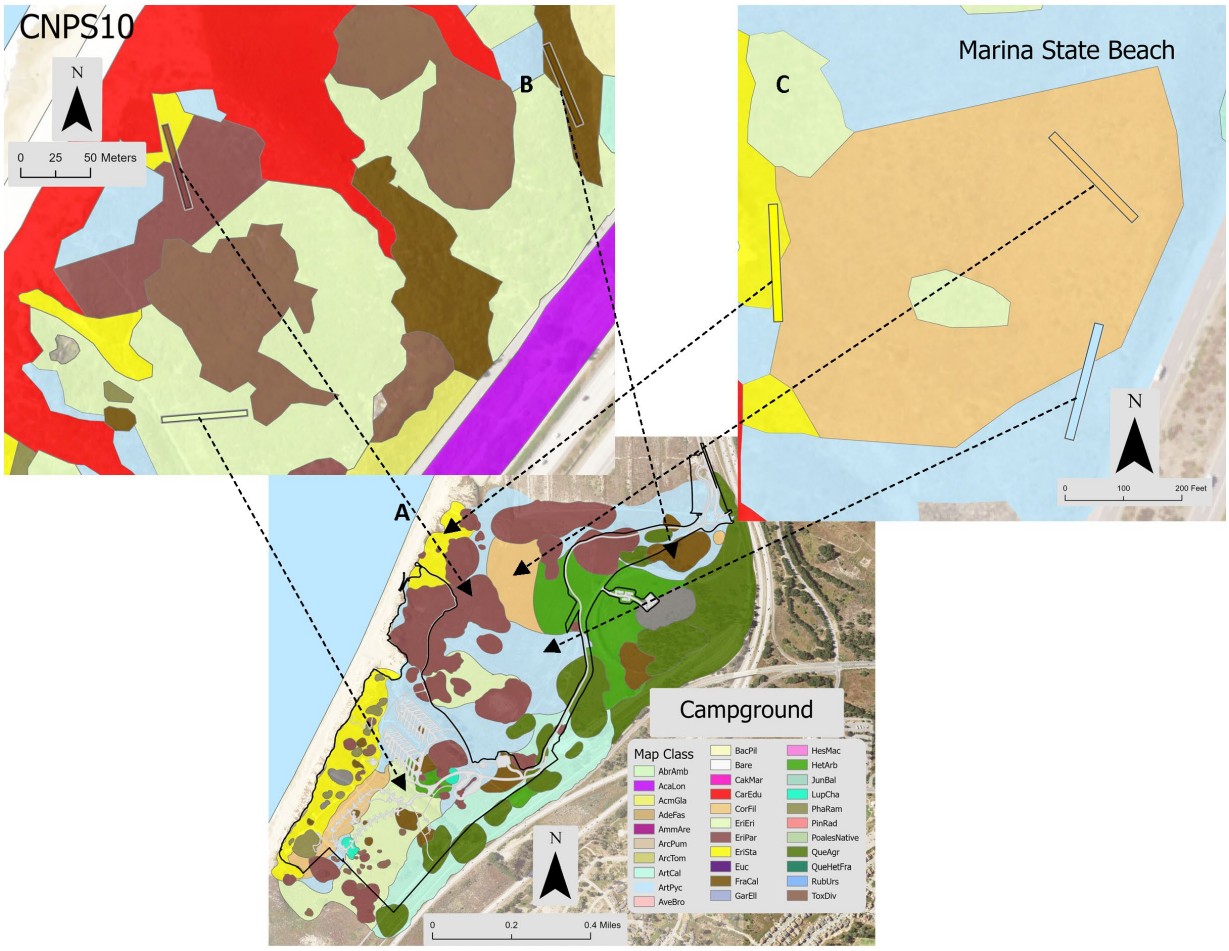

Figure 12.1. Proposed vegetation polygons in (A) the campground restoration area, with corresponding permanent survey plots in (B) CNPS10 and (C) MSB reference areas.

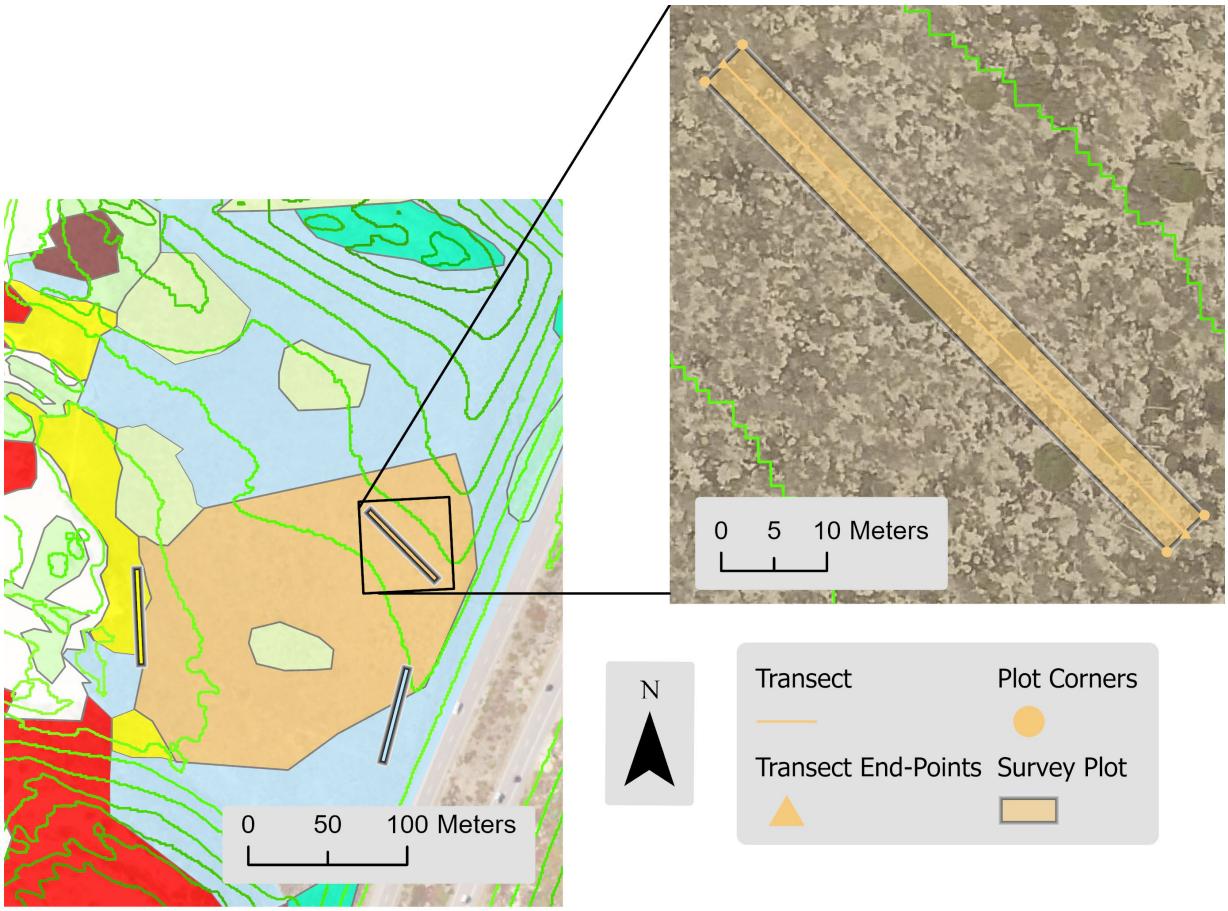

Figure 12.2. Example of survey plot placement and layout.

Figure 12.3. Photo of survey transect.

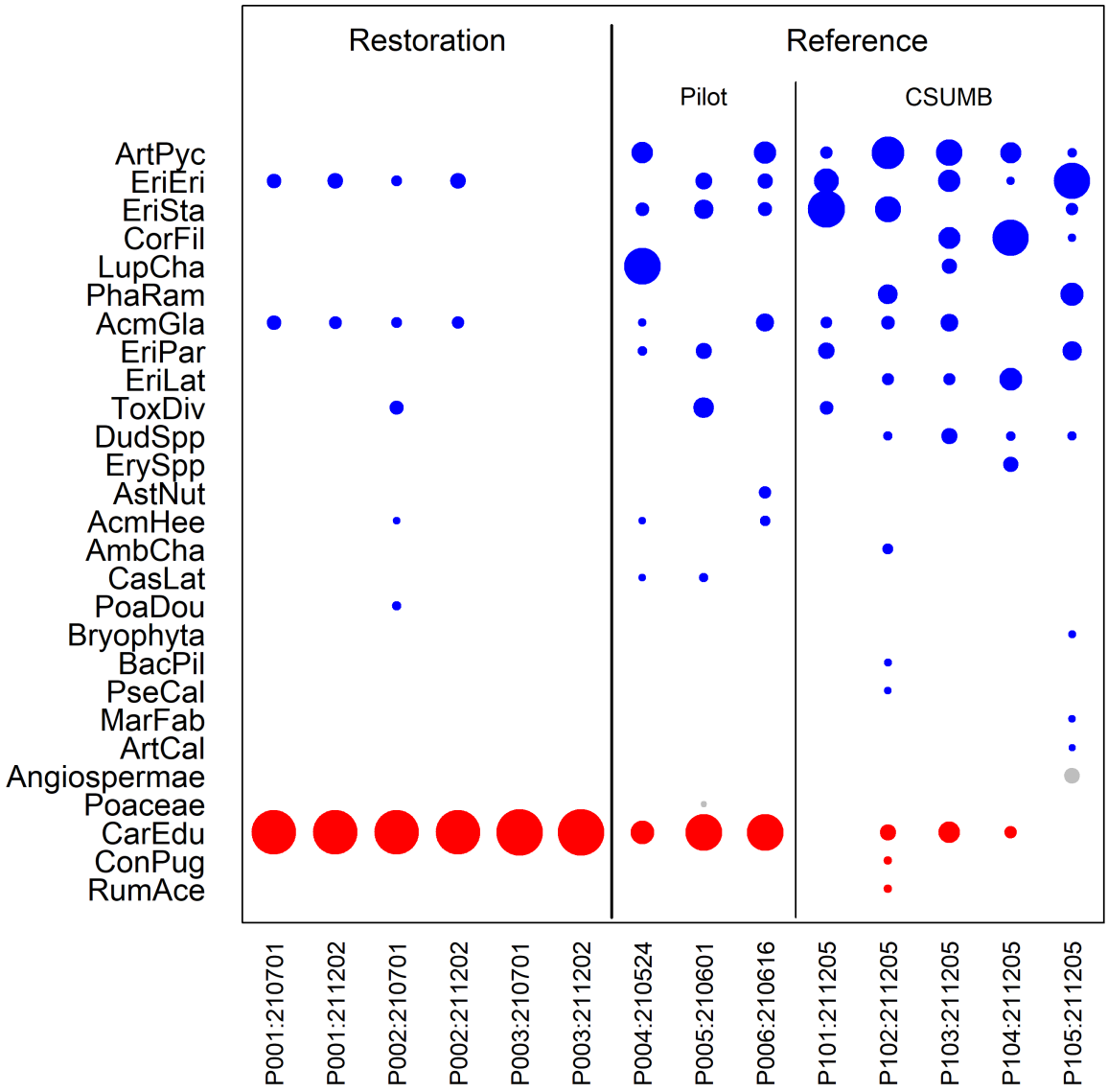

Figure 12.4. Relative canopy cover of plant species along each 50 m transect. Native, exotic, and unspecified species are represented by blue, red, and gray dots, respectively.

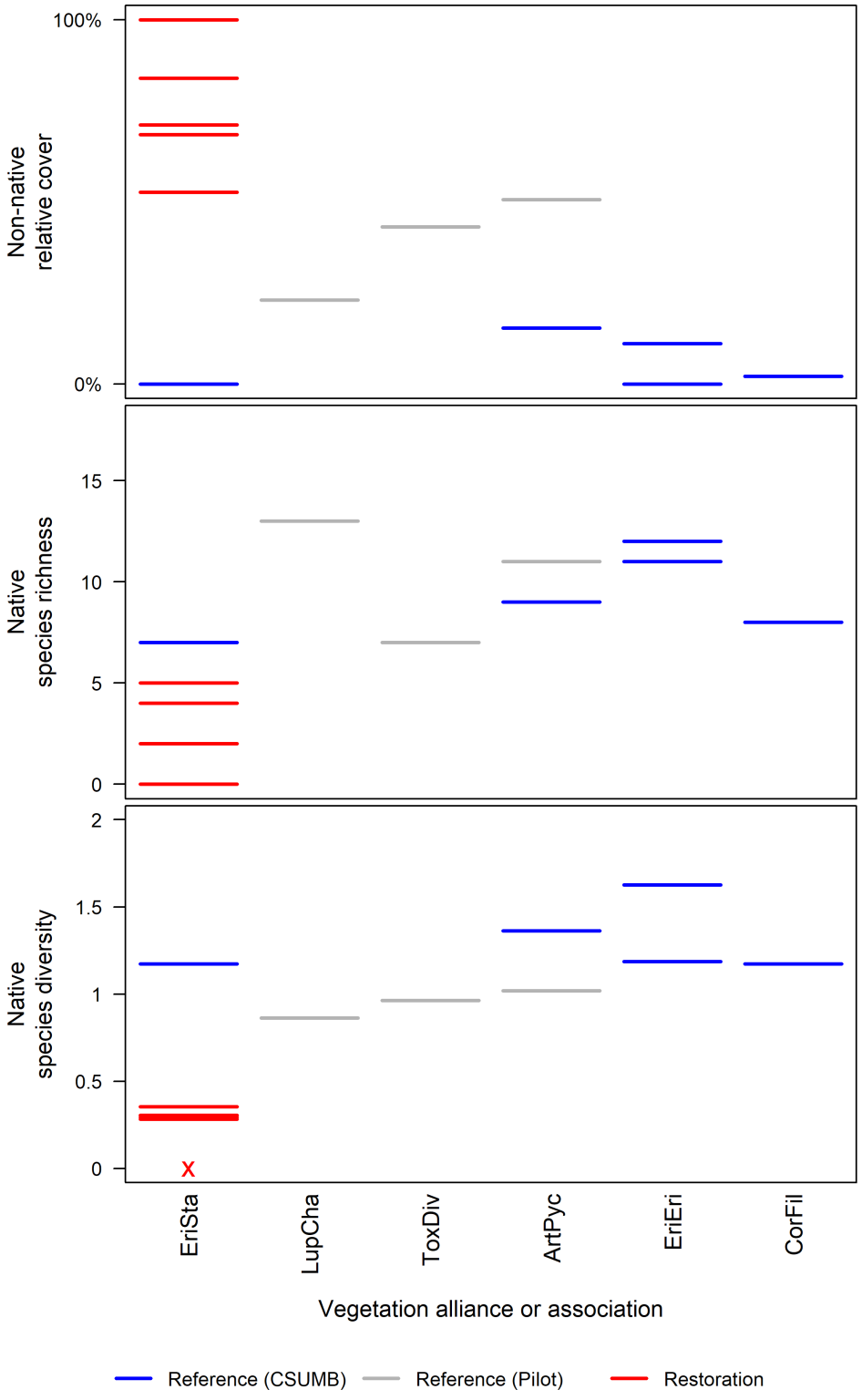

Figure 12.5. Restoration success criteria compared between plots in restoration areas and reference areas.

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