Ecological site group R004BM201CA(15489)
Windy coastal beaches and dunelands

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Key Characteristics

- West of the San Andreas fault line on the Pacific Plate – LRU M
- Soils that support upland rangeland vegetation

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Physiography

Gently sloping to steep (2-50%) dunelands with elevations that range from sea level to 500 ft.

Climate

The average annual precipitation is 25-35 inches with annual average temperatures between 53-56 degrees F, and frost-free days from 300-365 days.

The Point Reyes/Farallon Islands LRU M includes the Point Reyes Peninsula, Bodega Head and the sand spit at the north end of Bodega Bay, and the offshore Farallon Islands. The maritime climate is temperate and humid, and fog often occurs. Heavy coastal winds are an influential factor in vegetation expression in this LRU that occur primarily in the summer months, explaining the large extent of coastal prairies and coastal scrub species along much of the coastline. Where trees are present along or near the coastline and within the reach of these heavy winds, the tree canopies form unidirectional windswept crowns.

Soil features

The soils in this group are dominantly near the coast. The dune lands are very deep, with very low available water capacity and formed dominantly by wind-blown deposits and range from loose dunes to somewhat stabilized dunelands, which are found on the Sirdrak soils. The Sirdrak soils are very deep, somewhat excessively drained with a surface horizon that is very dark grayish brown sand. Of minor extent it will also include beaches, Hydraquents, Kehoe, Sirdrak Variant, and Tomales soils.

Vegetation dynamics

This provisional ecological site concept attempts to describe the coastal scrub and coastal prairies of dunelands within this small LRU. They exist in a continuum of herbaceous to dense woody shrub cover wherever the cooling influence of the Pacific Ocean moderates the summer drought (high evapotranspiration rates). This concept lumps the unique scrub and prairie expressions into one large concept, due to no soils mapping within much of this LRU. The extent of this ecological site concept stretches along the coastline from approximately Bodega Bay sand spit south to the coastal bluffs near Bolinas. This provisional ecological site concept covers a narrower range of coastal scrub and prairie dynamics, however since there is no soils information for most of this LRU, future work will need to be done to better understand the soil and site characteristics that drive the vegetation expression for this provisional ecological site concept.

Abiotic Factors

This ecological site is generally found between the coastal strand and Douglas-fir-redwood and bishop pine forests

of LRU M and LRU K. This site is generally found below 1000 ft. on the coastal strand, coastal dunes, and coastal plains and terraces. The primary factors that maintain these sites in either coastal scrub or coastal prairie are the unstable substrates and high, salty winds that are common along the coastline and their adaptability to the warmer days that dry out the soils too much for trees and other shrubs commonly found in the adjacent mountains. Coastal scrub and herbaceous species are more readily able to colonize and stabilize and adapt to these heavy winds and salty conditions, which explains why they dominate these open plains along the coastline.

Primary Disturbances

The primary natural disturbances to this ESG are fire and wildlife grazing and unstable soils. Historically, lightning-ignited fires are thought to have occurred in the surrounding forested habitats every 30-135 years and with the winds, would have burned significant acres across many soil types and landforms. Between soil and landform differences and frequencies and intensities of burning that would be interacting with yearly weather patterns that shifted between wet years to drier years, this would have created a patchwork of areas that returned over time to forest while others remained in coastal scrub and grassland. It is also believed that native grazers were common in these lower gradient coastal plains and may have contributed to the open nature and complex patchwork of coastal scrub and prairies. In combination with the fires and periodic droughts, grazers may have assisted in maintaining areas with good soils in more herbaceous vegetation and the less ideal soils in a more coastal scrub and grass patchwork expression. Native American use along these coastlines would also have included burning to maintain as much of the coastal prairies as possible, often times quite frequently to improve hunting and grass and forb production for plant harvesting.

Grazing has had a much more significant influence on this ESG in the more recent history within LRU M, as there are several historic ranching operations and small dairies sharing this areas forage and covering most of the coastal prairie and coastal scrub shrublands in this LRU. This has assisted in maintaining some of the more diverse coastal prairie native perennial grasslands left in the state since burning is no longer occurring, due to the yearly removal of biomass by the native and livestock grazers that allow the perennials to be more competitive with the invasive species pressures that are a common threat to this ecological site. Livestock grazing was grandfathered into the land uses of the Point Reyes National Seashore and continues today, however some of the historic ranches no longer operate cattle and those areas have become more heavily dominated by coastal scrub species over time. However, the tule elk herd and invasive albino deer that can be found in this area have helped maintain large areas of the coastal prairie where cattle no longer graze.

Historically, this ecological site would likely have been much more extensively covered by the coastal prairies due to the repeated burnings by many of the coastal tribes and the scrub species would have likely been more confined to the rocky bluffs, steep slopes, and exposed ridges. As the fires became less and less frequent, the coastal scrub species was able to encroach back into the prairies and dominate much of the coastline. Areas where grazing still occurs either by livestock or native grazers, tend to maintain the open prairies, however they have become a mix of native perennials and forbs and annual grasses and forbs since the introduction of the non-native seed sources and heavy pressures from grazing. Fire to this ecological site is less likely now, due to the urban development and cultivation of much of these areas along the coast.

The sandy beaches and dunes have been lumped into this site concept. They are a narrow portion of this LRU and since there are no soils to correlate to, the groupings are coarse and it was determined that for now, there would only be one site for this area of LRU M. The beaches and dunes do support a unique assemblage of species. The dunes rise above the reach of the highest tides and are exposed to the strong summer winds. To keep from being completely buried by sand, beach strawberry and beach morning glory can grow up new shoots from horizontal underground stems. The sand has few nutrients available for plants, so dune lupine allows special bacteria into its roots that converts nitrogen in the soil into a form plants can use. Much of the grass that is currently found in these dunes is European beachgrass, a highly invasive. Iceplant, native to South Africa, has likewise colonized a large portion of these dunes, thanks to its fleshy leaves that prevent water loss and help it outcompete native vegetation (Point Reyes National Seashore website, accessed 4/20/18).

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Major Land Resource Area

MLRA 004B
Coastal Redwood Belt

Stage

Provisional

Contributors

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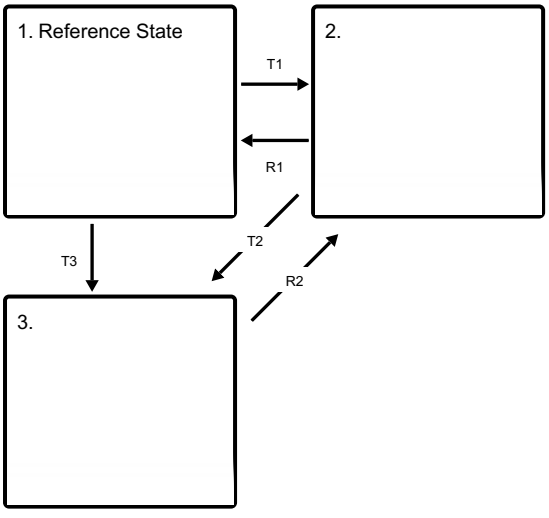
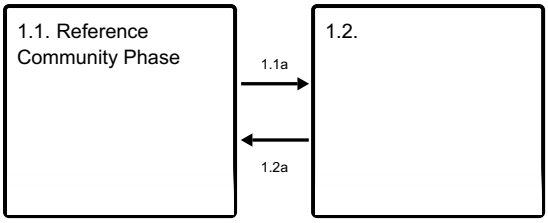
State and transition model

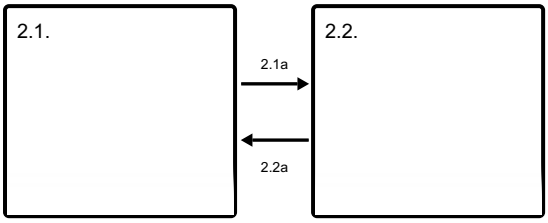
Ecosystem states



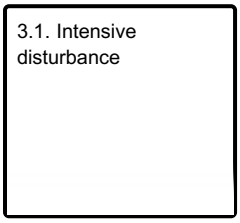
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

Figure . Patchwork of coastal scrub and coastal grasslands looking north from Pt. Reyes lighthouse

The dynamics described below are general to the level that the site concept has been developed for provisional ecological site concept identification and further investigation purposes only. It is meant to give a general overview of the ecological dynamics of the system and should not be viewed as a model for a specific ecological site level management. It is supported by the current available literature that was reviewed for a general understanding of the system and basic understanding of the abiotic and biotic drivers. Further investigations and soil-site data collection and analysis should be conducted before specific land management can be applied at the ecological site specific scale. This STM only serves to explain the general ecology and dynamics. Reference State (State 1) – This reference state includes a patchwork of coastal scrub dominated shrublands and coastal prairie dominated grasslands. These communities are all varied in size and extent, depending on the width of coastline available, elevation and slope, the geologic and soil substrates, and dynamics of disturbance. This variability requires further site investigation and field data collection to refine these communities to the appropriate ecological site scale for more specific site characteristics for each of these finer-scaled differences that have impacts on the land management decision-making process. The coastal prairie is less dominant in this ecological site due to the infrequent fires, and reduction in grazing activities that would have assisted in keeping the coastal scrub species

from encroaching into the prairies and dominating the overstory structure. Much of this ecological site is now coastal scrub and dominated primarily by coyotebrush.

Community 1.1
Reference Community Phase

This community phase represents the more stable and resistant and resilient community phase dominated by coastal scrub vegetation. The coastal scrub species are well adapted to the high, frequent summer winds and salty air and are highly competitive and capable of capitalizing on the available resources of the cool, maritime climate in this LRU. Coastal scrub can be found on the steep slopes, rocky bluffs, sandy and loamy plains, and exposed ridgelines. Where the site characteristics create less ideal growing conditions, the coastal scrub species are more consistently stable and uniform in their dominance, and receive less disturbance pressures that impact the ecological dynamics. However, in the areas where the site characteristics are ideal for plant growth (lower slopes, higher fertility soils), the coastal scrub species are more intermixed with herbaceous species and are less likely to be uniform, and more likely to be experiencing a multitude of pressures from disturbances both natural and manmade. Coastal scrub is dominated by coyote brush (*Baccharis pilularis*), other common associates are California blackberry (*Rubus ursinus*), poison oak (*Toxicodendron diversilobum*), coffeeberry (Rhamnus californica), thimbleberry (*Rubus parviflorus*), yellow bush lupine (*Lupinus arboreus*), mimulus (Mimulus aurantiacus), salal (*Gaultheria shallon*) and blue blossom (Ceanothus thrysiflorus). It may also be found in association with as well as non-native and native grasses, sedges (Carex spp.) and rushes (Juncus spp.). Some coastal sage species are also present including California sagebrush (*Artemisia californica*) and buckwheat (*Eriogonum fasciculatum*).

Community 1.2

Figure 1. Point Reyes grasslands (Point Reyes National Seashore).

This community phase represents the native coastal prairie vegetation. This community phase is most common on the flatter coastal plains where grazing practices assist in maintaining the herbaceous cover. Historically, the community phase was also maintained by more frequent fires by the Native Americans living along the coastline that were dependent on the food and materials the herbaceous communities provided. This community is currently

dominated by native perennial grasses such as *Deschampsia cespitosa* (tufted hairgrass), *Danthonia californica* (California oatgrass), *Hordeum brachyantherum* (meadow barley), *Bromus carinatus* (California brome), and *Calamagrostis nutkaensis* (Pacific reedgrass) among other species and a variety of perennial and annual forbs—many of which are endemic and disappearing due to loss of habitat and invasive species pressures.

Pathway 1.1a
Community 1.1 to 1.2

Reference Community Phase

This pathway occurs after a fire or grazing that is sufficient enough to remove most of the woody species and open the canopy and soil resources to the herbaceous species. This pathway may also include periods of extended drought or extended periods without summer fog that is common to this LRU, creating drought stress to the coastal scrub species that require sufficient summer soil moisture to survive the summer heat. Herbaceous species may capitalize on this drought-caused mortality.

Pathway 1.2a
Community 1.2 to 1.1

Reference Community Phase

This pathway occurs over time as the coastal scrub species re-establish or encroach into the grasslands where grazing has been removed or fire is infrequent. This pathway may also be hastened during periods of excessive moisture that favor the scrub species over the herbaceous plants.

State 2

This state represents the community phases that have been invaded by non-native species. This ecological site is highly susceptible to non-natives and invasives, given the current types of pressures from fire removal and human use in this LRU. Non-natives and invasives are able to capitalize quickly on available resources much better than the native species can, especially during years that are hotter and drier than average. This state currently represents all the different types of communities found in this coastal strand and coastal plains and terraces portion of LRU M. In the future more information and research should be done to determine more specific dynamics in this state that are more heavily related to the different community expressions within this state and the dynamics amongst them all.

Community 2.1

Non-native plants were introduced to provide soil stabilization to these dunelands and since the late 1930s some species cover has increased over 500% (Buell et al., 1995). Most of the dunelands within the Park are now either dominated or have iceplant or European beachgrass present within the vegetation communities (see Appendix E). Non-native species and their deep root and rhizome systems armor dune systems and prevent natural migration, which leads to overly large and steeply sloped foredunes and backdunes. Additionally, some species can maximize the nutrients made available by both native and non-native nitrogen-fixers, such as Lupinus spp. further increasing their competitive dominance over native vegetation while others monopolize soil water (McGraw et al., 2017 and D'Antonio and Mahall, 1991). The community phase represents the non-native coastal scrub plant community. It will generally look similar to the reference CP, however a significant portion of the canopy cover will also include *Cakile maritima* (searocket) and Carpobrutus chilensis (iceplant).

Community 2.2

This community phase represents the non-native herbaceous plant community that is dominated by annual grasses, such as annual Lolium multiflorum (Italian wild rye), *Hordeum murinum* (farmer's foxtail) and Vulpia species (rattail fescue). Non-native perennial species are also common and are of management concern. These species include

Holcus lanatus (purple velvet grass) and Phalaris aquatic (Harding grass). Non-native forbs include *Hirschfeldia incana* (shortpod mustard), and *Raphanus raphanistrum* (wild radish).

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs after a fire or a significant defoliation event by grazers that is sufficient enough to remove most of the woody species and open the canopy and soil resources to the herbaceous species. This pathway may also include periods of extended drought or extended periods without summer fog that is common to this LRU, creating drought stress to the coastal scrub species that require sufficient summer soil moisture to survive the summer heat. Herbaceous species may capitalize on this drought-caused mortality.

Pathway 2.2a
Community 2.2 to 2.1

This pathway occurs over time as the coastal scrub species re-establish or encroach into the grasslands when grazers have been removed or fire has been suppressed or is infrequent. This pathway may also be hastened during periods of excessive moisture that favor the scrub and non-native searocket and iceplant species over the grass and forb plants.

State 3

Figure 2. Historic Pierce Point Ranch, Point Reyes National Seashore

This state represents the intensive land uses that have significantly altered this ESG in a myriad of ways including removal of topsoil, fertilizer additions and other topsoil manipulations, hydrologic alterations that remove native soil fauna, among many other things and is typically due to urban developments, recreational activities, and intensive agriculture. More information about this state is needed to flesh out the various impacts these types of land uses/alterations have had on the ecological site in order to better understand how to manage these areas or potentially attempt restoration of these areas where possible.

Community 3.1

Intensive disturbance

This community phase represents all the varied land uses that significantly alter this ecological site group. This is an extremely varied community phase that includes all types of alterations that so significantly alter the ecological site that it is permanently changed and no longer has typical or even representative ecological dynamics. Land use models would be an appropriate option to develop these types of variations in altered landscapes. At this scale of grouping, specific drivers and triggers and expressions of communities is too varied and broad to be more specific. More data collection and field verification is necessary.

Transition T1
State 1 to 2

Reference State

This transition occurs when the seed source is introduced to the ecological site. At Point Reyes, non-native plants were introduced to provide soil stabilization in this duneland ecosystem in order to reduce the movement of the dunes that impacted the ranching and dairy farms and settlements. This ESG limited resistance to outside pressures like invasive species, and in Community Phase 1.2 the site is most at-risk of this type of invasion. The threshold is crossed when feedback mechanisms shift from natural dynamics to feedback mechanisms that cater to the invasive species.

Transition T3
State 1 to 3

Reference State

This transition is caused by significant human alterations that remove essential topsoil horizons, alter hydrologic functions, and/or add significant inputs that change soil chemistry and soil properties for housing developments, urban infrastructures or intensive cropping systems and force this ecological site over a threshold and change the function and structure of this site in extensive ways.

Restoration pathway R1
State 2 to 1

Reference State

Restoring ecological processes to the coastal dunelands in Point Reyes National Seashore is a complex task, due to the combination of stressors and the economic and social interests related to this park and these dunelands. Removing the European beachgrass, searocket and iceplant would increase the instability of dunes slopes and basins and change system topography, with the degree of change dependent upon the restoration approach that is used. Destabilizing the dunes would ideally provide the release from the root stabilization of these non-native plants, however it could further damage what may remain of sensitive or limited populations of the native dune plants as well (NPS, 2015). Given the nature of the duneland environment, without immediate recovery of the native vegetation, either through plantings or natural re-seeding, the extremely successful non-native species will return in short order (McGraw et al., 2017). Manual removal is the preferred method of removal for European beachgrass and has been found to reduce competition with the native species when there are intact stands of native species in

proximity of the treated areas. However, if European searocket or iceplant are also in the mix of species, additional strategies will be necessary to avoid a transition to a monotypic stand of one of these species instead (Buell et al., 1995). Another consideration to management of invasives in these dunelands, is that European searocket is able to maximize the nitrogen made available by native and non-native nitrogen-fixers common in these dunelands making them larger and more resistant and resilient to disturbance or stress. Targeting areas with limited nitrogen-fixers or undesirable nitrogen-fixers (non-native bush lupines) may be easier to treat than those with a mix of native dune lupines, including the endangered Tidestorm's lupine (McGraw et al., 2017 and NPS, 2015). Restoration would encourage more natural dune processes that would result in more natural dune topography, providing vital habitat for endemic plants and animals that is also more resilient to potential future disturbances such as sea level rise, increased wave scour and storm surge, and, potentially, stronger coastal winds, all of which might necessitate migration of dunes systems inland if they are to persist in the future (NPS, 2015).

Context dependence. The very nature of this ESG makes it difficult to tackle restoration, since the primary ecological disturbance, wind-blown sand deposition and destabilization, creates a complex patchwork of active blowing dune sands all the way to semi-stabilized dunes. Restoring this dynamic may include deposition in associated areas where sediment deposition is undesirable. These associated areas are coastal grasslands and coastal scrub areas that provide wildlife habitat and forage for the still active dairy and beef operations still present within the boundaries of the National Seashore. Impacts such as these are generally avoided or minimized through implementation of several mitigation measures, including tapering slopes, limiting restoration activities near the livestock operations when possible, and conducting active revegetation (plug plantings, etc.) of back dune areas that are more inland and will have greater impacts to the associated sites (NPS, 2015).

Transition T2
State 2 to 3

This transition is caused by significant human alterations that remove essential topsoil horizons, alter hydrologic functions, and/or add significant inputs that change soil chemistry and soil properties for housing developments, urban infrastructures or intensive cropping systems and force this ecological site over a threshold and change the function and structure of this site in extensive ways.

Restoration pathway R2
State 3 to 2

This restoration pathway occurs only when significant time and money inputs are focused on areas that have not been permanently altered by urban developments. This restoration pathway may be more likely than R1, since most of these very altered landscapes will be more hospitable to invasive species than to the native species that are more particular and require specific growing conditions that may not be replicable due to the alterations to the site that had occurred.

Citations