Ecological site group R019XG904CA
Dunes

Last updated: 07/05/2023
Accessed: 05/08/2024

Key Characteristics

- located on sand dunes

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

This ESG is found on dunes with varied slopes from sea level to 180 feet elevation.

Climate

The average annual precipitation of this MLRA covers a diverse landscape of valleys and mountains and can range anywhere from 8 to 53 inches (215 to 1,354 millimeters), increasing with elevation. Most of the rainfall occurs as low- or moderate-intensity, Pacific frontal storms during winter. Rain can turn to snow at the higher elevations. A little snow may fall in winter, but it does not last. Summers are dry, but fog provides some moisture along the coast. The average annual temperature is 38 to 67 degrees F (3 to 19 degrees C). The freeze-free period averages 310 days in the valleys, 245 days in the mountains, and ranges from 125 to 365 days along the coast. It decreases in length with elevation. The longest freeze-free period occurs at the lower elevations along the western edge of the area.

Soil features

The soils of this ESG are primarily coarse sands composed primarily of eolian sands and alluvium. They are Typic or Lamellic Xeropsamments.

Vegetation dynamics

Beach dunes represent the more rapidly changing to older, more stabilized areas directly adjacent to the beaches. They consist of actively moving to well vegetated dunes that are all oriented parallel to the prevailing winds. Many of the older, more stabilized dunes covered in coastal scrub are being transitioned back to actively moving, poorly vegetated dunelands due to changing winds and human alterations and land uses. The extent of this ESG stretches from the back side of the foredunes to the edge of the back dunes. This ESG covers a wide variety of dune dynamics and expressions that may need to be further refined to better represent dynamics on a smaller, more ecologically specific scale. For the purposes of this concept, however, all that variation is lumped into one site concept.

Abiotic Factors/Primary Disturbances

Salt spray, soil salinity, sea-water immersion and sand movement are the most critical abiotic factors for this ESG, primarily in the context of geologic processes and coastline water and wind currents. The salt spray gradient is a function of wind speed, distance from the tide line, height above the ground, and microtopography. Hypertrophy (succulence) accounts for the ability of dicots to withstand salt spray, and grasses that lack this ability, rely on a thick cuticle instead. Salt spray tolerance dictates the species composition that dominates the different areas of this ecological site, but also impacts the structure of the vegetation expression as well. Although beach species are not obligate halophytes, they are tolerant of soil salinity and occasional seawater immersion. Germination and establishment phases of most beach species is when they are the most vulnerable to the soil salinity, and therefore depend on times that seawater immersion and impacts from salt water are minimal until after full establishment.

Water deposition, onshore winds, desiccation, nutrient limitations, and sand burial are the most important disturbances that naturally drive the dynamics of this ecological site concept. Adaptations to sand burial are key adaptations for vegetation in this ecological site, developing larger, heavier seeds that have the ability to emerge from much greater depths once germinated. These species have also adapted to planting themselves deeper in the sands to take advantage of higher soil moisture content and protection from the wind/sea salt spray. Other adaptations include plant morphologies and canopy densities. Different accumulations of sands occur with different plant canopies, for example plants with intermediate canopy densities with loose, cylindrical silhouettes cause a decrease in wind velocities within the plant canopy leading to accretion of fine sands and the formation of hummocks typical of this ecological site.

Desiccation is a major stressor to this ecological site, namely from intense solar radiation and evapotranspiration, seasonal drought, and low water-holding capacities of the sands typical of this ecological site. The species that dominate this ecological site are adapted to these conditions, using various rooting strategies, leaf morphologies that can withstand high levels of solar radiation, high light intensities for photosynthesis, and wind desiccation, and root and shoot strategies to ameliorate the low-fertility soil conditions.

Dune morphology begins when beaches with vegetation create shadow dunes or beach mounds. These shadow dunes occur when a plant causes wind to be deflected, slowing its speed and dropping sand particles into an elongated tongue of sand in the lee of obstacles. Changes in wind direction result in accumulations on all sides and the formation of a beach mound. These can be easily blown out by wind gusts or winter waves. However, when they are built on relatively wide areas of beach, a foredune can develop. A foredune is a vegetated ridge of sand parallel to the beach, rising above the ordinary high tides. These foredunes support greater species richness and plant cover than the upper beach, but fewer species that are found just inland on dune ridges. These incipient shadow dunes and the briefly stabilized foredunes are a part of the other ecological site, R004BA200CA Beaches, which captures the areas of the coastline that are more rapidly changing and consistently impacted by seasonal storms and weather events, shifting the site back and forth between unvegetated beaches to reasonably stabilized beach foredunes only. Anything further away from the winter storm high tide marks that can develop into more stabilized, well vegetated sand dunes are a part of this ESG.

Blowouts that occur in a continuous foredune may result in incipient parabola dunes that later stabilize with vegetation, becoming relatively narrow dune ridges. Ridges alternate with depressions classified as dune swales when they are deep enough to support distinct vegetation and can become classified as deflation basins that are poorly drained and support a distinct ecological site, R004BA206CA Deflation Basins site. Where large areas of mobile sand occur in combination with a wide receptive area and unidirectional winds, transverse dunes form. Crests of these dunes are sinuous, oriented perpendicular to wind direction, and of variable length. These transverse dunes form during low sea levels with abundant sand supply from prograding shorelines and the exposed continental shelf. These dunes move too rapidly to support all but transient vegetation and they may even become superimposed over the large-scale parabola dunes that are formed in areas of stabilized vegetation. These transverse dunes, parabola dunes, and large areas of sand sheets make up the active dune portions of this ecological site concept. In the stabilized, vegetated back dunes, older ridges and stabilized parabolas support forest dune vegetation and troughs support swale vegetation or deflation basin vegetation. This dune ecological site may need to be divided into more ecological site concepts based on more locally specific site dynamics and abiotic factors, but at this time these dynamics are all included in one ESG.

Information taken primarily from Barbour et al, 2007. Terrestrial Vegetation.

Major Land Resource Area

MLRA 019X
Southern California Coastal Plains and Mountains

Subclasses

- R019XD035CA–SANDY
- R019XD075CA–Coastal Strand 14-18" P.Z.
- R019XG904CA–Dunes

- R019XI101CA–Sandy dunes 13-34" p.z.

Correlated Map Unit Components

23477366, 23477457, 22666458, 22666328, 22643346, 22643348, 22669126, 22669204, 22669213, 22668948, 22668376, 22669137, 22669239, 22669145, 22668979, 22668415, 22668984, 22668690, 22669017, 22669013, 22668205, 22668206, 22670492, 22670669, 22670698, 22670931, 22670933, 22670934, 22670970, 22670971, 22670972, 22671183, 22671182, 22671528, 22671530

Stage

Provisional

Contributors

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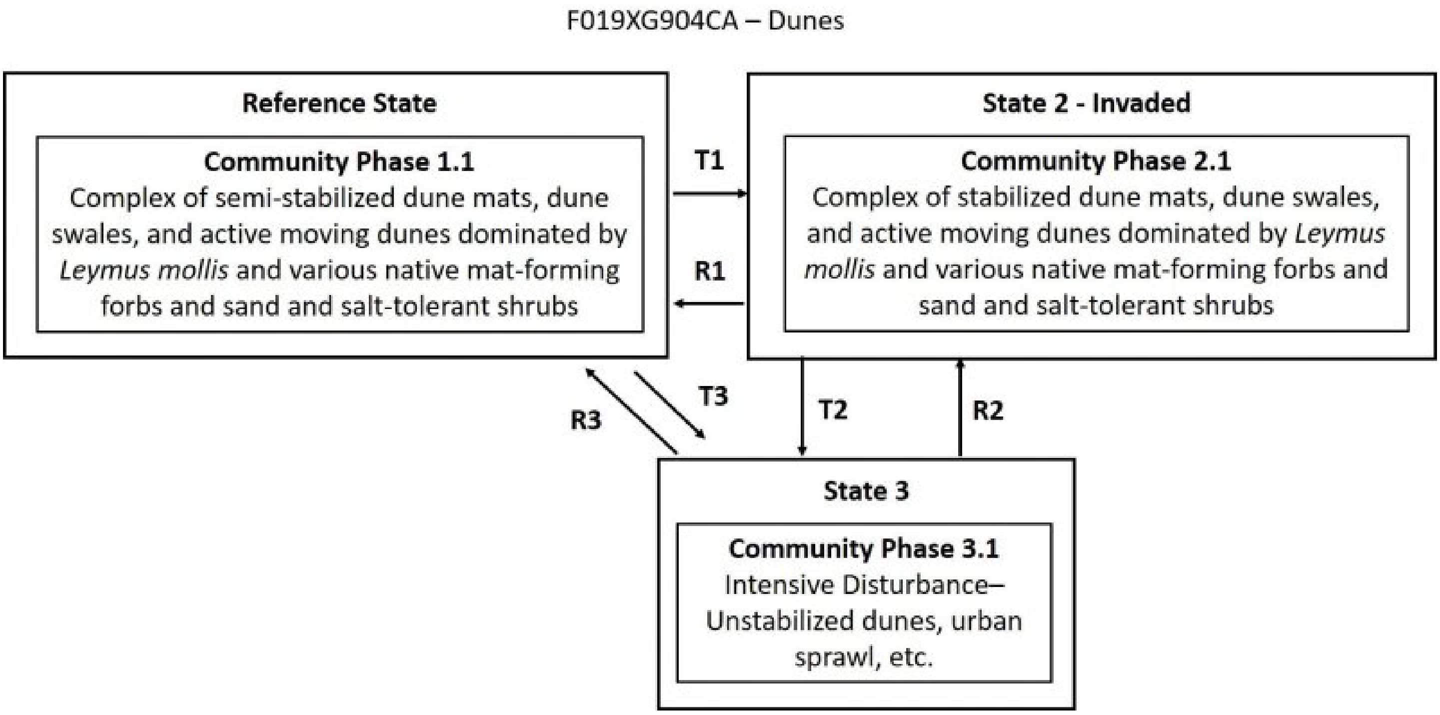
State and transition model



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 the highly variable dynamics of the active dunes, dune mats, and dune swales. These communities are all varied in size and extent, depending on the width of coastline available, the geologic history of the deposits, and long-term shifts in prevailing winds that impacted a specific area of coastline. The active dunes and dune mats are more transitory in nature, with the dune mats being of limited extent along dune ridges mostly. At this very general scale, this reference state only really captures the generalities related to the functional groups that are most dominant and does not capture the more specific dynamics and patterns that would be found at the more detailed and refined ecological site scale that focuses on specific abiotic factors that drive some of these various complex plant expressions. More data and refinement is needed to capture the information needed in order to make specific land management decisions at the ecological site-component scale.

Community Phase 1.1 –This community phase represents the varied and mostly unstable community phase represented primarily by active dune, semi-stabilized dune mat, and dune swale or deflation basin vegetation. This community phase exists in areas that have been more heavily impacted by winter storms that modify the dune environment and the prevailing winds for a significant time period that creates these more transitory communities. Even the swales can be rather transitory in nature, developing over time while water is available in the low portions of the dunes and then disappearing as the sands deposit into the swales when the winds shift, burying these swales and becoming active dunes and dune mats with new low lying areas that become new swales.

Transition 1 (T1) – this transition occurs when the non-native seed source is introduced to the ecological site. This ecological site is not highly resistant to outside pressures like invasive species, constantly 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, which includes stabilizing the dunes so they no longer shift and blow and renew on a regular basis.

Restoration Pathway 1 (R1) – this restoration pathway occurs through the control of invasive species can potentially restore this ecological site to its reference state. It is more likely that the invasions are minimized and controlled, but complete removal of the invasives may not be possible without significant time and money inputs and repeated treatments.

State 2 – this state represents an invaded condition that has been stabilized by non-native species. This ESG in general is highly susceptible to invasives, given the more transitory nature of these communities they are primed for openings by non-natives that can capitalize quickly on available resources much better than the native species can. This state is currently only one community phase, representing all the different types of communities and 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 Phase 2.1 – the community phase represents all the different community expressions of an invaded state. The dune mat community is the most at-risk for invasion and is dominated by the aggressive *Ammophila arenaria* (European beach grass). It is native to Europe and is a successful sand-binder that monopolizes the dune mat communities and outcompetes the native beach grass and other native forbs. It alters sand movement, decreases invertebrate abundance and diversity, and most significantly builds a steep, continuous foredune replacing the low, hummocky foredunes that are representative of the reference state dunelands. Other common invasives to this ecological site include *Carpobrotus spp.*, annual grasses.

Transition 2 (T2) – This transition is caused by significant human alterations that remove soils, alter hydrologic functions such as flooding regimes, flooding influence and wind influence, and/or add significant inputs that change soil chemistry and soil properties for housing developments, urban infrastructures or intensive cropping systems and force this ESG over a threshold and change the function and structure of this site in extensive ways.

Restoration Pathway 2 (R2) – 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 R3, 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.

State 3 – This state represents the intensive land uses that have significantly altered this ESG due to urban developments, recreational activities, and 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 better manage of these areas or potentially attempt restoration of these areas where possible.

Community Phase 3.1 – this community phase represents all the varied land uses that significantly alter this ecological site. 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.

Transition 3 (T3) - This transition is caused by significant human alterations that remove soils, alter hydrologic functions such as flooding regimes, flooding influence and wind influence, and/or add significant inputs that change soil chemistry and soil properties for housing developments, urban infrastructures or intensive cropping systems and force this ESG over a threshold and change the function and structure of this site in extensive ways.

Restoration Pathway 3 (R3) – Restoration will depend on the type of dunes, and how fragmented they are as well as how heavy the urban influences are on the dunelands, as well as the need to return the natural hydrologic functions and wind activity needed for restoration. This pathway is time and money intensive and is likely not possible in many dunes of this MLRA.

Citations