Ecological site group F004BL103CA
Fog-influenced, low elevation mountain slopes

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Key Characteristics

- Elevated coastal plains
- Dissected coastal plateaus with high acidity – LRU L
- Sea spray does not have a dominant influence on soils and 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

This ESG is found on fluviomarine terraces and hills on slopes from 5-50% and elevations generally under 1000 ft in LRU L.

Climate

The average annual precipitation in this MLRA is 23 to 98 inches (585 to 2,490 millimeters), increasing with elevation inland. Most of the rainfall occurs as low-intensity, Pacific frontal storms. Precipitation is evenly distributed throughout fall, winter, and spring, but summers are dry. Snowfall is rare along the coast, but snow accumulates at the higher elevations directly inland. Fog is a significant variable that defines this MLRA from other similar MLRAs. Summer fog frequency values of greater than 35% are strongly correlated to the extent of coast redwood distribution, which is a primary indicator species in this MLRA. Nightime fog is approximately twice as common as daytime fog and seasonally, it reaches its peak frequency in early August, with the greatest occurrence of fog from June through September (Johnstone and Dawson 2010). The average annual temperature is 49 to 59 degrees F (10 to 15 degrees C). The freeze-free period averages 300 days and ranges from 230 to 365 days, decreasing inland as elevation increases.

The Fort Bragg/Fort Ross Terraces form an elevated coastal plain that has less relief (200-800 feet) than the adjacent low elevation mountains of LRU K. Monthly and annual temperature variations are minimal and summer fog is common.

Soil features

This ESG is found on isomesic, well-drained soils that are derived from alluvium derived from sedimentary rocks. They are fine-loamy, Typic Tropohumults that have good water-holding capacity, have high runoff and slow permeability and are slightly acidic.

A representative soil for this site is the Empire soils within Mendocino County.

Vegetation dynamics

This provisional ecological site concept attempts to describe the coast redwood-Douglas-fir dominated slopes that can be found within this LRU. This concept is primarily supported through literature and available information from the Mendocino County Survey. This provisional ecological site concept covers the mountains within close proximity to the coast and at the lower elevations that spend longer periods within the summer coastal fog. 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

Sequoia sempervirens (coast redwood) and Pseudotsuga menzeisii (Douglas-fir) forests in this LRU dominate the more well-drained, less acidic soils of LRU L that are solidly within the coastal fog influence, especially during the summer months. Although coast redwood and Douglas-fir can grow on a variety of soils, the soils are found at elevations below 1,000 feet between the ocean and the first main north-south ridge. Where frequent heavy summer fog is intercepted by a tree canopy, a significant amount of moisture is added to the soil. Soils have water available for plant growth most or all of the year, and average soil temperatures at a depth of 20 inches vary by less than 5 degrees C between summer and winter.

Coast redwood attains a height of 395 ft (~120 m), and an age of at least 2200 years. Roots are shallow without a taproot. Trees begin bearing cones by 5 to 15 years of age and seed production is generally high, however seed viability is low. Wind and gravity disperse the seeds, with most falling within 395-400 ft of the parent tree. Seedling establishment is best on moist soil lacking litter but can occur on duff or logs. Plants are moderately shade tolerant, but they grow faster in higher light levels if soil moisture is present (MCV 2018).

Douglas-fir is a large, coniferous, evergreen tree. Adapted to a moist, mild climate, it grows bigger and more rapidly than the inland variety. Trees 5 to 6 feet (150-180 cm) in diameter (150-180 cm) and 250 feet (76 m) or more in height are common in old-growth stands. These trees commonly live more than 500 years and occasionally more than 1,000 years. Old individuals typically have a narrow, cylindric crown beginning 65 to 130 feet (20-40 m) above a branch-free bole. It often takes 77 years for the bole to be clear to a height of 17 feet (5 m) and 107 years to be clear to a height of 33 feet (10 m). In wet coastal forests, nearly every surface of old-growth Douglas-fir in this ecological site is often covered by epiphytic mosses and lichens (Uchytil, 1991). This tree's rooting habit is not particularly deep. The roots of young Douglas-fir tend to be shallower than roots of many of the same aged conifers like ponderosa pine, sugar pine, or incense-cedar. Some roots are commonly found in organic soil layers or near the mineral soil surface.

This ecological site is dominated by a multi-tiered canopy of conifers, with coast redwood making up more than 50% of the stands basal area and Douglas-fir and other hardwoods accounting for between 30-50%. Pacific rhododendron and tanoak readily establish after disturbance and may dominate the overstory for several years post-disturbance. Fallen logs are an essential part of this ecological site, providing significant habitat for wildlife species and conifer recruits. Conifer recruitment on the bare mineral soil is rare, due to the thick litter layer and organic surface soil and is therefore relegated only to areas of surface soil disturbance from mass wasting, logging practices, wind throw, and recreation trails.

Primary Disturbances

Fire is the principal disturbance agent in both young-growth and old-growth stands. Lightning-ignited fires occur in this zone with fair regularity, however, Native American burning is thought to have also played a major role with fires set in areas adjacent to redwood forest burning into the redwood zone (Veirs, 1996). Natural fire intervals ranged from 500 to 600 years on the coast, 150 to 200 years on intermediate sites, and 50 years or less on inland sites. The northern range of redwoods evolved within a low to moderate natural disturbance regime (Veirs, 1979). The mean fire interval is quite variable, depending on environmental site conditions. Old-growth stands show evidence of three or more severe fires each century, and the distribution of fires appears as a natural pattern of several short intervals between fires followed by one or more long interval (Stuart 1987, Jacobs et al. 1985).The co-dominance of Douglas-fir and hardwoods in this provisional ecological site concept indicates a more regular occurrence of fires and disturbance, since Douglas-fir would only persist in this type of forest if there were adequate openings and mineral soils periodically exposed to facilitate regeneration and canopy recruitment. Fire scars are abundant throughout old-growth stands and are evidence of this fire history. Previous harvesting and the use of fire to treat logging slash in this area has also changed species composition on many formerly redwood-dominated sites (Noss et al, 2000).

Both redwood and tanoak can re-sprout following fire (Veirs, 1996). After fire, redwood may sprout from the root crown or from dormant buds located under the bark of the bole and branches (Noss, 2000), while tanoak typically only sprouts from the root collar. The sprouting ability of redwood is most vigorous in younger stands and decreases with age, while the ability to survive fire increases with age as its fibrous bark thickens. Frequent fire reduces tanoak's sprouting ability and also tends to keep understories open (Arno, 2002). Fire exclusion would allow for the gradual increase of tanoak in the understory (McMurray, 1989). Surface fires likely modified the tree species composition by favoring the thicker-barked redwood and killing *Notholithocarpus densiflorus* (tanoak). Fires also expose the mineral-rich soil and reduce competition from other plants, thereby increasing the establishment of Douglas-fir (Veirs, 1979, Agee, 1993). Tanoak seedlings and sapling-sized stems are often top-killed by surface fire, though larger stems may survive with only basal wounding (Tappeiner, 1984).

A moderate fire could lead towards a mosaic in regeneration patterns an uneven-aged structure. Patches of trees would be killed leaving others slightly damaged or unharmed. Douglas-fir regeneration would be favored in the large gaps that are created following a moderate fire, potentially leading to a larger proportion of Douglas-fir to redwood for several centuries (Agee, 1993). Without these gaps caused by fire, Douglas-fir regeneration is unsuccessful, and with continued lack of disturbance it may slowly be replaced by redwood as the dominant canopy species (Veirs, 1979, 1996).

Fires will also alter the composition of shrubs and forbs in the understory community. *Vaccinium ovatum* (evergreen huckleberry) is a common species in both moist and dry Douglas-fir and redwood environments. It is normally a fire-dependent shrub species, but little is known concerning it's adaptation to fire under low to moderate fire return intervals (Tirmenstein, 1990). Following a fire, evergreen huckleberry will often re-sprout and recover rapidly. *Rhododendron macrophyllum* (Pacific rhododendron) is considered sensitive to fire. Following a surface fire, it may reestablish seedlings by sprouting from the root crown or stem base (Crane, 1990). After a disturbance such as fire, a decrease in plant cover is common, and will be followed by a gradual increase in cover over time.

Another important disturbance for this redwood ecological site is damage from winter storms that can cause top breakage and blowdowns. This breakage may kill individual or groups of trees and create small openings from windfall (Noss, 2000). This would likely favor the establishment of redwood and other shade tolerant conifers.

Significant disturbance to this ecological site would occur if there are climatic changes great enough to impact the amount of fog influence this ecological site experiences on a yearly basis. Coast redwoods reliance on fog is crucial to its survival and without the moisture available in the summer from the daily blanket of fog, redwoods may begin to die out and Douglas-fir would begin replacing those redwood stands. Well established redwoods may persist where access to water is still available (concave depressions, valley bottoms, etc.) until removed by fire or other types of human disturbance.

Coast redwood is one of the signature trees of California, with 95% of its range existing within the state. Years of logging have left significantly lower amounts of the original forest (Sawyer et al. 2000b). Old-growth stands exist mainly in protected areas including parks, experimental forests, and private reserves. Asexual regeneration is prolific and many stands of younger trees exist, but many areas are on the third cycle of regeneration with collateral impacts of erosion, streambed siltation, and alteration to watershed and wildlife values. Residential development is an increasing concern.

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Major Land Resource Area

MLRA 004B
Coastal Redwood Belt

Stage

Provisional

Contributors

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State and transition model

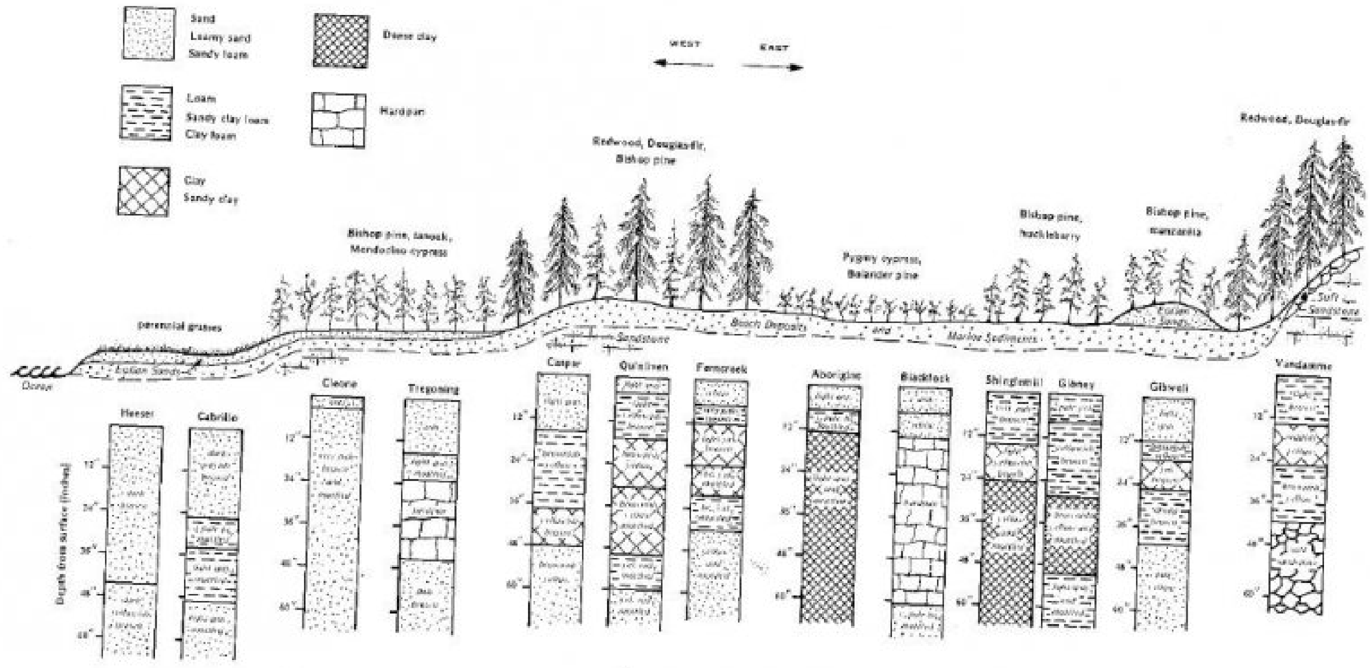

Figure 10.—Idealized illustration of the general relationships among marine terrace soils. This simplified cross-section is typical of the marine terraces near the town of Caspar. The width of the terrace system, from the ocean on the west to the mountainous uplands on the east, is approximately 4 miles at this location. Other cross-sections of the terrace system would reveal different combinations of soils. The upper terrace in this diagram represents perhaps three or more terrace levels. The diagram is not to scale.

State 1
Reference State

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. No alternative states were found during the literature review, however that does not mean they do not exist and more time should be spent determining whether or not this model captures all the dynamics of this system, especially once more is known about the soil-site characteristics of this LRU and ecological site concept. Reference State (State 1) – The reference state for this provisional ecological site concept is dominated by *Sequoia sempervirens* (coast redwood) and Pseudotsuga menzeisii (Douglas-fir), with a significant component of *Notholithocarpus densiflorus* (tanoak) and *Rhododendron macrophyllum* (Pacific rhododendron) in the lower canopy. The ecological dynamics represented in the reference state are driven primarily by periodic fires (extended periods between fires) that create the complex dynamics and plant expressions reflected by the community phases described. Depending on the intensity, severity, timing, and weather conditions associated with each fire and which community phase is impacted by the fire, this ecological site will respond to varying degrees. 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 1.1
Reference Community Phase

The reference community for this site is a redwood and Douglas-fir forest with Sitka spruce present in areas nearest the ocean. Coast redwood dominates in the overstory, with Douglas-fir and tanoak and Pacific rhododendron found as associates in the subcanopy. The understory is shrub-dominated with *Vaccinium ovatum* (California huckleberry), *Rhododendron macrophyllum* (Pacific rhododendron), and *Gaultheria shallon* (salal). Occasionally *Polystichum munitum* (western swordfern) may be found in the understory layer, but forb cover is generally low. The estimated age for this community is 200 years or more. Windthrow from winter storms or small partial cuts can create small gaps which will provide openings for Douglas-fir and hardwoods to maintain their subcanopy dominance and potentially increase the cover of shrubs as well.

Community 1.2

This community phase represents a stand primarily dominated by Douglas-fir with redwoods as a sub-dominant with a higher cover of tanoak and/or Pacific rhododendron in the subcanopy and heavier cover of a variety of shrubs. This community phase will look very similar to the provisional ecological site concept that is dominated by Douglas-fir as the reference condition, so it will be important to understand the abiotic factors and influences of the site in order to distinguish this community phase from another concept.

Community 1.3

Tanoak and/or Pacific rhododendron, shrubs, and western swordfern will rapidly establish the site after a disturbance with Douglas-fir and redwood seedlings present.

Pathway 1.1a
Community 1.1 to 1.2

The reference community may transition to Community Phase 1.2 following a significant storm event that brings down redwood trees, opening the canopy as redwood mortality occurs providing more niche space for the more shade-intolerant Douglas-fir. This community pathway could also occur if the timing of a moderate-intensity fire that removes many of the conifers occurred in combination with a short-term weather change that limited the moisture availability for redwoods to re-establish, giving significant edge to the Douglas-fir to establish and dominate. A selective timber harvest for redwoods would produce a similar result, albeit different in the impacts associated.

Pathway 1.1b
Community 1.1 to 1.3

The reference community may transition to Community Phase 1.3 following a significant fire that removes the conifers and hardwoods from the canopy and allows the understory shrubs to dominate for a short time as the conifers and hardwoods attempt to re-establish.

Pathway 1.2a
Community 1.2 to 1.1

With time, redwoods should gradually re-establish and will eventually take over dominance once again in the upper most canopy layer returning the site to Community Phase 1.1.

Pathway 1.2b
Community 1.2 to 1.3

This community phase may transition to Community Phase 1.3 following a significant fire that removes the conifers and hardwoods from the canopy and allows the understory shrubs to dominate for a short time as the conifers and hardwoods attempt to re-establish.

Pathway 1.3a
Community 1.3 to 1.2

With time, the conifers will re-establish dominance and overtop the shrubs. Douglas-fir will likely be the dominant conifer in the overstory for several years, since it more shade intolerant, requires less moisture to establish and grows quickly. Redwoods will regain dominance over time and thin out the Douglas-fir as it develops enough canopy to begin shading out the Douglas-fir.

State 2
Intensive disturbance

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 2.1

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

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.

Citations