Ecological site group F004BJ101CA
Fog-influenced, low elevation slopes and footslopes

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Key Characteristics

- Heavy coastal fog dominates the landscapes below 1500 ft.
- Soil moisture is ustic – LRU J
- Fog-influenced, low elevation slopes and footslopes

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

The site occurs on mostly well-drained mountain slopes in LRU J, however there are small areas that are found on stabilized debris flows that have a seasonally high water table and redox features. Slopes are gently sloping to very steep reaching elevations just under 2000 ft, and the site is limited to areas of high annual precipitation and a cool, maritime climate that provides fog drip and sufficient summer moisture to mollify evapotranspiration rates in the summers.

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.

Although this is one of the wettest spots in California, precipitation-wise--the hot, dry, offshore summer winds of LRU J keep out the fog and make the King Range too dry to support a dominant overstory of redwoods, like that of the surrounding LRUs. The key difference between the redwood dominated slopes of this LRU and those of LRU I, is that when redwoods are harvested from LRU J, they will not re-establish on their own, they must be planted.

Soil features

The soils within this ESG are variable, however they will have isomesic soil temperature and typic or aquic soil moisture regimes over colluvium or residuum parent materials.

The representative soils for this ESG will be Redwohly (fine-loamy Ultic Haplustalfs) and Sproulish (fine-loamy Typic Dystrustepsts) that are well drained and slow permeability.

Vegetation dynamics

This provisional ecological site concept attempts to describe the coast redwood dominated low elevation mountain slopes and footslopes that can be found within this LRU. This concept is primarily supported through literature and

available information from current soil survey products. This provisional ecological site concept covers the mountains within proximity to the coast and the coastal fog-influence that lies within LRU J. This site is different from the similar redwood site concepts of LRUs I and L due to the marked drop in fog influence in the summer months within LRU J that significantly affects the regeneration potential of coast redwood after disturbance. This drop in fog influence allows for a less conifer-centric floristic expression with tanoak (*Notholithocarpus densiflorus*), madrone, and chinquapin occurring more often as codominant species occupying a sub-canopy beneath redwood and Douglas-fir. California bay laurel, bigleaf maple, Pacific yew and vine maple are found in areas with springs or seeps or along small headwater streams. Conifers that associate with redwood further north or nearer the coast, such as Sitka spruce, western hemlock and grand fir, are not present within this ESG. 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.

Sequoia sempervirens (coast redwood) forests are unique in this MLRA in their ability to dominate the low hills and mountains of LRU J that are solidly within the coastal fog influence that still affects parts of LRU J, especially during the summer months.

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).

This ecological site is dominated by a multi-tiered canopy of conifers, with coast redwood making up the bulk of the stand's basal area and hardwoods accounting for a continuous sub canopy. 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, fire, and recreation trails.

Primary Disturbances

Fire is the principal disturbance agent in both young-growth and old-growth stands. Lightning-ignited fires do occur (Van Wagtendonk and Cayan, 2008, Kalashnikov et al 2022), and Native American burning likely played a major role as fires from neighboring grasslands and hardwood forests passed into the redwood zone (Greenlee and Langenheim, 1990, Veirs, 1996). The mean fire interval for redwood forests is quite variable across its range. In some areas, 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 intervals (Stuart 1987, Jacobs et al. 1985). Natural fire intervals for this LRU are severely understudied, but the frequency of fire in this redwood ESG during pre-Euro American settlement times can be inferred as somewhat frequent based on research done in redwood forest types both south and north of LRU J. Because LRU J harbors more open grassland, oak woodland and hardwood forests, it compares more readily to the Central Coast, and therefore, fire regimes here are likely more frequent (e.g. Jacobs et al. 1985, Greenlee and Langenheim, 1990, Jones and Russell, 2015) than some of the long return intervals found for fire close to the coast in the far North of redwood’s range in Redwood National Park and Prairie Creek Redwoods State Park (e.g. Veirs, 1979, 1980, 1996). Fire scars are abundant throughout old-growth stands in LRU J, indicative of historic fires. 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).

Redwood, tanoak and other hardwoods 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 (Veirs, 1996, Noss, 2000), while tanoak and other hardwoods sprout from the root crown, root collar, lower part of the stem and underground burls (McDonald and Tappeiner 1986). 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 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 young 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) and facilitating redwood and hardwood resprouting. Tanoak seedlings and sapling-sized stems are often top-killed by surface fire, though larger stems may survive with only basal wounding (Fryer, 2008).

A moderate fire could lead towards a mosaic in regeneration patterns. Patches of trees would be killed leaving others slightly damaged or unharmed. Douglas-fir (*Pseudotsuga menziesii*) and resprouting hardwoods would be favored in the large gaps that are created following a moderate fire, potentially leading to a larger proportion of Douglas-fir and hardwoods to redwood for several centuries. 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).

Another important disturbance in this ESG is winter storms that can cause top breakage and blowdown. 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.

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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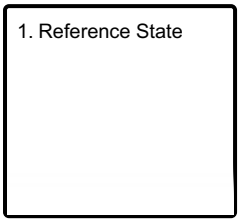
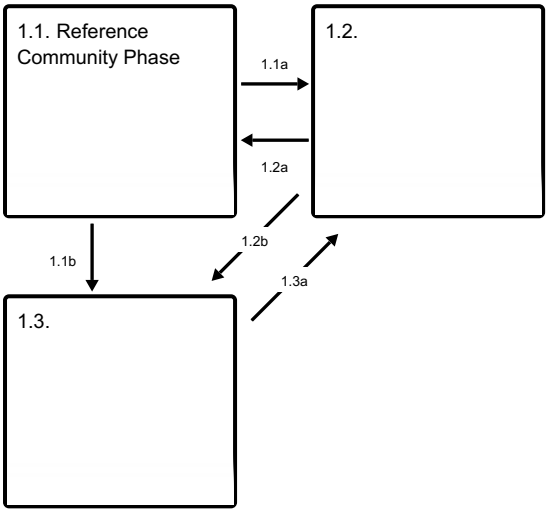
State and transition model

Ecosystem states



State 1 submodel, plant communities



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 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. 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 California huckleberry (*Vaccinium ovatum*), Pacific rhododendron (*Rhododendron macrophyllum*), and salal (*Gaultheria shallon*). Occasionally western swordfern (*Polystichum munitum*) 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.

Dominant plant species

- redwood (*Sequoia sempervirens*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- tanoak (*Notholithocarpus densiflorus*), tree
- tanoak (*Notholithocarpus densiflorus*), shrub
- Pacific rhododendron (*Rhododendron macrophyllum*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub

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 provisional ecological site concept.

Community 1.3

Tanoak and/or Pacific rhododendron, blueblossom ceanothus, and western swordfern will rapidly establish the site after a disturbance with Douglas-fir and redwood seedlings present. Redwood-sorrel may also increase in cover. The red alder/redwood plant community evolves after the initial red alder invasion. Redwood sprouts may be dominated by alder for a period of 75 years or more. Over time, redwood continues to grow and responds by filling in canopy gaps. Remnants of salmonberry remain until the canopy has completely closed and California huckleberry, western swordfern and redwood-sorrel begin to regain dominance.

Pathway 1.1a
Community 1.1 to 1.2

The reference community may transition to Community Phase 1.2 following a temporary change in weather patterns that reduces the fog influence and summer moisture required for redwoods, 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 removed 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.

Citations