Ecological site group F004BI101CA
Low Elevation Marine and Floodplain Terraces

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Key Characteristics

- Heavy coastal fog dominates the landscapes below 1500 ft.
- Soil moisture is udic – LRU I
- Under 500 ft elevation and within sea spray zone
- Marine terraces and non-flooded floodplain terraces

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 occupies young marine terraces and dissected marine terraces that were formed between ~80,000 and 100,000 years ago. The marine terrace sequence around Trinidad demonstrates the fluctuations of sea level and tectonic uplift over the past 400,000 years. The recent formation of these terraces and somewhat less recent dissected terraces provide a complex of soils that both have limitations to the amount of soil development that has yet occurred. This ESG occurs on uniform, nearly level to gently sloping surfaces, however in some areas can go up to 50% slopes. The general flat terrace geomorphology and proximity to coastal harbors have made these soils prime for pasture and urban development. Elevations are typically under 1000 ft but can go up as high as 1500 ft., with varied slopes and aspects.

This LRU is primarily influenced by hydrological processes and contains beaches, dunes, rivers, and marine terraces below 400 feet elevation. Wet forests, lakes, estuarine marshes, and tea-colored (tannic) streams are characteristic features of this LRU. Marshes and wetlands have been widely altered and/or drained with many converted to agriculture and urban developments.

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, and 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. Nighttime 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).

In LRU A, coast redwood and Sitka spruce are both limited to areas of cool, maritime climate that provides long periods of fog drip and sufficient summer moisture to mollify evapotranspiration rates in the summers, and low elevation floodplains within close proximity of the ocean.

Soil features

This ESG encompasses a wide array of soil types that are mostly isomesic, typic or oxyaquic, and vary in both surface and subsurface textures. Water table depth ranges from 0-55 inches in most cases, but some soils are greater than 6 ft. Soil moisture regimes are udic and aquic and soil temperatures are isomesic.

Vegetation dynamics

This provisional ecological site concept attempts to describe the Sitka spruce- coast redwood dominated forests of this LRU. This concept is primarily supported through literature and available information from Redwood National Park Soil Survey. 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

These co-dominated slopes of *Picea sitchensis* (Sitka spruce) and *Sequoia sempervirens* (coast redwood) are unique in this MLRA in their ability to dominate these low marine terraces that are close to the coast line but experience less sea salt spray influence, allowing redwoods to assume co-dominance in most cases. This ecological site straddles the boundary of this salt-laden marine influence, so both Sitka spruce and redwood occupy the site. Areas that are still more prone to receiving more direct wind and salt spray from the storms off the ocean will still be more dominant in Sitka and areas that are a bit more inland and less exposed to the storms and salt spray will be more redwood dominate. *Alnus rubra* (red alder) is a common associate species on this site and can dominate the site in an early seral stage. Although coast redwood and Sitka spruce can grow on a variety of soils, within MLRA 4B the soils are primarily found on moist, very deep soils formed in weakly consolidated marine sediments and are found on marine terraces close to the coast.

Primary Disturbances

This Sitka spruce-coast redwood ecological site has evolved with a low natural disturbance regime in coastal areas with a fog influence. Its close proximity to the coastal zone has caused the site to evolve with small to moderate disturbances from wind events. This is the primary disturbance to these Sitka spruce-redwood forests. Windthrow can account for up to 80 percent of the mortality within stands. Regeneration from gap phase replacement, however, is rapid. Winter winds from the northwest can be extreme and repeated disturbance by wind is evidenced by a hummocky ground appearance caused by fallen trees and root wads (Agee, 1996). Rarely, more severe wind events could lead to larger amounts of windthrow. Red alder will often establish dominance in these openings that are created during these wind events that open the canopy and knock down the redwood and/or Sitka spruce trees. Pioneer species such as native shrubs and nitrogen-fixing red alder may quickly colonize windthrow gaps. In the Sitka spruce coastal zone following logging, dense shrub communities can arise, and nurse logs are important for spruce regeneration (Franklin and Dyrness, 1973).

Rubus spectabilis (salmonberry) and *Gaultheria shallon* (salal) may become very dense following a disturbance and can potentially form large brushfields (Tirmenstien, 1989). These species can reproduce vegetatively following timber harvesting or fire. Though these brush species are most prevalent in early to mid-seral successional stages, they persist in the openings of mature stands. Windborne spores from *Polystichum munitum* (western swordfern) may also rapidly infill new openings. It is found throughout successional communities, and will increase over time to become dominant (Zinke, 1977).

Sitka spruce seed will germinate on almost any substrate, although mineral soil or a mixture of mineral soil and organic soil are considered the best seedbeds. The "nurse log syndrome" has a key role in the regeneration of Sitka spruce in its wetter environments, such as this LRU. Germination and seedling survival are greater on rotting logs then on the forest floor. Seedling establishment and growth can be enhanced with the inoculation of the mycorrhizal fungi, Thelephora terrestris. Sitka spruce shows strong trends in hardiness and growth in relation to geographic origination. These trends can be used to increase growth rate, but they can also have adverse effects on survival.

Fire is not an important factor in the ecology of Sitka spruce. Its thin bark and a shallow root system make it very susceptible to fire damage. Natural fire intervals near the ocean range from 250 to 500 years; they are rare and of low intensity. If a severe crown or surface fires were to occur, it would result in total stand replacement (Griffith, 1992).

Human interactions with the coast landscape have left a significant mark on this ecological site. Much of this ecological site is currently in pastureland and residential use between Crescent City and Smith River in Del Norte County. Historical photos indicate European settlers cleared terrace land around Trinidad for agriculture in order to provision the growing port (Trinidad Museum). Established before the towns around Humboldt Bay, Trinidad was a bustling port servicing miners coming down from the Klamath Mountains and ships loaded with goods headed up the Oregon Coast or down to San Francisco Bay.

Further evidence for land clearing and an open coastal prairie landscape is indicated by the dense even-aged stands of Sitka spruce now occupying much of the Trinidad headlands. Older open grown wolf trees can also be seen in the area indicating a more open pasture landscape. Sitka spruce can rapidly invade adjacent coastal prairies after cessation of burning, grazing, or tilling (Franklin and Dyrness 1973). If land clearing and stump removal did occur, redwood regeneration may be slow to infill onto the site. Historically, land clearings would have been occupied by native perennial and annual grasses and forbs with deliberate plantings of other species for forage and cultivation. Current cleared areas of this site are now dominated by both native and non-native species.

References and Citations

Agee, James. (1996). Fire Ecology of Pacific Northwest Forests. The Bark Beetles, Fuels, and Fire Bibliography.

Barbour, M., Keeler-Wolf, T., & Schoenherr, A. A. (Eds.). 2007. Terrestrial vegetation of California. Univ of California Press.

Burgess, S. S. O., & Dawson, T. E. 2004. The contribution of fog to the water relations of *Sequoia sempervirens* (D. Don): foliar uptake and prevention of dehydration. Plant, cell & environment, 27(8), 1023-1034.

Franklin. J.F. & C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. United States Department of Agriculture, Forest Service, General Technical Report PNW-8. p. 417.

Fryer, Janet L. 2008. *Notholithocarpus densiflorus*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: www.fs.usda.gov/database/feis/plants/tree/notden/all.html / [2024, January 9].

Greenlee, J.M. and J.H. Langenheim. 1990. Historic Fire Regimes and Their Relation to Vegetation Patterns in the Monterey Bay Area of California. American Midland Naturalist, vol 124: 239-253.

Griffith, Randy Scott. 1992. *Picea sitchensis*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov/database/feis/plants/tree/picsit/all.html [2024, January 9].

Griffith, Randy Scott. 1992. *Sequoia sempervirens*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov/database/feis/plants/tree/seqsem/all.html [2024, January 9].

Jacobs, Diana F., D.W. Cole, and J.R. McBride. 1985. Fire History and Perpetuation of Natural Coast Redwood Ecosystems, Journal of Forestry, Volume 83, Issue 8: 494–497. https://doi.org/10.1093/jof/83.8.494

Johnstone, J. A., & Dawson, T. E. 2010. Climatic context and ecological implications of summer fog decline in the coast redwood region. Proceedings of the National Academy of Sciences, 107(10), 4533-4538.

Koopman, M, D. DellaSala, P. Mantgem, B. Blom, J. Teraoka, R. Shearer, D. LaFever, and J. Seney. 2014. Managing an Ancient Ecosystem for the Modern World: Coast Redwoods and Climate Change. RedwoodsManuscript20141016 (climatewise.org). Accesse 9 Jan. 2024.

Munster, J., & Harden, J. W. 2002. Physical data of soil profiles formed on Late Quaternary marine terraces near Santa Cruz, California (No. 2002-316). US Geological Survey.

Noss, R.F. 1999. The Redwood Forest History, Ecology, and Conservation of the Coast Redwoods. Save the Redwood League. 366 pages.

Painter, Elizabeth L. “Threats to the California Flora: Ungulate Grazers and Browsers.” Madroño, vol. 42, no. 2, 1995, pp. 180–88. JSTOR, http://www.jstor.org/stable/41425065. Accessed 9 Jan. 2024.

Tirmenstein, D. 1990. *Vaccinium ovatum*. In: Fire Effects Information System, [Online]. U.S. Department of

Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov/database/feis/plants/shrub/vacova/all.html [2024, January 9].

Uchytil, Ronald J. 1991. *Pseudotsuga menziesii* var. menziesii. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov/database/feis/plants/tree/psemenm/all.html [2024, January 9].

Varner, J.M. and E.S. Jules. 2016. The Enigmatic Fire Regime of Coast Redwood Forests and Why it Matters. Proceedings of the Coast Redwood Science Symposium, Sequoia Conference Center, Eureka, CA. pp. 15-18.

Veirs, S. D. 1996. Ecology of the coast redwood. In J. LeBlanc (technical coordinator) Proceedings of the conference on coast redwood forest ecology and management (pp. 9-12).

Zinke, Paul J. 1977. Mineral cycling in fire-type ecosystems. In: Mooney, Harold A.; Conrad, C. Eugene, technical coordinators. Proc. of the symposium on the environmental consequences of fire and fuel management in Mediterranean ecosystems; 1977 August 1-5; Palo Alto, CA. Gen. Tech. Rep. WO-3. Washington, DC: U.S. Department of Agriculture, Forest Service: 85-94.

Major Land Resource Area

MLRA 004B
Coastal Redwood Belt

Subclasses

- F004BX107CA–Redwood/western swordfern, hills, soft sandstone, clay loam
- F004BX110CA–Sitka spruce-red alder/salmonberry/western swordfern, hills, sandstone and mudstone, clay loam
- F004BX111CA–Redwood/western swordfern-redwood sorrel, floodplains and terraces, loam
- F004BX118CA–Sitka spruce-redwood/salal/western brackenfern, marine terraces, marine deposits, fine sandy loam
- F004BX120CA–Redwood-Sitka spruce/California huckleberry-salmonberry/western swordfern-deer fern, marine terraces, loam
- F004BX121CA–Redwood-Sitka spruce/salal-California huckleberry/western swordfern, marine terraces, marine deposits, sandy loam and loam
- F004BX124CA–Redwood-Douglas-fir/California huckleberry-salal, marine terrace, silty eolian deposits over marine deposits, loam

Stage

Provisional

Contributors

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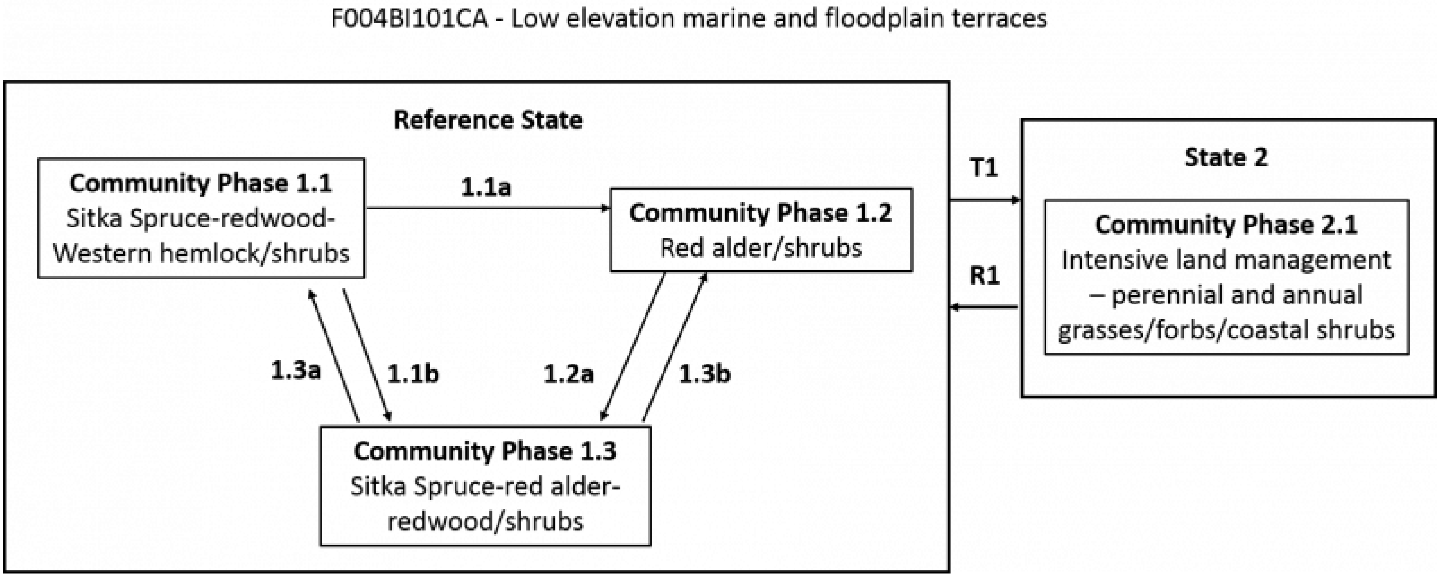
State and transition model



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 ecological site concept is dominated by *Picea sitchensis* and *Sequoia sempervirens*, with *Alnus rubra* most dominant in the open patches. It represents the three community phases that are most commonly noted in the literature with windthrow and salt-spray driving the bulk of the ecological dynamics. 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 plant community for this site is dominated by *Picea sitchensis* (Sitka spruce) and *Sequoia sempervirens* (redwood) in the overstory, with *Alnus rubra* (red alder) occurring in patches throughout the plant community. Sitka spruce, redwood and red alder often occur in a mosaic pattern due to frequent small disturbances. *Tsuga heterophylla* (Western hemlock) and occasionally *Pseudotsuga menziesii* (Douglas-fir) may also occur on this site, but this is very rare. The understory is dominated by *Rubus spectabilis* (salmonberry) and *Polystichum munitum* (western swordfern). On some sites *Gaultheria shallon* (salal) may co-exist with only salmonberry. Windthrow from winter storms or small partial cuts can create small gaps which will maintain the Sitka spruce-redwood/red alder plant community. Both salmonberry and western swordfern are maintained in the understory.

Community 1.2

Red alder dominates the plant community. It is a prolific seeder and colonizer which allows for rapid growth. Sitka spruce and redwood that became established at the same time as the alder will be quickly overtopped. The estimated tree age for this community is 15 to 40 years.

Community 1.3

Sitka spruce and red alder co-dominate the canopy with a significant secondary canopy of redwood, while salmonberry and salal may be patchier and will exist primarily in openings caused by windfall. The estimated tree age for this community is 40 to more than 80 years. Western swordfern remains the dominant ground cover.

Pathway 1.1a
Community 1.1 to 1.2

The reference phase may transition to Community Phase 1.2 following a significant windthrow event, a rare substantial fire or large acreage block harvest. The remnants of red alder, salmonberry and salal in the shrub community may rapidly expand and colonize an area. Swordfern may also be present in sites with more moisture.

Pathway 1.1b
Community 1.1 to 1.3

Following a significant windthrow event or timber harvest practice, red alder can rapidly establish and dominate the site, transitioning this community to Community Phase 1.3. Western swordfern may also infill.

Pathway 1.2a
Community 1.2 to 1.3

With no management, red alder may dominate a site for 25 years or more, slowing the growth of conifers. Over time, Sitka spruce infill that occurred at the time of disturbance becomes equal in height to the red alder, and the community shifts to Community Phase 1.3. Salmonberry and salal remain in the understory. Western swordfern continues to dominate the ground cover.

Pathway 1.3a
Community 1.3 to 1.1

With continued growth and no significant disturbance Community Phase 1.3 will transition to Community Phase 1.1. Sitka spruce and redwood continue to grow in height and will eventually overtop the red alder to become the dominant species in the canopy. Red alder is still part of the site but is no longer the dominant tree cover.

Pathway 1.3b
Community 1.3 to 1.2

Smaller windthrow events or a partial cutting of Sitka spruce and/or redwood may cause red alder to re-dominate the openings for a time, moving the community back to Community Phase 1.3.

State 2
State 2

This state represents the intensive land uses that have significantly altered this ecological site 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 2.1
Intensive disturbance

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 T1
State 1 to 2

This transition is caused by significant human alterations that 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

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 may not be a feasible transition due to the specific growing conditions required that may not be replicable due to the alterations to the site that had occurred.

Citations

. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

. 1998. NRCS National Forestry Manual.

. 1998. USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.. USNVC: http://usnvc.org/.

Barbour, M.G., T. Keeler-Wolf, and A.A. Schoenherr. 2007. Terrestrial vegetation of California.

Brown, P.M. and T.W. Swetnam. 1994. A cross-dated fire history from coast redwood near Redwood National Park, California. Canadian Journal of Forest Research 24:21–31.

Dawson, T.E. 1998. Fog in the California redwood forest: ecosystem inputs and use by plants. Oecologia 117:476–485.

Noss, R.F. 1999. The Redwood Forest: History, Ecology, and Conservation of the Coast Redwoods. Island Press.

Viers, S.D. 1996. Ecology of the Coast Redwood. Conference on Coast Redwood Forest Ecology and Management 9–12.