USDA Natural Resources Conservation Service

Ecological site F004BX102CA Douglas-fir-redwood/tanoak, mountain slopes, sandstone, clay loam

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General information

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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

Classification relationships

There is no relationship to other established classifications.

Similar sites

F004BX109CA	**Douglas-fir/redwood/tanoak/California huckleberry, mountain slopes, sandstone and schist, clay loam** F004BX109CA is similar in vegetation composition but less productive than F004BX102CA. There are areas in F004BX109 where the soils are heavier in clay and closer to bedrock than in F004BX102, which may account for the difference in productivity.

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii* (2) *Sequoia sempervirens*
Shrub	(1) *Lithocarpus densiflorus*
Herbaceous	Not specified

Physiographic features

This ecological site is found on the eastern edge of the redwood geographic range, in the inland mountain slopes of the lower Redwood Creek and Prairie Creek basins. It occurs on the shoulders of ridges, and uniform to slightly convex positions of the middle to lower mountain slopes. These deeply incised slopes are steep to very steep.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	101–904 m
Slope	30–50%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Summertime temperatures are warm and range from 75 to 90 degrees F. The total annual precipitation ranges from 75 to 95 inches and generally falls from October to May.

No local climate station data is available for this site. *This information provided below may not represent the conditions on the site.

Table 3. Representative climatic features

Frost-free period (average)	270 days

Freeze-free period (average)	270 days
Precipitation total (average)	2,159 mm

Influencing water features

There are no influencing water features on this site.

Soil features

These well-drained, very deep soils have developed dominantly from colluvium and residuum derived from sandstone and mudstone, with some areas derived from schist. They are very strongly to moderately acidic at 40 inches with a loamy subsurface rock content ranging from gravelly to extremely gravelly.

Soils that have been tentatively correlated to this ecological site include the following:
Soil Survey Area: CA605 - Redwood National and State Parks

Mapunit Soil

541 Wiregrass
541 Rockysaddle
539 Wiregrass

Table 4. Representative soil features

Surface texture	(1) Very gravelly silt (2) Extremely gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	2.54–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.5–6
Subsurface fragment volume <=3" (Depth not specified)	30–80%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The redwood's interior range is largely contained within the coastal fog belt. Coastal fog ameliorates the effects of solar radiation on conifer transpiration rates (Daniel, 1942). Research in the redwood region (Dawson, 1998) has indicated that fog drip and direct fog uptake by foliage may contribute significant amounts of moisture to the forest floor during summer months and over the course of the year.

Previous harvesting and the use of fire to treat logging slash have changed species composition on many formerly redwood-dominated sites (Noss et al, 2000). Within many areas of the park, aerial seeding of Douglas-fir has led to a 10:1 ratio of Douglas-fir to redwood (Noss, 2000).

The historical origins of fires within the northern redwood region remain unknown. Lightning-ignited fires are considered rare. However, Native American burning is thought to have played a major role by burning fires from the interior 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 on inland sites. The northern range of redwoods evolved within a low to moderate natural disturbance regime (Veirs, 1979).

Surface fires likely modified the tree species composition by favoring the thicker-barked redwood (*Sequoia sempervirens*) (Veirs, 1979). Western hemlock's (*Tsuga heterophylla*) shallow roots and thin bark make it susceptible to fire damage (Arno, 2002). Fires also expose the mineral-rich soil and reduce competition from other plants, thereby increasing the establishment of new western hemlock (Veirs, 1979, Williamson, 1976). Tanoak (Lithocarpus densiflorus) seedlings and sapling-sized stems are often top-killed by surface fire, though larger stems may survive with only basal wounding (Tappeiner, 1984).

Both redwood and tanoak have the ability to 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). The sprouting ability of redwood is most vigorous in younger stands and decreases with age. 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).

A moderate fire could lead towards more of a mosaic in regeneration patterns. Patches of trees would be killed leaving others slightly damaged or unharmed. Douglas-fir (*Pseudotsuga menziesii*) 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. California huckleberry (*Vaccinium ovatum*) is a common species in both moist and dry 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, California huckleberry will often re-sprout and recover rapidly. Pacific rhododendron (*Rhododendron macrophyllum*) is considered sensitive to fire. Following a surface fire, it may reestablish seedlings by sprouting from the rootcrown or stembase (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.

Other potential disturbances in the redwood zone include winter storms that can cause top breakage. 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. On alluvial sites with periodic flooding, redwood and other colonizing hardwoods would dominate (Veirs, 1996). Where existing redwoods are inundated, new roots would develop in newly deposited silt (Veirs, 1996).

State and transition model

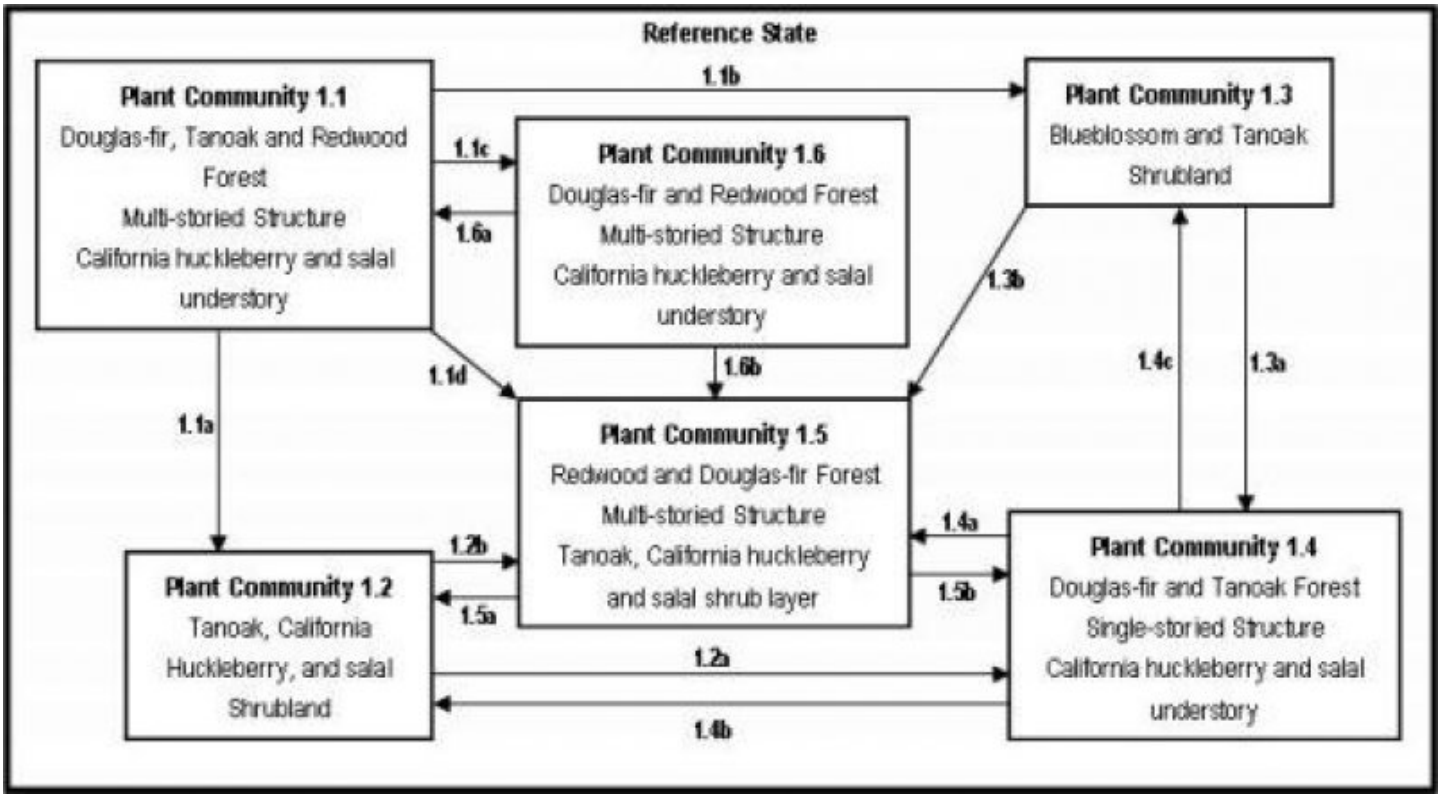

Figure 6. State and Transition Model

State 1
Reference State - PC 1.1, Douglas-fir, Tanoak and Redwood Forest

Community 1.1
Reference State - PC 1.1, Douglas-fir, Tanoak and Redwood Forest

The reference plant community has an overstory dominated by Douglas-fir (*Pseudotsuga menziesii*), with a moderate amount of tanoak (Lithocarpus densiflorus) in the sub-canopy. Redwood (*Sequoia sempervirens*) is not present on all sites, but it may be found in moderate amounts in a few areas. Occasional stands of Pacific madrone (*Arbutus menziesii*) may also be found. Partial cutting or periodic moderate fire could maintain this plant community. The estimated age for this plant community is 200 years or more. The understory is shrub-dominated, with the shrub form of tanoak providing the most cover. Salal (*Gaultheria shallon*) and California huckleberry (*Vaccinium ovatum*) are also present. The cover of grasses and forbs is either very low or not present. A minor amount of western swordfern (*Polystichum munitum*) may be found on these sites. The historic plant community is assumed to be similar to this reference state, though no mature or old growth stands were identified within the survey area. Community Pathway 1.1a: Block harvesting or a moderate to severe fire could lead to PC 1.2, a shrub community dominated by tanoak. Community Pathway 1.1b: Block harvesting, followed by post-harvest burning could lead to a profusion of blueblossom (*Ceanothus thyrsiflorus*), if a seed source is present or if seed is banked in the soil. The presence of this blueblossom seed source will transition this community to PC 1.3. Community Pathway 1.1c: Partial stand replacement, fire, or block harvesting in an area that does not have much tanoak could lead to PC 1.6, a nearly pure stand dominated by Douglas-fir, with redwood as a common associate. This community may also result in areas previously treated with herbicides. Community Pathway 1.1d: Fire exclusion will inhibit natural regeneration of Douglas-fir. Without fire created openings, redwood successfully reproduces in the understory, leading to PC 1.5.

Forest overstory. The main overstory is dominantly Douglas-fir and redwood.

Tanoak forms a sub-canopy layer beneath the primary overstory. On some sites an occasional Pacific madrone may be present.

Average Percent Canopy Cover:

Main canopy

Redwood (Sequoia sempervirens)
15-20%
Douglas-fir (Pseudotsuga menziesii) 45-85%

Sub-canopy

Tanoak (Lithocarpus densiflorus) 25-35%
Other hardwoods <5%

Forest understory. The understory is dominated by the shrub form of tanoak, which is present on most sites. Salal and California huckleberry are also present on some sites.

Average Percent Canopy Cover:

Tanoak (Lithocarpus densiflorus) 5-25%
California huckleberry (Vaccinium ovatum) 0-15%
Salal (Gaultheria shallon) 20-30%
Forbs <5%

State 2
PC 1.2- Tanoak Shrubland

Community 2.1
PC 1.2- Tanoak Shrubland

Tanoak and other evergreen shrubs sprout vigorously after cutting or fire and may rapidly dominate a site. Tanoak will dominate for years following a disturbance (Mc Murray, 1989). The rapid growth potential of tanoak may inhibit natural regeneration of Douglas-fir and slow the growth of redwood sprouts for a short period of time. Periodic fire could maintain this plant community. Community Pathway 1.2a: Without management, this community will transition to PC 1.4. Douglas-fir will gradually infill from outside seed sources; however, there may be a time delay in establishment and growth. Redwood will also sprout in the understory. Community Pathway 1.2b: This community could transition to PC 1.5 with tanoak management, either through mechanical or chemical treatment. This treatment will accelerate the establishment of redwood and Douglas-fir. Natural infill or planting of Douglas-fir and redwood could also speed the recovery of the site.

State 3
PC 1.3 - Blueblossom Shrubland

Community 3.1
PC 1.3 - Blueblossom Shrubland

If a seed source is present, block harvesting and post-harvest burning may prompt blueblossom (*Ceanothus thyrsiflorus*) to dominate the site (Adams, 1992). Fire favors germination of stored seeds by eliminating duff cover and reducing other plant competition. It is also thought that the germination of blueblossom is increased by the pulse of heat from burning (Adams et al, 1992). This shrub’s growth is rapid and it will

quickly develop into the tree form. Tanoak will also sprout following cutting or burning. Seedlings present prior to a disturbance rapidly respond to increased light conditions (Adams, 1992). Periodic fire could maintain this plant community. Community Pathway 1.3a: This community will transition to PC 1.4 if the area is left to develop without disturbance. Abundant infill of Douglas-fir from adjacent stands could occur (Burns, 1990), and redwood will sprout from existing stumps. Redwood will also infill from adjacent seed sources into the shade of established Douglas-fir. Community Pathway 1.3b: This community could transition to PC 1.5 with chemical control of blueblossom and tanoak trees and shrubs, in conjunction with tree planting or infill. A redwood-dominated plant community will establish.

State 4
PC 1.4 - Douglas-fir and Tanoak Forest

Community 4.1
PC 1.4 - Douglas-fir and Tanoak Forest

Infill of Douglas-fir and tanoak will occur over time, eventually dominating the canopy. Redwood infill will start to occur below in the shade of established Douglas-fir. Redwood developed from sprouts may also be part of the canopy layer. Evergreen shrubs, such as California huckleberry and salal may be part of the understory. The estimated age for this site ranges from 10 to more than 80 years. Community Pathway 1.4a: This community will transition to PC 1.5 if tanoak is chemically controlled and Douglas-fir is partially cut, leading to a redwood dominated site. Community Pathway 1.4b: A moderate fire or block harvest could transition this community back to PC 1.2, the tanoak shrub community. Community Pathway 1.4c: If there is a blueblossom seed source present, a moderate fire with partial stand replacement could transition this community back to PC 1.3, the blueblossom and tanoak shrub community.

State 5
PC 1.5 - Redwood and Douglas-fir Forest

Community 5.1
PC 1.5 - Redwood and Douglas-fir Forest

Natural regeneration of Douglas-fir declines without openings created by fire or harvest. Redwood infill occurs over time, gradually resulting in a plant community slightly more dominated by redwood than Douglas-fir. The estimated age for this plant community ranges from 20 to 200 years. Community Pathway 1.5a: Block harvesting could transition this community back to PC 1.2 for a short period of time. Community Pathway 1.5b: Block harvesting could allow tanoak to fill into created openings, transitioning this community to PC 1.4.

State 6

PC 1.6 - Douglas-fir and Redwood Forest

Community 6.1
PC 1.6 - Douglas-fir and Redwood Forest

If tanoak was not an integral part of the original stand composition, heavy chemical treatment following a harvest or moderate fire could result in a nearly pure stand of Douglas-fir and redwood. The estimated age for this community ranges from 10 to more than 100 years. Community Pathway 1.6a: If an adjacent seed source is present, tanoak will gradually infill into the stand, transitioning this community back to PC 1.1. Community Pathway 1.6b: Fire exclusion may result in a lack of open areas in which Douglas-fir is able to regenerate. Redwood seedlings would continue to infill, resulting in a slightly higher proportion of redwood to Douglas-fir in the overstory, and moving this community to PC 1.5.

Additional community tables

Animal community

The Redwood forest provides habitat for many species of mammals and native birds. Predators include black bear, fisher and marten, mountain lion, fox and bobcat. Ungulates included deer and elk.

Many bird species use the redwood forest on a seasonal basis. Bird species include warblers, tanagers, sparrows, blackbirds, the Marbeled Murrelet, the Northern spotted owl and the Bald Eagle.

Common reptiles found in forested areas would include the alligator lizard and garter snake.

Amphibians are mostly associated with riparian and wetland areas. The northwest salamander and two newt species spend much of their lives in upland habitat.

Hydrological functions

These soils have a moderate infiltration rate when thoroughly wet. They are very deep and well-drained.

Hydrologic Groups

541 Wiregrass--C
541 Rockysaddle--C
539 Wiregrass--C

Refer to the Soil Survey Manual for further information.

Recreational uses

Steep slopes may limit recreational use and development on some sites.

Wood products

Redwood is a highly valued lumber because of its resistance to decay. Uses of redwood include: house siding, paneling, trim and cabinetry, decks, hot tubs, fences, garden structures, and retaining walls. Other uses include fascia, molding and industrial storage and processing tanks.

Douglas-fir is employed in residential structures and light commercial timber-frame construction. It is also used for solid timber heavy-duty construction such as pilings, wharfs, bridge components and warehouse construction.

Other products

Redwood burls are used for tabletops, veneers, bowls and other turned products. Redwood bark is widely used as garden mulch.

Douglas-fir is a very desirable Christmas tree; branches and cones are also used as materials for Christmas wreaths.

California huckleberries are made into wine, as well as processed into pie fillings for home and commercial use. Foliage of the California huckleberry is used by florists in floral arrangements and to make Christmas decorations.

Table 5. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
redwood	*SESE3*	165	185	254	319	–	–	–	
Douglas-fir	*PSME*	150	175	158	186	–	–	–	

Inventory data references

No plots were established in mature or old growth timber as most areas where this site is located have been cutover.

8 Wood-5 plots were established:

Rockysaddle - Vegetation Plot #6026,6028,6043,6050.

Wiregrass - Vegetation Plot
#6025,6027,6044

Other references

Burns, Russell M.; Honkala, and Barbara H., technical coordinators. Silvics of North America. Volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture, Forest Service: 541-551.

Finney, M. A.; Martin, R. E. 1991. Prescribed underburning and some initital effects in young-growth coast redwood forests of California. In: Andrews, Patricia L.; Potts, Donald F., eds. Proceedings, 11th annual conference on fire and forest meteorology; 1991 April 16-19; Missoula, MT. SAF Publication 91-04. Bethesda, MD: Society of American Foresters: 328-334.

McMurray, Nancy E. 1989. Lithocarpus densiflorus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available:http://www.fs.fed.us/database/feis/ [2006, May 31].

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: http://www.fs.fed.us/database/feis/ [2006, May 31].

Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	

Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

   _____

5. **Number of gullies and erosion associated with gullies:**

   _____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

   _____

7. **Amount of litter movement (describe size and distance expected to travel):**

   _____

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

   _____

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

   _____

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**