

OREGON WHITE OAK WOODLANDS OF REDWOOD NATIONAL PARK: DESCRIPTION AND MANAGEMENT CONSIDERATIONS

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ABSTRACT

Preliminary studies of *Quercus garryana* stands were conducted in the Bald Hills area of Redwood National Park. Three general stand types were found: 1) oak savanna-open stands dominated by few large, widely scattered individuals; 2) closed canopy with numerous, medium size clustered individuals; 3) closed canopy with dense, small single stem individuals. The understories of the savanna and clustered closed canopy stands are characterized by high herbaceous cover dominated by grasses. A few tall shrubs are scattered throughout. Low shrubs dominate the understory of the dense, single stem stands. Herbaceous cover, especially that of grasses, is low. Douglas-fir is present in low amounts throughout the woodlands. Localized concentrations may be caused by recent human activities including logging, livestock grazing and fire suppression. Primary considerations in oak stand management include the potential dominance of Douglas-fir and the role of fire, natural and prescribed.

INTRODUCTION

Oregon white oak *Q. garryana* grows in the Coast Ranges and Cascades from British Columbia south to the Santa Cruz mountains (Fowells 1965). Along the north coast of California in Humboldt and Mendocino Counties, stands are formed which have been referred to as Bald Hills oak woodlands. These are characterized by the dominance of either Oregon white oak or grass in savannas rather than the balance found in other northern oak woodlands (Griffin 1977). Detailed description of Oregon white oak stands in the Willamette Valley of Oregon has been published (Thilenius 1968) but little information on Bald Hills woodlands is available.

STUDY AREA

In Redwood National Park, oak stands border the Bald Hills prairies extending up channels and becoming continuous woodlands near Schoolhouse Peak. Well-developed stands occur at elevations from 250 ft on the east bank of Redwood Creek to nearly 3,000 ft on Schoolhouse Peak. The largest and most extensive stands are near the southeast park boundary. Narrow border strips of oak range as close as 7 mi from the Pacific Ocean. Scattered oaks are found closer to the coast but these are largely restricted to conifer stands on prairie boundaries where Oregon white oak is in the understory of the *Pseudotsuga menziesii* stands that have become established in the past 100 yrs. Localized concentrations of Douglas-fir may be caused by recent human activities such as logging, grazing and fire suppression.

For approximately 2,000 yrs the Chilula Indians utilized the Bald Hills oak woodlands in what is now Redwood National Park. They utilized oaks for acorns and evidence exists that they periodically burned both the oaks and adjacent grasslands (King and Bickel 1980).

With arrival of white settlers in the 1850s came sheep and cattle grazing. Periodic burning was discontinued and wildfires were suppressed. When Redwood National Park was expanded in 1978, it included portions of the Bald Hills prairies and about 600 ac of oak woodland. In 1981, studies were initiated in the Bald Hills oak woodlands to determine management needs and how they might best be met. Vegetation description, stand dynamics and the effects of fire and fire suppression on vegetation are presently being investigated. This paper covers the work completed to date.

METHODS

1) Prior to sampling, field reconnaissance was completed to determine the locations, acreage and general structure of the oak woodlands in Redwood National Park. Representative stands were located for tree, shrub and herbaceous sampling.

Fifty-six 0.1 ha (20 m x 50 m) plots were located in a variety of stand types and elevations. Diameter at breast height (1.5 m) for each tree in the plot, total canopy, shrub and herbaceous cover, elevation, slope and aspect were recorded. Herbaceous vegetation was sampled in both spring and summer to obtain complete species lists. All species present and their cover values were noted for each plot. Data reported here reflects presence/absence analysis only.

2) To determine tree age, growth rate and reproductive mechanisms of *Q. garryana*, trees were cut and cross sections obtained from ground level and breast height (1.5 m). Sections were sanded and rings counted, noting any fire scars present. Cross sections were also obtained from stumps of known history.

3) The role of fire in Bald Hills oak woodlands is poorly known. In 1981, a 3-ac section of woodlands was burned using a combination of head and backing fire (Davenport 1981). Rate of spread averaged 2 to 3 ft/min. Generally, flame lengths averaged 2 to 3 ft and flame height averaged one ft, reaching a maximum of 3 to 4 ft. Relative humidity at the time of burning averaged 55%, dry bulb temperature averaged 66% and wind was from the south at 0 to 2 mph. Douglas-fir and Oregon white oak trees were monitored to observe the effects of scorch and fire. Twenty of each species were photographed, tagged and described immediately following the fire and ten months after. Trees and shrubs were observed for sprouting and top dieback during the following summer. Douglas-fir has been establishing itself in the burn site since before establishment of the park.

RESULTS

1) Three types of oak stands were determined on the basis of cover, size and number of trees and shrubs present (Table 1).

Table 1

Average Values for Three Stand Types

	Canopy Cover	Shrub Cover	Herb Cover	Stems/Ha	DBH Range
Young, Dense	90%	45.5%	58%	4,500 - 12,000	Less than 12 cm
Clustered	86%	1.5%	80%	740 - 2,550	10 cm - 30 cm
Savanna	76%	1.1%	85%	60 - 530	Seedling to more than 1 m

Extremely dense stands with 4,500 to almost 12,000 stems occur in a narrow band extending up the slope through stands of larger trees in two directions from the base of an extensive woodland reaching the ridgetop park boundary on one side. Trees are less than 12 cm in diameter and 5 m to 10 m tall. Canopy cover ranges from 80% to 100% with shrub cover being 30% to 70%. High cover values for *Symphoricarpos albus* and *Satureja Douglasii* and the presence of *Trillium chloropetalum*,

Cynoglossum grande, *Ligusticum apiifolium*, *Festuca californica*, *Holodiscus discolor*, *Amelanchier pallida*, and *Cerastium arvense* characterize this type (Table 2).

Table 2

Occurrence Frequency of Selected Species in Stand Types

Species	Frequency Young, Dense (%)	Frequency Savanna/Clustered (%)
<i>Amelanchier pallida</i>	60	11
<i>Aster radulinus</i>	60	11
<i>Brodiaea Ida-Maia</i>	100	52
<i>Cerastium arvense</i>	80	9
<i>Cynoglossum grande</i>	90	28
<i>Festuca californica</i>	80	15
<i>Holodiscus discolor</i>	60	17
<i>Ligusticum apiifolium</i>	90	33
<i>Rubus vitifolius</i>	100	48
<i>Satureja Douglasii</i>	100	37
<i>Symphoricarpos albus</i>	100	17
<i>Trillium chloropetalum</i>	90	11
<i>Avena barbata</i>	0	41
<i>Brodiaea laxa</i>	10	63
<i>Bromus diandrus</i>	0	43
<i>Bromus mollis</i>	0	41
<i>Carex tumulicola</i>	0	63
<i>Galium nuttallii</i>	10	54
<i>Hypochoeris radicata</i>	10	80
<i>Lolium perenne</i>	10	52
<i>Plantago lanceolata</i>	20	83
<i>Pteridium aquilinum</i>	0	39
<i>Rumex Acetosella</i>	30	74
<i>Stellaria media</i>	10	63
<i>Taraxacum officinale</i>	20	78

Closed canopy stands composed of numerous, uniformly-sized, multiple-stemmed and clustered individuals make up most of the oak woodlands within the park boundaries. Diameters range from 10 cm to 30 cm width, 740 to 2,550 stems/ha. Canopy cover ranges between 80% - 95% and shrub cover is from 1% - 5%.

Open savannas are composed of a wide size range, dominated by relatively few large trees. This is the only stand type not composed of very distinct size classes. Individuals are mostly single stemmed and range from seedlings to more than one m DBH. Savannas occur adjacent to open grasslands forming distinctly oak-dominated clusters in mosaic with grass-dominated areas. Within these clusters, canopy cover ranges 60% to 95% with 60 to 530 stems/ha. Shrub cover is very low (0% - 2%) except on exposed rock outcrops where it reaches 30%.

Herbaceous cover in both the clustered closed canopy and savanna stands averages between 75% - 95%. The data has not yet been fully analyzed but both are characterized by the presence of high grass cover in the herb layer and few predominantly tall shrubs. *Bromus mollis*, *Lolium perenne*, *Plantago*

lanceolata, *Brodiaea laxa*, *Galium nuttallii*, *Carex tumulicola*, *Stellaria media*, *Rumex acetosella*, *Taraxacum officinale* and *Hypochoeris radicata* characterize this group.

2) In two stands, trees of two different size classes were cut, a smaller size with no moss or lichen on trunks and a larger with moss and lichens.

The larger size class was composed of individuals which were all 35 yrs and older, while mossless and lichenless trees were 33 yrs and younger. The occurrence of fires 32 and 34 yrs ago (determined by fire scars) appears to have stimulated massive reproduction for about 10 yrs. Although the stands had 11,450 and 7,910 stems/ha, no individuals were found younger than 23 yrs (excluding seedlings less than 6 in tall). Those trees surviving the fires (greater than 34 yrs old) were clearly dominant, being much taller and more robust (Table 3).

Table 3

Data from Cross-Sections of Oregon White Oak

Age (Base)	Age (1.5 m)	Years to 1.5 m	DBH	Fire Scars
Stand 1				
25	15	10	3.0	
27	20	7	4.0	
28	24	4	4.5	
30	26	4	5.0	
31	26	5	8.0	
32	29	3	6.5	
33	26	7	6.0	
50	41	9	7.5	
52	44	8	12.5	32, 34
60	50	10	10.0	32, 34
Stand 2				
23	15	8	2.0	
27	25	2	2.2	
30	26	4	4.1	
32	28	4	7.6	
32	30	2	10.4	
36	30	6	7.6	
42	40	2	9.1	32
43	40	3	12.7	32
44	41	3	14.2	

3) Ten months following the prescribed fire, 13 of 14 Douglas-fir trees with 70% or greater scorch were dead. Seven of eight with less than 70% scorch were living. All *Q. garryana* less than 20 ft tall were top killed but sprouted back vigorously from the base. Oaks taller than 20 ft all lived with little apparent damage and little sprouting. All shrub species present died back and re-sprouted vigorously (Table 4). Herbaceous growth was extremely dense following the burn with high cover for lupines and many perennials with rootstocks and bulbs. Annual plants had low relative cover.

Table 4

Tree and Shrub Response to Fire

Species	Sprouting	Main Stem Condition (10 Mo.)
<i>Pseudotsuga menziesii</i> , less than 70% scorch	0	Live (87.5%)
<i>Pseudotsuga menziesii</i> , more than 70% scorch	0	Dead (92.2%)
<i>Quercus garryana</i> , more than 20 ft tall	0/+ (33%)	Live
<i>Quercus garryana</i> , less than 20 ft tall	+	Dead
<i>Holodiscus discolor</i>	+	Dead
<i>Corylus cornuta</i>	+	Dead
<i>Lonicera hispidula</i>	+	Dead
<i>Ribes roezlii</i>	+	Dead
<i>Rosa</i> spp.	+	Dead
<i>Rubus vitifolius</i>	+	Dead
<i>Symphoricarpos albus</i>	+	Dead
<i>Rhus diversilobum</i>	+	Dead

DISCUSSION AND CONCLUSIONS

Preliminary analysis of the data shows three distinct stand types present. Uniformly-sized, densely grouped small stems appear to be of a uniform age class. The information obtained from cross sections suggest that these stands originated from massive reproduction during the 10 yrs following intense fire. Understory plants are quite distinct with high cover of low shrubs, especially *S. albus*, and dominance of plants adaptive to moist, shady conditions.

Savannas exist on the margins of and intermix with grasslands. These stands do not form the grass-oak balance of interior oak savannas, but form up to 95% canopy covers within stands in mosaics with grasslands. Stands are dominated by few large individuals and include all size classes. Individuals are distinct to the base and very rarely clustered into close groups.

Closed canopy, uniform-sized stands make up most of the oak woodlands in Redwood National Park. Size of the individuals varies between stands but is very consistent within stands. Trees are clustered but not usually physically attached above the ground. Further investigation should reveal if these stands represent more mature stages of the dense, small stemmed type.

Understory vegetation of the savannas and closed canopy uniform-sized stands were not separated at the time of this paper. However, together they were distinguished from dense stands by the presence of few tall shrubs and the high occurrence of grasses in the herb layer. With further analysis, it is expected that savannas will be characterized by the dominance of grassland species and uniform-sized stands will be dominated by predominantly woodland species.

Douglas-fir is present in about 75% of all plots. Number of stems and size varies but sufficient numbers are established to present a significant threat to the future dominance of the oaks. The discontinuation of grazing on park lands earlier this year may reduce establishment and growth of

Douglas-fir in the oak woodlands by allowing competing vegetation to more effectively deplete soil moisture (Hedrick and Keniston 1966, Hall et al. 1959). However, to insure continued dominance of *Q. garryana* in the next few decades, utilization of some control measure for the existing Douglas-firs should be considered.

In the presence of frequent fire, it seems unlikely that the savannas develop directly from the young dense stands due to difference in stand composition and shrub occurrence. Vigorous sprouting of shrubs and trees following prescribed burning in young stands explains the dense low shrub cover. Reduction of both canopy stems/ha and shrub cover will likely result from absence of intense fire over long periods of time. Re-introduction of low fire in taller canopy stands could eventually result in savanna development. Continuous establishment of Douglas-fir in the understory of oaks appears to be controlled by fire until individuals either became too large to be killed or too dense to allow spread of ground fire. It appears that fire and fire suppression have had major roles in oak woodland development. Further study will enable more complete description of vegetation patterns present, their dynamics and development of management plans.

MANAGEMENT RECOMMENDATIONS

At this time, it is too early to recommend an overall oak woodland management plan. Upon completion, the following in-progress studies will enable effective management policy to be recommended.

- 1) Analysis of data collected and re-sampling to improve description of vegetation present is essential.
- 2) Investigation of historical fire frequency and the effects of fire on the three stand types and associated understory vegetation.
- 3) Investigation of stand and Bald Hills history both from historical records and field evidence.
- 4) Investigation of the history and dynamics of Douglas-fir in oak woodlands and prairie margins.
- 5) Investigation of soil influence on stand distribution and dynamics.