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An Isolated Occurrence of Alaska-Cedar (*Chamaecyparis nootkatensis* (D. Don) Spach) in the Aldrich Mountains, Central Oregon

Abstract

A 4.3 ha stand of *Chamaecyparis nootkatensis* (D. Don) Spach in the Aldrich Mountains, central Oregon is isolated by 220 km from its main, but scattered distribution in the Cascades. The *C. nootkatensis* stand is a small inclusion in the more widespread *Abies grandis*/*Vaccinium membranaceum* association, and present tree size class distribution suggests *Chamaecyparis*, *Abies*, and *Pseudotsuga* are reproducing in quantities roughly proportional to their present importance. This near-climax vegetation inclusion has withstood a number of fires and probably is a relict of a Late-Glacial forest which was adapted to cooler and moister conditions than now prevail in central Oregon.

Introduction

A small grove of Alaska-cedar, *Chamaecyparis nootkatensis* (D. Don) Spach, has been known to exist in the Aldrich Mountains of central Oregon for over 40 years (Anon., 1929; Hitchcock *et al.*, 1969; Harris, 1971), yet its precise extent, location, stand structure, and associated vegetation have never been recorded. The purpose of this report is to establish an ecological record for this eastern outlier of a tree species which normally is found approximately 220 km to the west at scattered locations in the Cascades and also along the north Pacific coast.

Of six species in the small genus *Chamaecyparis*, two, *C. lawsoniana* Parl. and *C. nootkatensis*, are narrowly confined to the north Pacific coast. The former is restricted to northwestern California and southwestern Oregon, while the latter, *C. nootkatensis*, ranges from strung-out occurrences in the Siskiyou Mountains in northwestern California to Wells Bay on Prince William Sound, Alaska (Fig. 1). The tree attains its finest development in north coastal British Columbia and southwestern Alaska (Anderson, 1959; Little, 1971). Although in Alaska *C. nootkatensis* grows from tidewater to timberline, south of Juneau its sea level distribution diminishes and it is more commonly found at higher elevations. Besides the discontinuous distribution toward the southernmost limit in Oregon, there are two striking interior disjunctions, one 700 km inland on the shores of Hird and Evans lakes at approximately 1700 m elevation in southeastern British Columbia and the other discussed here, at the head of Buck Cabin Creek, Malheur National Forest at approximately 1750 m elevation.

The Site

Situated on the northeast slope of Aldrich Mountain at the head of Buck Cabin Creek about 60 m below the northwest trending ridgeline (SE $\frac{1}{4}$, S 22, T. 14 S., R. 28 E., W. M.), the *C. nootkatensis* grove occupies an area of approximately 4.3 ha and extends downstream from a series of springs forming the source of the permanently flowing creek (Fig. 2). Scattered trees are found along the creek below the main stand. The

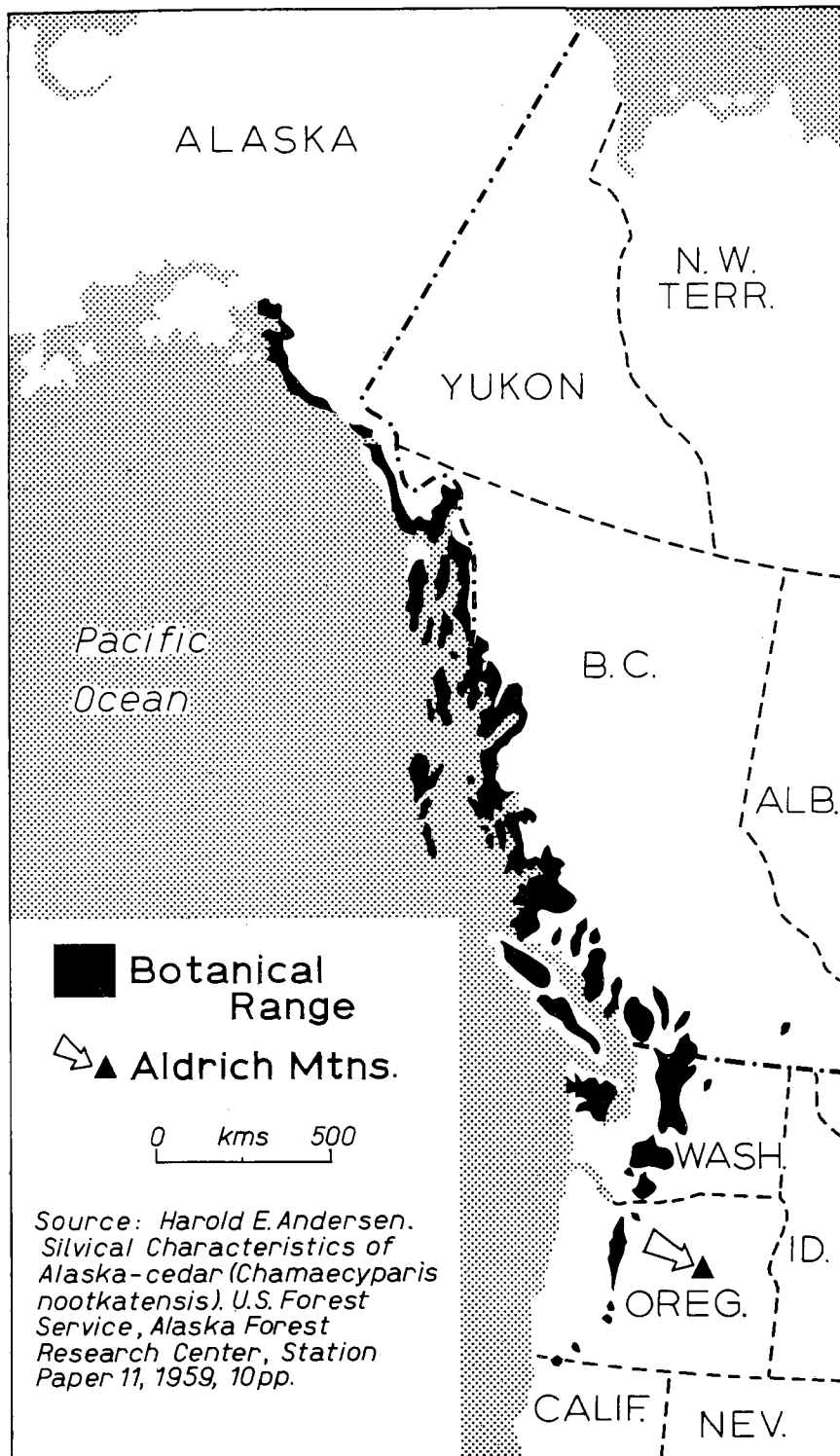


Figure 1. Distribution of *Chamaecyparis nootkatensis* (D. Don) Spach.

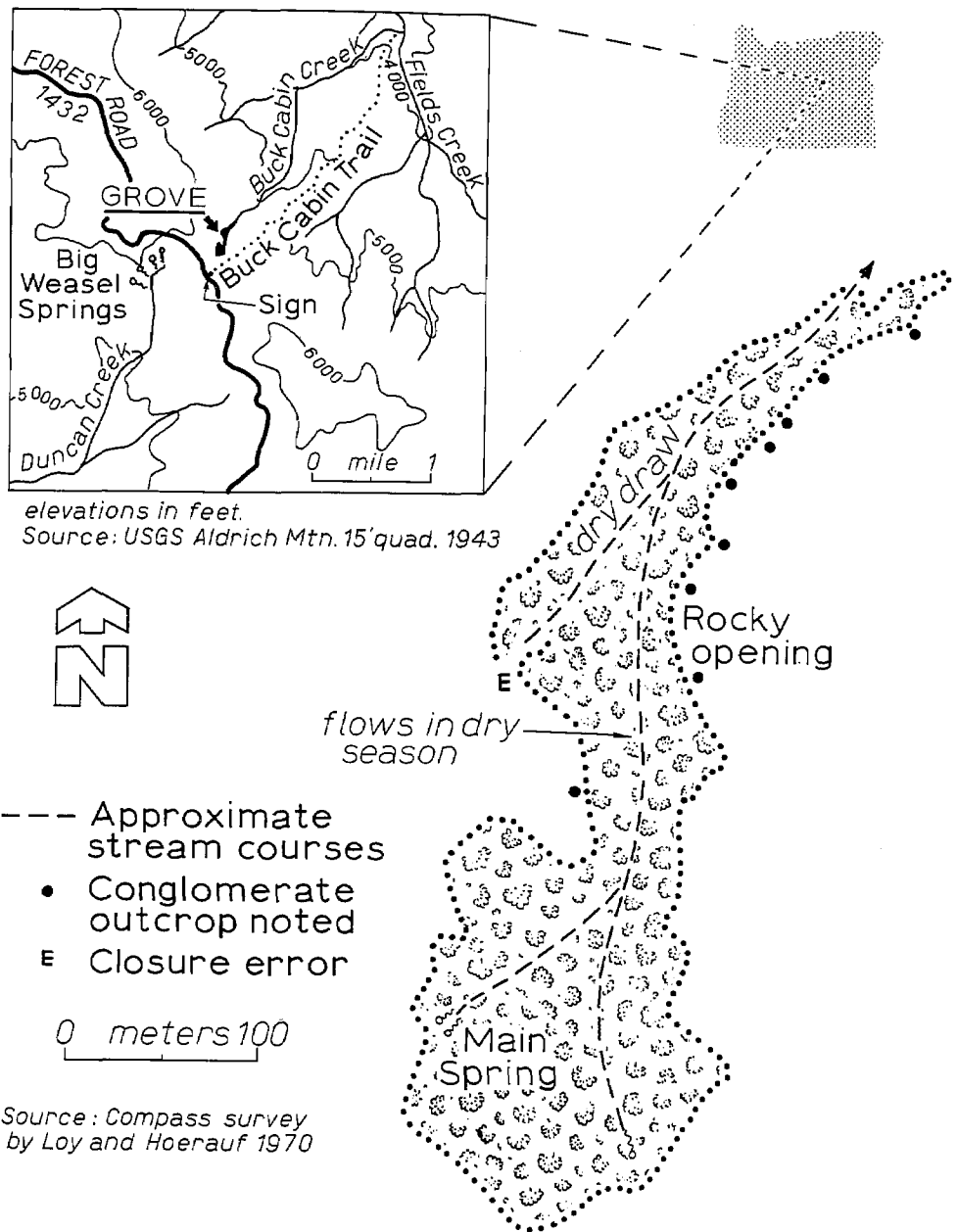


Figure 2. Location of Aldrich Mountain *Chamaecyparis nootkatensis* stand.

grove at its widest is about 150 m across and is generally confined to the steep narrow canyon where slopes approach 30°.

Soils, derived from volcanic conglomerate representing the Clarno Formation which frequently outcrops in the area (Thayer and Brown, 1966), are coarse loams with a variable but strongly differentiated A horizon and a weakly developed B horizon. Except for the lower canyon slopes, soils in the surrounding area are shallow, rocky

and generally of low fertility (USFS, 1966). Hankins series soils are associated nearby with *Abies grandis* forests at elevations between 1280 and 1500 m. Despite the regional prevalence of shallow soils, the *Chamaecyparis* trees are established on moist sites with fairly deep soils.

The *C. nootkatensis* stand may be regarded as a small inclusion in the surrounding widespread *Abies grandis*/*Bromus vulgaris* association recognized by Hall (1967) in his study of vegetation-soil relationships in the eastern Ochoco Mountains, an area the eastern boundary of which lies approximately 20 km to the west of the Aldrich Mountain site. This association is regarded as related to the *Abies grandis*/*Vaccinium membranaceum* association within the extensive midslope *Abies grandis* Zone of Franklin and Dyrness (1973) and is analogous to forests within Küchler's (1964) Grand Fir-Douglas-Fir type.

Methods

The extent of the stand was mapped in the field by reconnaissance methods. Five, 5 x 5 m quadrats were established to record the ground flora. A complete floristic list of vascular plants was also prepared covering the entire stand. Phytosociological data was recorded using the Braun-Blanquet cover-abundance index (see footnote to Table 1). In order to describe stand structure, four transects spaced about 100 m apart and each 100 m in length were extended across the stand with sampling points at 10 m intervals. At each point, distance to the nearest tree (DBH > 10 cm), distance to the nearest sapling (DBH < 10 cm), diameter of tree and sapling and respective species were recorded. Forest structure was analyzed using Cottam's (1947) "closest individual" method which yielded tree and sapling density, basal area, relative density, and relative dominance (Cottam and Curtis, 1956).

Because there was evidence of prior fire history, thirteen trees, mostly mature *C. nootkatensis*, were cored with an increment borer to gain further information regarding stand history.

Description and Discussion

With the exception of the dominant tree species, *C. nootkatensis*, the flora of the stand was not widely different from that reported for other stands within the *Abies grandis* Zone (Hall, 1967; Daubenmire and Daubenmire, 1968; Franklin and Dyrness, 1973). Table 1 gives the floristic composition based on a subjective judgement of species occurrence throughout the stand. Species cover-abundance index is italicized in cases where recordings were made within the five, 5 x 5 m quadrats. Two lists are shown in order to distinguish the extensive, drier portions of the grove from the narrow, riparian band.

TABLE 1. Cover-abundance estimates for vascular plants in the Aldrich Mountain *Chamaecyparis* stand^a

Species	Cover Index ^b
Dry Sites	
Trees	
<i>Abies grandis</i> (Dougl.) Lindl.	3(4)
<i>Chamaecyparis nootkatensis</i> (D. Don) Spach	3(2)
<i>Larix occidentalis</i> Nutt.	+
<i>Pinus ponderosa</i> Dougl.	+
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	1

TABLE 1. (continued)

Species	Cover Index ^b
Shrubs	
<i>Pachistima myrsinites</i> (Pursh) Raf.	1
<i>Ribes hudsonianum</i> var. <i>petiolare</i> (Dougl.) Jancz.	+
<i>Ribes lacustre</i> (Pers.) Poir.	1
<i>Rosa gymnocarpa</i> Nutt.	+
<i>Vaccinium membranaceum</i> Dougl. ex Hook.	2(4)
<i>Vaccinium scoparium</i> Leiberg	r
Herbs	
<i>Achillea millefolium</i> ssp. <i>lanulosa</i> Piper	r
<i>Actaea rubra</i> (Ait.) Willd.	+
<i>Adenocaulon bicolor</i> Hook.	1
<i>Antennaria racemosa</i> Hook.	r
<i>Aquilegia formosa</i> Fisch.	r
<i>Arenaria macrophylla</i> Hook.	1
<i>Arnica cordifolia</i> Hook.	2(3)
<i>Berberis repens</i> Lindl.	r
<i>Bromus vulgaris</i> (Hook.) Shear.	+
<i>Carex geyeri</i> Booth	1(2)
<i>Chimaphila umbellata</i> var. <i>occidentalis</i> (Rydbg.) Blake	1(2)
<i>Circaea alpina</i> L.	r
<i>Clintonia uniflora</i> (Schult.) Kunth	1
<i>Festuca occidentalis</i> Hook.	+
<i>Fragaria vesca</i> var. <i>bracteata</i> (Heller) Davis	+
<i>Galium triflorum</i> Michx.	+
Gramineae sp.	r
<i>Goodyera oblongifolia</i> Raff.	+
<i>Habenaria unalaskensis</i> (Spreng.) Wats.	+
<i>Hieracium albiflorum</i> Hook.	+
<i>Hieracium scouleri</i> Hook.	r
<i>Linnæa borealis</i> var. <i>longiflora</i> Torr.	1(2)
<i>Lupinus polyphyllus</i> var. <i>burkei</i> (Wats.) C. L. Hitchc.	1(2)
<i>Melica subulata</i> (Griseb.) Scribn.	+
<i>Mitella stauropetala</i> Piper	1
<i>Osmorbiza purpurea</i> (Coul. & Rose) Suksd.	+
<i>Pedicularis bracteosa</i> Benth.	+
<i>Pedicularis racemosa</i> var. <i>alba</i> (Pennell) Cronq.	r
<i>Pyrola secunda</i> var. <i>secunda</i> L.	1
<i>Sedum lanceolatum</i> var. <i>lanceolatum</i> Torr.	+
<i>Smilacina racemosa</i> (L.) Desf.	+
<i>Smilacina stellata</i> (L.) Desf.	+
<i>Thalictrum occidentale</i> Gray	r
<i>Valeriana occidentalis</i> Heller	r
<i>Viola</i> sp.	+
<i>Woodsia oregana</i> D.C.	r
Wet and Riparian Sites	
Trees	
<i>Abies grandis</i> (Dougl.) Lindl.	1
<i>Chamaecyparis nootkatensis</i> (D. Don) Spach	2
Shrubs	
<i>Ribes lacustre</i> (Pers.) Poir.	1(3)
Herbs	
<i>Agrostis</i> sp.	+
<i>Athyrium filix-femina</i> (L.) Roth	1(2)
<i>Cardamine cordifolia</i> var. <i>lyallii</i> (Wats.) Nels. & Macbr.	+
<i>Carex</i> sp.	1
<i>Epilobium angustifolium</i> L.	r
<i>Epilobium glandulosum</i> var. <i>macounii</i> (Trel.) C. L. Hitchc.	+
<i>Epilobium watsonii</i> var. <i>occidentale</i> (Trel.) C. L. Hitchc.	1(2)
<i>Equisetum sylvaticum</i> L.	+
<i>Listera convallarioides</i> (Sw.) Nutt.	1(2)
<i>Mimulus moschatus</i> Dougl.	1(2)

TABLE 1. (continued)

Species	Cover Index ^b
<i>Mimulus guttatus</i> D.C.	+
<i>Ranunculus uncinatus</i> var. <i>uncinatus</i> D. Don	+
<i>Saxifraga arguta</i> D. Don	1(3)
<i>Stellaria crispa</i> Cham. & Schlect.	r
<i>Streptopus amplexifolius</i> var. <i>chalaratus</i> Fassett	1(2)
<i>Veronica americana</i> Schwein ex Benth.	1(2)

^a Nomenclature follows C. L. Hitchcock *et al.* (1955-1969). Species determinations were made by the author and in consultation with staff at the Oregon State University Herbarium. Voucher specimens are on file in author's herbarium.

^b Cover-abundance indices follow Braun-Blanquet (1964); where, r and + = negligible cover, 1 = 1-5% cover, 2 = 6-25% cover, 3 = 26-50% cover, 4 = 51-75% cover, and 5 = 76-100% cover. Numerals in parentheses indicate occasional divergence in sampling from the normal cover class. Italicized cover indices or +p indicate occurrence in 5 x 5 mm samples.

Tree canopy coverage exceeded 75 percent in almost all areas within the stand and consisted of *C. nootkatensis* and *Abies grandis* as dominants with an intermixture of *Pseudotsuga menziesii* and an occasional individual of *Pinus ponderosa* and *Larix occidentalis*. The *Pinus* occurred chiefly at the eastern margin of the stand on rocky slopes with a more southerly exposure. The *Chamaecyparis* was most dense in the wettest areas, especially near the springs and along the western margin of the creek. A patchy shrub understory was present and consisted chiefly of *Vaccinium membranaceum* with an occasional area where *Pachistima myrsinites* dominated, but overall shrub cover was less than 20 percent. Along the creek *Ribes lacustre* was the most prominent shrub. Like the shrub layer, ground layer vegetation was patchy, being dominated by *Arnica cordifolia* and *Lupinus polyphyllus* var. *burkei*, the latter two species achieving greater cover in areas of less dense shadow. Shaded areas were mostly free of herbaceous vegetation. A general estimate of overall ground layer vegetation cover was less than 10 percent; however, a thick carpet of litter and numerous fallen trees occupied the stand floor.

Forest structure was analyzed by Cottam's (1947) "closest individual" method and is summarized in Table 2. Species density of *Abies grandis* slightly exceeds that of *Chamaecyparis nootkatensis* for both trees and saplings and basal-area data further suggest the slight dominance of *Abies* over *Chamaecyparis* in both diameter classes. *Pseudotsuga menziesii* was much less important in the stand but appeared to be maintaining itself in the sapling class even though it is regarded as a shade intolerant species. Search of the forest floor indicated that both *C. nootkatensis* and *A. grandis* were reproducing by seed; the former seedlings being most numerous in moist, shady microhabitats, the latter seedlings occupying drier, shady sites.

The largest *Chamaecyparis nootkatensis* tree measured was 1.60 m DBH, however several other *Chamaecyparis* trees were of comparable size; only a few *Abies grandis* approached this diameter. The distribution of tree diameters in the sample suggests a mixed age structure of the two dominants. Presence of charred stumps, buried pieces of charcoal, and fire scars on living trees gave evidence of past fires. Of the thirteen cored trees, nine *Chamaecyparis* exceeded 150 years, some of these were older than 300 years. A marked fire scar occurred between 130 and 135 rings. Three large individuals of *Abies*, 0.5 to 0.75 m DBH, dated from 130 years and there were relatively few *Abies* of greater than 0.75 m DBH. Fire scar and age data suggest that the large *Chamaecyparis* trees pre-dated the most recent severe fire of about 130 years ago and that most of the *Abies*, *Larix*, *Pinus*, and *Pseudotsuga* postdate this fire. Further-

TABLE 2. Density, basal-area, relative density, and relative dominance for trees and saplings in the Aldrich Mountain *Chamaecyparis* stand.

	Trees (>10 cm DBH)	Saplings (<10 cm DBH)
Density (trees/ha)		
Total	461	483
<i>Abies grandis</i>	231	215
<i>Chamaecyparis nootkatensis</i>	183	182
<i>Pseudotsuga menziesii</i>	48	86
<i>Larix occidentalis</i>	10	0
Basal-Area (m ² /ha)		
Total	95.0	1.5
<i>Abies grandis</i>	57.1	0.7
<i>Chamaecyparis nootkatensis</i>	33.7	0.6
<i>Pseudotsuga menziesii</i>	6.4	0.3
<i>Larix occidentalis</i>	0.6	0
Relative Density (%)		
<i>Abies grandis</i>	46.0	44.7
<i>Chamaecyparis nootkatensis</i>	42.0	38.3
<i>Pseudotsuga menziesii</i>	10.0	17.0
<i>Larix occidentalis</i>	2.0	0
Relative Dominance (%)		
<i>Abies grandis</i>	55.3	46.3
<i>Chamaecyparis nootkatensis</i>	37.7	34.9
<i>Pseudotsuga menziesii</i>	6.4	18.8
<i>Larix occidentalis</i>	0.6	0

more, the largest *Chamaecyparis* trees exhibited multiple fire scarring at ages greater than 130 years but it was difficult to identify synchrony in the scar age.

My conclusion from this brief structural analysis of the Aldrich Mountain *Chamaecyparis nootkatensis* stand is that the stand has survived a number of past fires and that healthy reproduction is occurring which approximates present mature forest structure and composition. Thus, barring severe disturbance, one would predict that over the next several hundred years the tree stand in the area would not appear substantially different from what is there at the present time. This, of course, constitutes an inference that this is climax or near-climax vegetation, or considering the special location of the stand, a topo-edaphic climax. However, two species which appear as minor constituents but which should not be part of the climax association are *Pinus ponderosa* and *Larix occidentalis*. These grow at the drier outer margins of the stand.

The marked disjunction of *Chamaecyparis nootkatensis* in central Oregon invites explanation. Disjunct distributions develop either by an organism traversing the area of non-occurrence, often an ecological barrier, to form a new outlier or by fragmentation from a former more continuous distribution related to the area of non-occurrence. The former possibility involving long distance dispersal is unlikely with *Chamaecyparis* as the species has a relatively heavy, non-succulent diaspore obviating avian or some other form of long distance dispersal.

The second case of distributional contiguity followed by subsequent fragmentation is more probable. *Chamaecyparis nootkatensis* is generally confined to a cool, humid climate characteristic of the north Pacific coast. Former contiguity in distribution most likely occurred in Late-Pleistocene times although specific fossil or subfossil evidence of *Chamaecyparis* is lacking in eastern Oregon and Washington. The most appropri-

ate regional evidence of Late-Glacial environments for the Ochoco-Blue Mountain area is Hansen's (1943) pollen profile at Anthony Lakes, 100 km northwest of the Aldrich Mountain site. These profiles exhibit a sequence since the last glaciation as one of an initial interval of cool, characterized by *Pinus albicaulis*, giving way to an interval of warmth (the Hypsithermal), marked by the entry and dominance of *Pinus ponderosa*, followed by somewhat cooler conditions. Fire history at Anthony Lakes is implicated by the sudden appearance in the pollen profile of *Larix occidentalis*, a post-fire invader. Pollen profiles from eastern Washington prominently portray a warm, dry interval between 8,000 and 4,000 B. P., a period of dessication favoring replacement of *Pinus ponderosa* by graminaceous species, chenopods and composites (Hansen, 1947; Heusser, 1960; Heusser, 1965). The disjunct stand of *Chamaecyparis nootkatensis* in the Aldrich Mountains is accordingly assumed to be a relict of a wider distribution in Late-Glacial and early Postglacial times of a cool, moist forest type in highland central Oregon. Other persistent pockets of *Chamaecyparis* have probably been destroyed through a combination of Hypsithermal dessication and fire.

Summary

Composition and structure of an isolated occurrence of *Chamaecyparis nootkatensis* in the Aldrich Mountains, central Oregon, 220 km east of the main distribution of this species, is described and discussed. The stand has withstood a number of fires and present tree regeneration approximates existing mature forest structure, suggesting that a climax or near-climax condition prevails. This single, isolated grove probably represents a relict of a Late-Glacial forest which was adapted to cooler and moister conditions than now prevail in central Oregon.

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