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Ponderosa Pine of the Willamette Valley, Western Oregon

Abstract

Ponderosa pine is an overlooked component of the historical vegetation in the Willamette Valley of western Oregon. Pollen, historical, and field data show that ponderosa pine has been a component of both lowland/floodplain and upland/foothill vegetation. In the latter, it was an important constituent of the savanna and open oak woodland vegetation that was widespread in the early 1800s. Much of the historical range of ponderosa pine has been converted to other land uses, such as agriculture, or changed by ecological succession to a closed forest dominated primarily by Douglas-fir. Efforts to understand past Willamette Valley vegetation or to restore historical ecosystems in the Valley should recognize the important ecological position once held by ponderosa pine.

Introduction

Most residents of the Willamette Valley of western Oregon do not recognize ponderosa (yellow) pine (*Pinus ponderosa*) as a natural part of their landscape. Most assume that the scattered ponderosa pine seen in the Valley were grown from seed collected east of the Cascade Mountains. In fact, some standard references (Franklin and Dyrness 1973) do not mention ponderosa pine occurring in the Valley north of Eugene. Thus, many are surprised to learn that ponderosa pine has been growing throughout the Willamette Valley for several thousand years (Pearl 1999) and that it is a genetic race distinct from the ponderosa pine found east of the Cascade Mountains (Gooding 1998)

Because of the increasing interest in ecological restoration and in establishment of ponderosa pine timber plantations in the Willamette Valley, we investigated the past and present distribution of ponderosa pine to develop a fuller understanding of its ecological requirements and successional position within the Valley. This paper presents a review of the literature on ponderosa pine, augmented with data we collected south of Eugene.

Prehistoric Ponderosa Pine

Sediment cores from Lake Labish and Onion Flats, two neighboring deep peaty deposits in the central Willamette Valley (Figure 1), revealed the presence of pine (Hansen 1947). Although this study predated ¹⁴C dating techniques, the chronology of the cores can be tied to the Mazama pumice deposit of about 6800 years before present (ybp). Pine was more abundant toward the bottom of the cores, declined to very low levels, then increased in abundance around 7000 ybp (just above the Mazama ash layer) to levels it maintained to the present. Dated sediment cores from an old ox-bow of the Willamette River near Albany (Pearl 1999) showed abundant pine pollen toward the bottom of the core at 11,000 ybp, declining to very low levels around 10,000 ybp, and rising slightly to the current low levels around 7,000 ybp. Many of the current Willamette Valley prairie and woodland species also became common in the pollen profiles around 7,000 ybp.

Interpretation of these pollen data is complicated because the pollen of ponderosa pine cannot be distinguished from lodgepole pine (*Pinus contorta*). Current ecological requirements of these species (Franklin and Dyrness 1973, Burns and Honkala 1990) and changes in community types depicted by the pollen cores (Pearl 1999) and concomitant climate change (Whitlock 1992)

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suggest that the pollen of 8,000 ybp and older is lodgepole pine (Hansen 1967) and that pine pollen deposited in the Willamette Valley in the last 7,000 years is ponderosa pine.

Ponderosa Pine Before 1850

Historical Records

Early accounts of the Valley provide anecdotal evidence of ponderosa pine. The journal of David Douglas (Davies 1980) described an oak-pine savanna in the north Valley near present-day Newberg (Figure 1). Douglas described pines growing in the foothills of the western and southern parts of the Valley. An unnamed missionary described groves of oak and pine near Salem in 1840 (Smith 1949). A sawmill built in 1852 south of Alpine processed pine cut from a stand near Monroe (Figure 1) (Anonymous 1942).

The historic vegetation distribution of ponderosa pine in western Oregon can be investigated

through the 1852-53 General Land Office (GLO) survey records. The GLO survey identified witness trees at each section and half-section corner by species and mapped vegetation boundaries. The survey records provide an unusually systematic description of vegetation at the time. The GLO records mention ponderosa pine with white oak (*Quercus garryana*) and sometimes Douglas-fir (*Pseudotsuga menziesii*) on the foothills, on the flood plain, and in riverine forests between Eugene and Halsey (Johannessen et al. 1971), near the Willamette River adjacent to Monroe where they were subject to inundation (Benner and Sedell 1997), and with Oregon white oak and Douglas-fir in grass northeast of Eugene (Boag 1992). Most of the pine was on the lower hills at the sides of the Valley (Johannessen et al. 1971, Boag 1992). On the prairie-dominated flood plain, isolated oaks, pines and Douglas-firs grew under special conditions created by former dwellings, thin soil and rock outcrops (Johannessen et al. 1971).

These direct accounts in the GLO records confirm the presence of ponderosa pine throughout much of the Willamette Valley. Ponderosa pine was not mentioned in Habeck's (1961) transect across the Valley at Salem and in Towle's (1982) transect at Monroe (where two other studies above mention pine), suggesting that ponderosa pine was not abundant in their study areas or was considered unimportant by these researchers.

The historical distribution of ponderosa pine can also be inferred from sources other than the GLO surveys. In a study of the Fox Hollow Research Natural Area, an unlogged area immediately south of Eugene, Cole (1977) found that Douglas-fir was the most common tree species before 1850. Ponderosa pine and white oak were common associates on the hilltop and upper southerly slope, where 23%–29% of the 64–70 trees per ha was ponderosa pine. A small amount of incense cedar (*Calocedrus decurrens*) was also present. Thus, this site in 1850 had a scattering of trees on an open hillside, with ponderosa pine as an important component.

These reports collectively suggest that ponderosa pine was widely distributed in the Willamette Valley before 1850. Ponderosa pine occurred in an open forest with combinations of oak and Douglas-fir on sites from the occasionally flooded valley bottoms to very well-drained hills. We found little record of ponderosa pine in

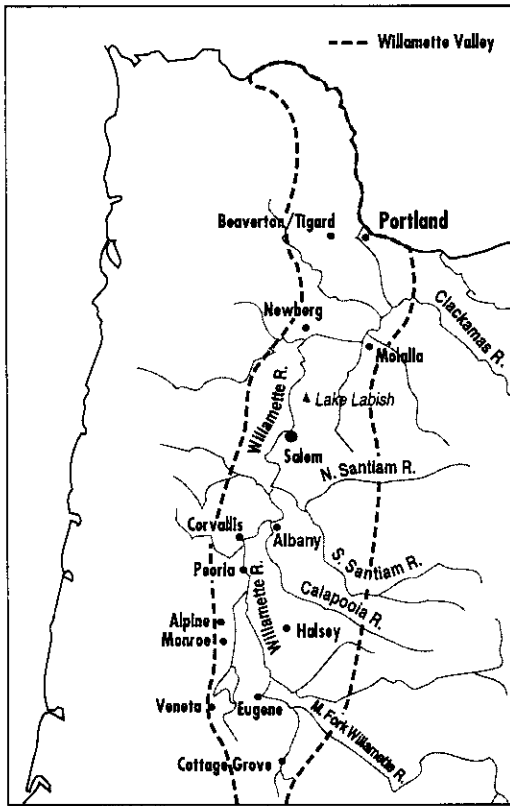


Figure 1. The Willamette River Valley, noting locations cited in the text.

the prairie zone or in the river-related bottom-land hardwood type.

Stand Reconstruction Study

We conducted a stand reconstruction study on Bureau of Land Management property in two 16-ha unlogged stands near the Fox Hollow RNA south of Eugene (sections 11 and 21 of T19S, R4W). We first surveyed each stand for old ponderosa pine. The stand in section 11 contained nine ponderosa pine trees, six of which pre-dated 1850. All were located in a north-south line on the west face of the hill, just below the top. A visual survey detected only 4–9 other trees that appeared to pre-date 1850 on the basis of bark, branch and stem characteristics, although there were a few dead open-grown white oaks of indeterminate dates of origin on the upper west slope. The stand in section 21 contained six ponderosa pine trees arranged roughly in pairs, as well as Douglas-fir and incense cedar that appeared to pre-date 1850. The older trees tended to be near the top of two west-facing ridges, not low on slopes or near the intervening stream.

We selected seven ponderosa pine trees from the two stands to serve as focal trees for further sampling. We mapped the location of immediately adjacent codominant and subdominant neighbors. We aged the focus pine and a sample of the adjacent trees by counting annual rings, adjusting age for height of the increment core or section. Six of the eight ponderosa pine trees in our sample (seven focus trees and one neighbor) originated before 1850 (1741, 1792, 1817, 1820, 1820, and 1835). In contrast, only six of 26 trees of other species that were codominant or subdominant canopy neighbors originated before 1850 (1677, 1773, 1795, 1801, 1808, and 1817); all were Douglas-fir.

We also sampled from three fixed-area plots (0.14 ha) centered on ponderosa pine trees in the section 21 stand. Three ponderosa pine and 31 Douglas-fir trees of the 131 trees in these plots originated before 1850 (Table 1). There was no evidence (stumps, logs, or snags) of a lost pre-settlement oak component in this stand, and little evidence in either stand of conifers that were canopy size in 1850 but had since died.

These results suggest that in 1850, the study area varied from ponderosa pine-Douglas-fir-oak savanna, to open woodland, to patches of closed-

TABLE 1. Total number of individuals per hectare by species in three 0.14 ha circular plots centered on ponderosa pine in the section 21 stand. The ponderosa pine originating before 1850 were focus trees. Note that these density values should not be extrapolated to the whole 16 ha of the stand. There were only 6 ponderosa pine trees in the stand, and their distribution was strongly clumped.

Species	Origin		Regeneration (<15 cm dbh)
	Before 1850	After 1850	
Ponderosa pine	7	2	2
Douglas-fir	74	86	119
Incense cedar	0	100	81
Grand fir	0	33	93
Black oak	0	7	7
Chinquapin	0	0	93
Bigleaf maple	0	0	2
Red alder	0	0	2

canopy forest. Judging by the surviving trees, the trees of the study were generally quite young in 1850 (median age = 30 yr).

Ponderosa Pine Since 1850

A few studies have examined modern distribution of ponderosa pine. Hansen (1947) reported seeing sizable pine stands in the central Valley in 1938; his photos of these stands appear to be of flat sites, not hillsides. Hansen also noted that ponderosa pine grew on the outwash plains southwest of Puget Sound and in the southern Willamette Valley. Ponderosa pine was mapped in western Oregon from Portland south through the Willamette Valley to the California border (Anderson 1938). In the central Willamette Valley, he noted the highest concentration of pine was in the same flood plain area identified by Johannessen et al. (1971) and Benner and Sedell (1997).

A community analysis of closed oak stands in the central Valley showed four community types (Thilenius 1968). Only the poison oak (*Rhus diversiloba*) type contained any ponderosa pine, and it was rare even in this type. All of the stands in this analysis were low-lying, not on hillsides. All were closed-canopy, and all appeared to post-date 1850. Within these closed oak stands were scattered (average 17 per ha), overtopped open-grown oaks ranging from 257 to 308 years old. Thus, these stands had earlier been oak woodlands of the type described elsewhere as having contained ponderosa pine.

Franklin and Dyrness (1973) discussed the oak type in the Willamette Valley province without mention of ponderosa pine. They concluded, however, that ponderosa pine occurred south of Eugene mixed with Douglas-fir, and some incense cedar and oak, on ridges and south slopes and along some streams. Juday (1976), also working south of Eugene, described a similar upper slope pine type. Curiously, he described this as the northern limit of ponderosa pine in western Oregon.

Cole (1977) suggested that incense cedar has regenerated in large numbers on drier sites since 1850 and would replace ponderosa pine as the pine senesces. On more mesic sites, grand fir would replace the Douglas-fir that colonized the woodlands. As a result, stands open in 1850 have become closed forests today. Our stand reconstruction data (Table 1) show a similar pattern. Stand density, grand fir and incense cedar all increased over time. Most of the Douglas-fir regeneration in our data can be attributed to increased understory light caused by a recent clearcut adjacent to one of the ponderosa pines. Because we observed abundant natural ponderosa pine regeneration in recent clearcuts adjacent to our study area in section 21, we concluded that the lack of young ponderosa pine in our study stands is related to poor regeneration conditions (low light), not a lack of viable seed.

A survey from Eugene to the Columbia River by the Willamette Valley Ponderosa Pine Conservation Association (Robert McNitt, WVPPCA, personal communication) showed that ponderosa pine was found in any abundance in only three locations: the Beaverton/Tigard area, low elevation Cascade foothills sites from Molalla to Cottage Grove, and lowland sites near rivers south

of Salem, with most occurring along a north-south line from Albany to Veneta. Ponderosa pine was conspicuously absent from Coast Range foothills.

These studies of contemporary conditions demonstrate that ponderosa pine occurs on both valley bottoms and hillsides. Because most studies north of Eugene were conducted in low-lying sites, they give the impression that it only occurs in such areas. The WVPPCA data show that today it also occurs on hillsides. Successional processes following fire suppression (Agee 1993) tend to reduce ponderosa pine abundance, although recent land use changes (e.g., farming, dwellings, Christmas trees) must also contribute to this reduction.

Conclusions

Efforts to restore historical vegetation in the Willamette Valley should include ponderosa pine woodlands. The current scarcity of ponderosa pine can be caused, not only by habitat loss, but also by fire exclusion that allows open woodland to be replaced through succession by closed forest. Reintroduction and long-term maintenance of ponderosa pine in the Willamette Valley will require active management to promote the open woodland conditions necessary for natural regeneration or the survival of planted seedlings.

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