

Population and Growth Responses of *Populus trichocarpa*
and *Alnus rubra* to Climate and Disturbance
in a Riparian Environment in western Oregon

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I. Introduction

Disturbance-mediated processes are well documented in riparian environments, (e.g., Baker 1990), and dendrochronological techniques have been used extensively to date flood events, particularly in western Canada (Parker and Jozsa 1973, Gottesfeld and Gottesfeld 1990). Yet little information is available concerning the response of *Populus trichocarpa* and *Alnus rubra* to flooding and varying climate regimes in the western Cascades of Oregon. Both species are common in riparian environments in northwestern North America. *Populus trichocarpa* is a fast-growing, nutrient and water-demanding species which often grows to more than 100 cm diameter at breast height (1.4m; dbh), and to almost 200 years in age. *Alnus rubra* is also fast growing, but usually reaches diameters and ages of no more than 50 cm and 70 years, respectively. It is an important successional species throughout the western Cascades and Coast Range (Fowells 1965).

The main objective of this study was to determine the distribution, age structure, and growth characteristics of *Populus trichocarpa* and *Alnus rubra* growing along a profile perpendicular to the McKenzie River, Oregon. Because elevation rises in discrete overbank zones with increasing distance from the river, this profile may represent a gradient of decreasing available water and increasing disturbance frequency. If this is the case, distribution, age, and growth characteristics of trees should increase discretely with distance from, or elevation above, the river. Furthermore, stand-initiating flood events should be detectable from establishment dates of *Populus* and *Alnus* or from discrete changes in radial growth in these species.

II. Study site

The study site is the northern edge of an island located close by the southern bank of the McKenzie River at an elevation of 450 m a.s.l., 44 10' N, 122 20' W in the Willamette National Forest, Oregon. The McKenzie River is a fifth order stream approximately 100 m wide at the study site. Highest flow rates occur from November through May. We know of at least two major flood events which occurred in December 1964, and in the mid-to-late 1880s.

The 85 ha island, approximately 2000 m in length and 500 m in width, is dissected by a complex network of flood channels, most of which are dry during the summer drought and active from November to May. The surface consists of both erosional and depositional environments, and is underlain by cobbles beginning at depths from 5-50 cm.

Tree species include *Alnus rubra*, *Populus trichocarpa*, *Acer macrophyllum*, *Fraxinus latifolia*, *Cornus nutallii*, *Pseudotsuga menziesii*, *Calocedrus decurens*, *Thuja plicata*, *Abies grandis* and *Tsuga heterophylla*. Generally, *Alnus* is found

Age and dbh increases with distance from the river bank for both *Populus* and *Alnus*, suggesting a gradient of decreasing disturbance frequency and severity. Overall growth rates (age/dbh), however, do not vary with distance from the river, suggesting that site quality is similar across the profile. Establishment dates appear to coincide with major flood events; 22 of the 35 *Alnus* stems aged on Transect 1 established within five years of the 1964 flood. Also notable is a cohort of *Populus* and *Alnus* that established as early as 1880, but for the most part during the early 20th century. These trees could be the remnants of a larger cohort of hardwoods that established after the late-1800s flood and have reached the end of their lifespan (Fowells 1965).

The master tree-ring chronology showed a series intercorrelation of 0.582 and a mean sensitivity of 0.251, indicating that the cores were in fairly close agreement and that the trees were responding in a similar fashion to climate. Overall, we found that tree growth is positively related to cool, wet late summers. By calibrating the series to the periods 1930 to 1955 (trees at younger ages) and 1955 to 1980 in PRECON, we found that climatic response of the trees was much stronger in the earlier period than the later period. Using deuterium/hydrogen ratios, T. Dawson and J. Ehleringer (personal communication; Department of Biology, University of Utah, Salt Lake City) found that in the riparian hardwood species *Acer negundo*, trees depended on surface water in the early part of their lives, but became relatively independent of annual climatic variations when root systems reached groundwater later in life. A similar model of surface water dependence, followed by groundwater usage would account for our observed change in climatic response by the *Populus* trees. However, because of the temporal restriction of 30 years and the limited number of sample cores, this conclusion must remain tentative. Further measurements and careful re-analysis of the remaining *Populus* and *Alnus* cores would help resolve this question, and this analysis is presently underway.

Summary.

1. Tree species occur in discrete elevational/distance zones.
2. Age increases with increasing distance from the river.
3. Dbh increases with increasing distance from the river.
4. Growth rates do not vary with distance from the river.
5. Periodic flooding appears to structure this community.
6. Trees were more responsive to climate in early years than in late years.

Literature cited.

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