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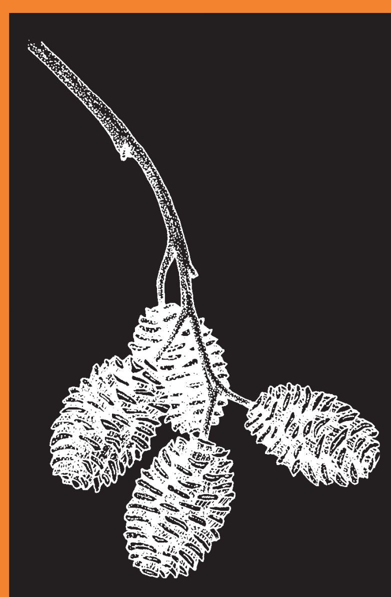
The Reproductive Ecology of Broadleaved Trees and Shrubs: Red Alder

Alnus rubra Bong.

by

Edward C. Jensen, Debra J. Anderson, and David E. Hibbs



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The Reproductive Ecology of Broadleaved Trees and Shrubs: Red Alder, *Alnus rubra* Bong.

Red alder is one of the most common broadleaved trees in Pacific Northwest forests. It is an early successional species that commonly occupies moist, recently disturbed sites. Historically, it has been discriminated against because it aggressively competes with conifers; however, its fast growth rate and its ability to rapidly occupy vacant sites are causing land managers to re-evaluate its commercial value. Ecologically, red alder's ability to fix nitrogen makes it an exceptionally important part of Northwest forests.

Physical Characteristics

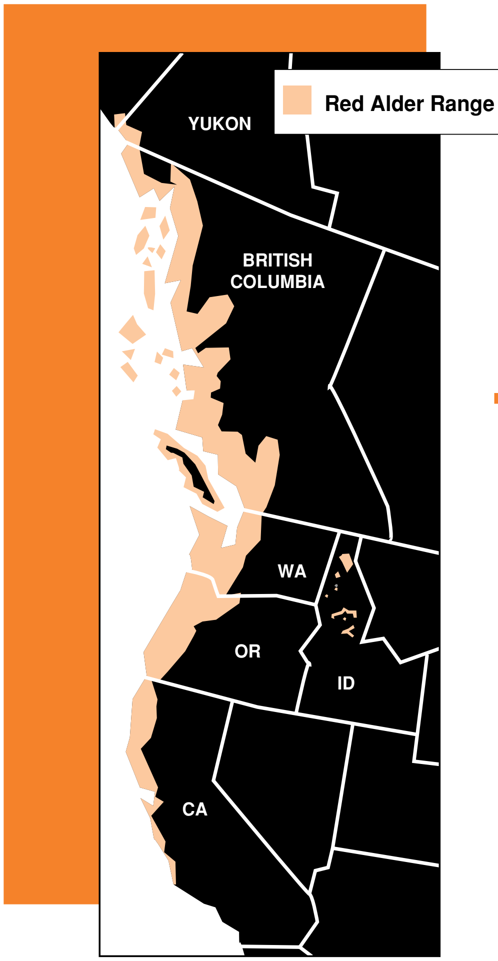
Leaves and Stems

Red alder leaves are simple, alternate, and deciduous; they are ovate in shape, have doubly serrate margins, and commonly range in length from 2 to 6 inches, although shade leaves may be larger. A leaf is typically shiny green and smooth on its upper surface and paler and pubescent along the veins on the underside. The leaves of red alder can be distinguished from those of other Northwest alders by the presence of tightly revolute (rolled under) margins.

Young twigs are distinctly triangular in cross section and are olive to reddish-brown in color. Lenticels are common. Buds occur on short stalks and have reddish valvate scales. The bark of mature trees is usually ashy gray and smooth, although it is commonly covered in lichen, which gives the appearance of horizontal stripes. The inner bark is tan, but it turns bright reddish-brown after being exposed to air for a few minutes.

Flowers and Fruits

Flowers are produced in late summer and are borne in clusters of aments (also called catkins) with 2–5 aments per cluster. Seeds are tiny winged nutlets borne inside woody cone-like fruits called strobiles. These strobiles are 1/2–1 inch long, cylindrical in shape, and turn from green and yellow to brown as they ripen. They persist on the tree long after seeds have been released. Seeds are lightweight and are blown long distances by the wind.



Growth Habit

At maturity, red alder typically has a single, straight bole ranging from 30 to 120 feet tall and 1 to 3 feet in diameter. When grown in the open, it has a broadly pyramidal crown; in stands, it is typically devoid of lower branches, and the crown gradually flattens as the tree ages.

Habitat and Range

Red alder ranges from southeastern Alaska through central California. Although it typically grows at low to moderate elevations (under 2500 feet) and within 125 miles of the Pacific Ocean, isolated populations occur in northern Idaho. Over most of its range it is typically found along streams, in valleys, and on moist mountain slopes. Ground-based logging activities of the past century have greatly increased the land occupied by red alder by providing acre upon acre of disturbed sites that have been readily colonized by red alder's light-winged seeds (Hibbs *et al.* 1994).

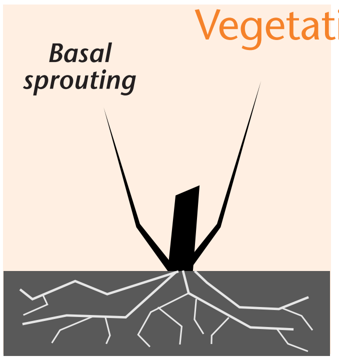
Method of Reproduction

Red alder most commonly reproduces by seed; however, it can also sprout from the base of its stem when young.

Sexual Reproduction

Red alder begins producing copious amounts of seeds around age 10, with maximum production occurring around age 25. Seeds are released during dry periods in winter. Predation by rodents and soil invertebrates substantially reduces the number of seeds available for germination (Carlton 1988). Red alder seeds contain no mechanisms for significantly delaying germination; therefore germination occurs quickly during the spring after seeds are dispersed. Although seeds can germinate on a variety of surfaces, they contain little stored energy, and their roots need to reach moist, mineral soil soon after germination if they are to survive. Exposed soil surfaces such as those occurring naturally along streams, or on hillsides disturbed by logging or other management activities, are especially good sites. Small seedlings are susceptible to mortality from herbivory and disease (damping-off) in the spring and moisture stress in the summer; in the fall they can be buried by leaf litter (Haeussler 1987).

In commercial operations, red alder can be planted to control its density, spacing, and genetic characteristics (Hibbs *et al.* 1994). Planting should occur from February to March to reduce the chance of frost damage and drought stress.



Vegetative Reproduction

Red alder sprouts vigorously from the root collar and stump when young. As a result, it can be coppiced repeatedly, although rootstock vigor declines with each harvest (Harrington 1990). By the time red alder reaches age 15, its ability to reproduce vegetatively is greatly diminished (Haeussler *et al.* 1990). Stump height and season of the year are important factors influencing sprouting; to maximize sprouting, stems should be cut in winter and stumps left at least 4 inches tall (Harrington 1990). Cuttings from young growth can be rooted easily (Harrington 1990).

Role in Succession

Red alder is a pioneer species that is intolerant of shade and understory conditions; seedlings grown in the understory will grow little and soon die (Harrington 1990). Red alder is also very opportunistic—alder stands easily establish in openings, along stream banks, or wherever mineral soil is exposed. If red alder becomes established in an opening, it out-competes most other species, quickly dominating the overstory. Beneath a red alder overstory, tolerant shrubs such as salmonberry and vine maple often flourish. Shade-tolerant trees such as western redcedar, western hemlock, and bigleaf maple may become established, but they are likely to be scattered; less tolerant trees are seldom found. Around the age of 80–120 years, red alder trees begin to die and stands self-thin, creating gaps in the canopy. Unless shade-tolerant conifers have managed to survive beneath the alder canopy, these gaps are likely to be captured by neighboring shrubs. As red alders continue to die, shrubs can strengthen their hold on the site, fully occupying it until the site is eventually disturbed again and trees have the opportunity to re-establish.

Response to Changes in Environment

Thinning a stand of red alder can result in a strong and rapid response in the remaining trees, especially if it occurs before the stand is 20 years old. If thinned early, remaining alders are likely to develop relatively deep crowns and short, stout stems. If thinned later, remaining trees are likely to develop shorter crowns and taller, thinner stems.

Fisheries and Wildlife

Various species of birds, mammals, amphibians, and invertebrates depend on red alder stands for all or part of their survival. The leaves of red alder support high numbers of invertebrates, which serve as the main food source for many insectivorous bird species. Columbian black-tailed deer and elk browse the leaves and twigs of red alder (Nyberg and Janz 1990, McComb 1994). Beavers also eat alder leaves and twigs, using larger stems for dam construction. Other species associated with red alder stands include roughskin newts, Pacific giant salamanders, tailed frogs, deer mice, Virginia opossums, western spotted skunks, Townsend's chipmunks, and pine siskins (McComb *et al.* 1993). Red alder contributes copious amounts of dead and decaying leaf material to streams, helping form the basis of the food chain in many small waterways. The roots of red alder also help maintain the stability of stream banks and provide shade, helping to moderate stream temperatures and maintain fish habitat.

Cultural and Historical Values

Northwest Indians use red alder as a pigment and as a medicine. When mixed with steelhead eggs, red alder bark produces a stable red dye; when mixed with iron oxide, it produces a reddish-orange stain. The Kwakiutl Tribe used a poultice made from the bark of red alder as an analgesic and dermatological aid. Some tribes chewed alder bark to stop hemorrhaging, to cure tuberculosis, and to treat heart pains. An infusion of bark from the stem of alder, but not the root, was used by the Gitksan Tribe for various maladies (Moerman 1986).

Red alder bark also contains the chemical compound epicatechin, which is one of several compounds that have shown promise in research on the HIV virus (Forlines *et al.* 1992).

Management Options

Because red alder competes so successfully with conifers, forest managers have long tried to eliminate it from conifer stands. However, a number of factors now cause it to be viewed in a more favorable light and to be actively managed on sites where it grows particularly well.

Nodules on the roots of red alder contain bacteria that are capable of fixing from 100 to 200 pounds of atmospheric nitrogen per acre per year. This ability can lead to increases in both content and availability of nitrogen in the soil. Nitrogen fixed by alder can reach the soil in several ways: by decomposition of dead roots or nodules, by leaching from the foliage, and by decomposition of the leaf litter, which is rich in nitrogen (Harrington 1990). Because of its ability to increase soil fertility, red alder can be used in mixture or in alternating rotations with conifers to increase conifer growth in nitrogen-poor soils.

Red alder can also be planted in areas containing *Phellinus weirii*, a root rot that affects many Northwest conifers. The only known biological control for this pathogen, which has the potential to survive in the soil for up to five decades, is to replace infected conifers with more resistant species, such as red alder (Li 1969). Following one cycle of red alder, it is generally safe to replant conifers.

Red alder is now used for a variety of products. The wood of alder is attractive and accepts stains easily and evenly. Furniture, cabinets, pallets, and novelties are commonly made from alder. Red alder can also be chipped and used for flakeboard or pulped and made into paper products (Hibbs *et al.* 1994), and it is commonly used for fuelwood. Because of these uses, it is increasingly common to find red alder planted in pure plantations where log production is the primary management objective.

When the growth of red alder needs to be controlled, several methods are available. One of the best ways is to prevent red alder from becoming established by minimizing site disturbance, which reduces the chance of alder seeds finding a conducive seed bed. Since red alder seeds need bare mineral soil to establish, careful aerial logging will reduce the amount of soil disturbed. Older stands of alder can be removed by logging the alder and burning the slash, again taking care to minimize the amount of disturbed soil.

Red alder can also be controlled through the use of herbicides. For example, germination of alder seedlings can be prevented by using atrazine during the early spring. If red alder has already germinated, applying 2,4-D during the early foliage period (April/May) will provide good control (Newton and Knight 1981). New data show that a mixture of glyphosate and imazapyr applied in September will control red alder without substantial injury to conifers (M. Newton, personal communication, 1993). Young red alders (less than 1 inch dbh) can be killed by spraying the lower part of their stems with either triclopyr or 2,4-D, although only triclopyr is currently registered for this use, which is known as the thin-line treatment (Hibbs and Landgren 1987).

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Associated Literature

Additional papers on the ecology and management of red alder are listed in the "Associated Literature" section that accompanies this educational package.

Additional Notes

Educational Package

This leaflet is part of a larger educational program on the reproductive ecology of Pacific Northwest broadleaved trees and shrubs. The complete program consists of two audio-visual components—a videotape on the reproductive ecology of broadleaved trees and shrubs and a series of slide-tapes on shrub identification—and four printed components: 1) an overview of plant reproduction, 2) a series of leaflets on PNW trees and shrubs, 3) a glossary of relevant terms, and 4) a list of associated literature. To obtain the complete educational package, contact: Forestry Media Center, College of Forestry, Oregon State University, Corvallis, OR 97331, (503) 737-4702. To obtain only the printed documents, contact: Forestry Publications Office, Forest Research Laboratory, Oregon State University, Corvallis, OR 97331-7401.

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Jensen, E.C., D.J. Anderson, and D.E. Hibbs. 1995. THE REPRODUCTIVE ECOLOGY OF BROADLEAVED TREES AND SHRUBS: RED ALDER, *ALNUS RUBRA* BONG. Forest Research Laboratory, Oregon State University, Corvallis. Research Publication 9c. 7 p.

Red alder is an integral part of Pacific Northwest forests. This leaflet describes principal identifying characteristics, habitat and range, methods of reproduction, role in succession and response to disturbance, value to humans and wildlife, and management options. This leaflet supports a complete educational package on the natural history and reproductive ecology of Pacific Northwest broadleaved trees and shrubs; other items in the package include a videotape, three slide-tapes, and a series of printed publications.

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