

CHAPTER 2

Ecology of Quaking Aspen

Stephen Fitzgerald



Figure 3. An aspen grove in autumn. (Photo: Stephen Fitzgerald)

QUICK FACTS ABOUT QUAKING ASPEN

Common names: Trembling aspen, mountain aspen, golden aspen, popple, poplar, trembling poplar

Family: Willow family (*Salicaceae*)

Age/Longevity: The above-ground portion of the tree is a short-lived “pioneer” species, generally 100 years old or less. Some individual trees have been aged to 220-plus years. Individual clones can be hundreds to thousands of years old.

Growth rate: Fast

Reproduction: Mostly from sprouts (vegetative reproduction); rarely from seed (sexual reproduction); grows in distinct stands or clones.

Successional role: Pioneer species

Geographic distribution of aspen

Quaking aspen (Figure 3) is one of the most widely distributed tree species in North America, as it can tolerate a wide range of environmental and site conditions (Perala 1990). In the United States, it is most common in Alaska and in the central to northern Rocky Mountain states; it is present to a lesser extent in the southern Rockies (Arizona and New Mexico). Aspen is also very widespread in the upper Midwest (Minnesota and Wisconsin) and in the eastern states. Aspen is also found in the Sierra Nevada Range in California (Figure 4, page 4).

In Oregon, aspen is not as widespread and is found in smaller, more distinct stands, primarily east of the Cascade Range. Ecologically, it is an important forest type within landscapes dominated by conifers and within areas of sagebrush and western juniper in the sagebrush steppe biome of central and eastern Oregon (Figure 5, page 4).

Habitats

Aspen grow on a variety of sites and soils. Shepperd et al. (2006) outline several physiological attributes that allow aspen to grow in a variety of situations:

- Tolerance of cold temperatures and a short growing season
- Vigorous sprouting, which allows stands to persist in environments with frequent disturbances, such as wildfire
- Ability to alter leaf morphology (size and shape) depending on moisture availability
- Ability to photosynthesize in low light conditions (Aspen's green bark has the ability to photosynthesize as well as to minimize transpiration water loss.)
- Tolerance of low soil-nutrient levels

Aspen typically grow where there is a high water table or along streams and creeks, slope bottoms, benches, and concave landforms that retain soil moisture (Shepperd et al. 2006). In arid areas, aspen are typically found where there is surface water in the form of seeps and springs. Throughout the boreal forest zone, aspen grow as a "pioneer species" on recently exposed glacial till (outwash) soils, which are low in nutrients. In Oregon, aspen grow on a variety of soil types, ranging from those dominated by volcanic deposits (ash and pumice) to more clayey soils.

Reproduction and establishment

Reproduction of aspen is primarily from sprouts arising from the root system of parent trees (vegetative reproduction). Sprouting is controlled by growth regulators (similar to hormones in animals) produced within the tree. The key growth regulators that control sprouting are cytokinin and auxin. Cytokinin is produced in the roots, and auxin is produced in the branch tips at the top of the tree. Cytokinin promotes sprouting from roots, while auxin suppresses root sprouting.

When the above-ground part of the tree is killed by fire or cutting, auxin is no longer produced to counter or suppress the effects of cytokinin, allowing prolific sprouting to occur.

Although an aspen clone may produce some sprouts in any given year, sprouts erupt profusely following disturbances. Sprouts emerge from roots growing within 4 inches of the soil surface. It is not uncommon to have several hundred



Figure 4. Distribution of quaking aspen. (Source: U.S. Geological Survey)



Figure 5. Aspen clone in a sagebrush-western juniper plant community. (Photo: Stephen Fitzgerald)

thousand sprouts per acre. Leaves on new sprouts are often larger than those on mature trees, allowing for increased photosynthesis and fast growth (Shepperd et al. 2006).

Sprouts from the parent tree's root system have the exact genetic makeup as the parent tree, and the combination of parent and sprouts is referred to as a clone. Individual clones can be small and comprise just a few trees, or they can be quite large. One aspen clone in Utah covers 107 acres (Perala 1990). Large aspen stands may comprise one or more clones.

Although the above-ground tree stems within a clone are often less than 100 years old, a clone itself may be hundreds, if not thousands, of years old. One of the oldest known aspen stands is the Pando clone in Utah. It is estimated to be 80,000 years old, weighs more than 6,000 metric tons, and is considered one of the world's oldest living organisms. Thus, aspen may be one of the longest lived tree species (Mitton and Grant 1996).

Quaking aspen can also reproduce from seed (sexual reproduction). Quaking aspen is dioecious, meaning that individual trees are either male or female. Thus, trees comprising a distinct clone are either all male or all female. Although aspen produce large quantities of viable seeds that can be transported in the wind for miles, germination and establishment of new quaking aspen seedlings from seed is very rare in the western United States. It is unclear why. One explanation is that aspen seeds remain viable for a very short period of time (2 to 4 weeks) and require a moist mineral seedbed in which to germinate and grow—conditions that rarely coincide.

However, following the 1988 wildfires in Yellowstone National Park, aspen did regenerate from seed in some places that were long distances from existing stands. According to Romme et al. (1997), conditions were conducive for establishment following the fire: viable seed landed on mineral soil, the spring was moist and cool during germination, and the young seedlings did not get browsed immediately by deer and elk, allowing the trees to establish.

Growth and persistence

As young sprouts grow, they compete with one another for resources and light. Only the most vigorous sprouts survive. Sprout height growth is fastest during the first 20 years or so. Over a period of a few decades, sprouts “self-thin,” creating stands with progressively fewer, but larger, stems per acre (Figure 6).

Because aspen usually resprout vigorously following disturbance, most stands are even aged. However, some stands are more uneven aged, which suggests that stands can perpetuate themselves in the absence of major disturbances. These stands may appear stable or in a climax state (Perala 1990).

Relationship to disturbance

Aspen has a strong association with periodic fire. Although wildfires often kill the above-ground portion of trees due to aspen's thin bark (Brown and DeByle 1989), fire rejuvenates older stands, which respond by producing an explosion of sprouts from the parent root system (Figure 7, page 6). The ability to resprout allows aspen to survive in an environment that historically was marked by frequent fire (Kauffman 1990).

Aspen's response to fire depends on the health and vigor of individual clones and on the severity of the fire (Bartos and Mueggler 1979; Bartos et al. 1991; Brown and DeByle 1989). Profuse sprouting occurs after moderate- to high-intensity fires; less sprouting occurs following light burns.

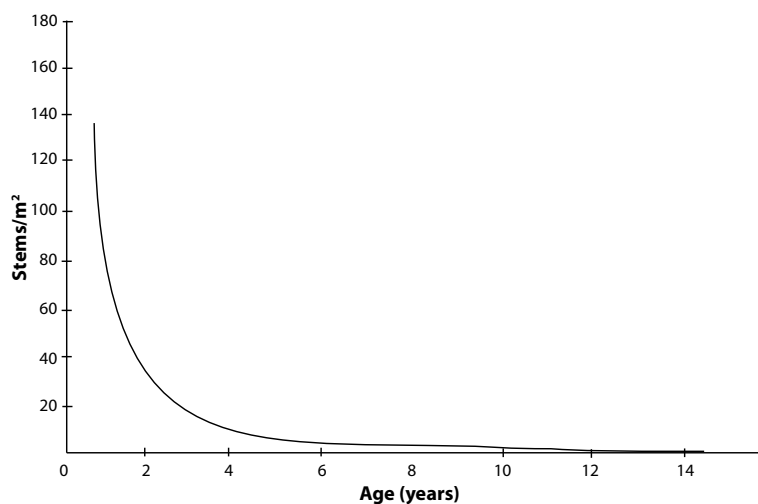


Figure 6. Self-thinning of aspen sprouts. (Source: Shepperd 1993)

Aspen decline and restoration

Across the West, aspen stands are in a widespread state of decline that seems to be accelerating. In Oregon, many aspen groves are in a severe state of decline and are made up primarily of older age classes (late successional). Aspen stands begin to deteriorate when large trees grow old in the absence of disturbance and begin to die and break off in windstorms. This creates gaps within the grove, but without appropriate conditions, little or no sprouting will occur to replace the declining overstory trees. Increased breakage from stem decay or insect attack in already weakened (nonvigorous) trees often accelerates or facilitates this process of decline.

Several factors, including a lack of disturbance (fire), invasion by conifers, heavy livestock use (browsing, soil compaction, and other associated impacts), and heavy browsing of sprouts by deer and elk, contribute to aspen's decline. Climate change may also be a factor or may become an increasingly important factor if predictions of increasing temperatures and changing precipitation patterns are realized.

In some areas, heavy grazing by livestock and browsing by elk have reduced aspen regeneration and abundance (Bartos and Campbell 1998). For example, in Yellowstone National Park, high elk populations and a lack of large predators had caused a decline in aspen abundance, particularly in meadows and in areas where elk tend to congregate. Reintroduction of wolves into Yellowstone has kept elk herds more on the move (through fear of predation), allowing aspen and other hardwoods to reestablish within these systems (Ripple and Larsen 2000).

In Oregon, aspen is often out-competed and replaced by conifer tree species due to the lack of periodic fire (DeByle et al. 1987; Bartos and Campbell 1998; Bates et al. 2006). In addition, due to the lack of periodic wildfire, fires today tend to burn hotter and can have greater detrimental effects, especially for stands already in a state of decline (i.e., in poor health).



Figure 7. Aspen sprouting following mortality of overstory trees by wildfire. (Photo: Stephen Fitzgerald)

Because of aspen's ecological importance in ecosystems across central and eastern Oregon, there is widespread interest in reversing its decline. Both private landowners and federal land management agencies, such as the U.S. Forest Service and the Bureau of Land Management, are interested in enhancing aspen.

Restoration of aspen has included cutting, burning, or a combination of the two, to rejuvenate declining aspen stands. In addition, fencing and other methods are often needed to exclude livestock, deer, and elk and to allow sprouts a chance to develop into mature trees and stands. To evaluate whether your aspen may need restoration, see Chapter 3. See Chapters 4 and 5 for management and treatment recommendations.

Insects, disease, and other damage

Aspen are highly susceptible to several insects and diseases. This is one factor that makes aspen so important to wildlife. Heart rot, fungi, and other diseases make the wood soft and easily excavated to create nest cavities for several bird and mammal species. These trees eventually fall to the ground, where they provide important ground nesting and travel habitat. Wildlife and livestock also find aspen very palatable. Appendix II provides an overview of aspen's most common insect, disease, and animal-damage problems in Oregon.

ARBORGLYPHS: A RECORD OF THE PAST

John Kaiser

If aspen is growing on your property, there is a chance that someone left a legacy of drawings on some of the older trees (Figure 8).

These drawings, called “arborglyphs” or “dendroglyphs,” were made predominantly by Basque and Irish shepherders from about 1920 through the 1950s in south-central Oregon. They were made with the point of a knife, nail, or similar sharp object. This sharp point cut lines into the thin bark of the aspen tree. As the tree healed, the lines expanded to reveal names, dates, drawings, messages, and maps. There are numerous arborglyphs because, during those decades, large numbers of sheep roamed all over the forest and were cared for by large numbers of herders. These men left their stories and experiences on the aspen trees.

These arborglyphs contain some fascinating stories. On the Fremont-Winema National Forests in eastern Oregon, we found an entire Shakespearean sonnet. Another carving tells of a young herder who lost his girl to another young man at a local dance.

Many of these tree writings are disappearing as the aspen trees age and fall over. Now is a critical time to conduct your aspen assessments and document these relics before they crumble back into the ground.

All is not lost. Perhaps you and your family will continue to “carve” names, dates, and messages on the white-barked trees, leaving your story for future generations to discover.



Figure 8. Arborglyphs found on the Fremont-Winema National Forests. (Photos: John Kaiser)