

Summary: Aspen Decline in the West?

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No other tree in the Rocky Mountain region is more highly valued for its amenities than aspen (*Populus tremuloides*). In Colorado, New Mexico, Arizona, and southern Utah, aspen covers entire mountain slopes and plateaus, sometimes forming the landscape matrix in which other cover types occur as patches. Northward aspen occurs in patches (figure 1), forming small groves that can be thought of as a *keystone cover type*—one that has more significant effects on species diversity and ecological processes than would be expected considering the comparatively small amount of land area that it occupies.

Much appreciated by many for the color and habitat diversity that it provides, aspen also has a remarkable suite of adaptations. It is a deciduous tree that survives where evergreen conifers are far more common. Notably, aspen bark has chlorophyll that is capable of photosynthesis in the late fall and early spring, making it a rather novel *deciduous evergreen* tree. Another adaptation is its longevity. The literature commonly refers to aspen's short-lived shoots (the ramets), but the plant itself (the genet) could be thousands of years old because of root sprouting. Indeed, aspen may live longer than any other tree. Seedlings are rarely encountered over much of aspen's range, but only a few successful seedlings are necessary to maintain the populations of such long-lived plants. The rate of genet mortality seems very low.

The ecological characteristics of aspen and aspen forests have been the topic of numerous workshops and conferences. Norbert DeByle and Robert Winokur edited the most notable review. In this fine book, published in 1985 (*Aspen: Ecology and Management in the Western United States*; USFS General Technical Report RM-119), we have access to information on the paleobotany, genetics, physiology, and reproductive biology of aspen; the effects of climate, fire, insects, diseases, and herbivores on aspen forests; the various resources for which aspen is valued; and traditional management strategies.

But much has been learned in the interim. Scientists and managers now have new tools for their work, such as geographic information systems, and they have made better use of repeat photography, remote sensing, and dendrochronology. There also has been an influx of new ideas generated by landscape ecologists and conservation biologists. Moreover, global climate change is now thought by most of the scientific community to be inevitable if not already occurring; and some managers are worried about the decline of aspen, whether due to climate change, fire suppression, or too many elk. At our conference in Grand Junction, managers were urged to “take action now” and “take action often” to counteract the loss of aspen in some areas (Bartos, this proceedings; Campbell and Bartos, this proceedings; Bartos and Campbell 1998).

Threats to existing aspen forests, whether from timber harvesting, disease, heavy browsing, or natural succession, are viewed with alarm. However, it is important to take a long-term perspective on the kind of changes that have been observed. Aspen is a species that responds quickly to disturbances. Widespread disturbances caused by timber harvesting and fires in the late 1800s and early 1900s may have enabled aspen to become unusually abundant in the Rocky

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Figure 1—Two photos illustrating the patchy growth of aspen in some parts of the Rocky Mountains. (a) The Black Hills of South Dakota, where browsing by deer can be heavy. (b) The foothills of the Wind River Mountains near Pinedale, Wyoming; there are no fences protecting the aspen groves in this area.

Mountains during the last century. If aspen is now declining, the explanation may lie in natural processes that have caused similar declines in the past—one phase in a series of natural fluctuations. There is no basis to suggest that aspen is threatened globally, nor are most aspen groves likely to be lost in the near future.

Change in Rocky Mountain ecosystems certainly will occur because of human activity as well as other phenomena. To illustrate, recent research suggests that Utah juniper and ponderosa pine have occurred on the land area known as Wyoming for less than 2,000 years (Stephen T. Jackson, personal communication). Both are expanding their distribution, probably due to the kinds of climatic changes that have characterized the Earth for millennia. Considering their probable longevity, individual aspen clones surely have survived many episodes of climate change.

The effect of climate change on aspen can be manifested in various ways. For example, the populations of large herbivores such as elk may have increased due to less winter mortality during periods of mild climate. Browsing on aspen twigs and bark would undoubtedly increase during such times, and the number of aspen saplings might have declined. Alternatively, if longer dry periods accompany such episodes, then fires could have been more common. More frequent fires would enable the aspen to become more abundant, at least in areas that are some distance from winter ranges where browsing would be intensive. Papers presented at the Grand Junction conference suggested that distance from high concentrations of elk is correlated with the growth of aspen saplings into trees (for example, Barnett et al.; Kaye et al., this proceedings).

A second example that illustrates the effects of climate pertains to seedling establishment. In Arizona, successful aspen establishment is more likely to occur following fire if the annual postfire precipitation is above average for several years (Moore, this proceedings; Romme, this proceedings). Drought, in contrast, could prevent seedling establishment. As important, drought could diminish the abundance of root sprouts after a disturbance, possibly because of a higher susceptibility to insects and pathogens during droughts (Jacobi, this proceedings).

In contrast to climate, the succession of aspen forests to coniferous forests can be altered through management. Aspen groves have been invigorated using prescribed burning, clearcutting, and the selective cutting of invading conifers, largely because of root sprouting. Some managers would pursue such options more widely for sustaining aspen forests and providing a source of wood (Bartos and Campbell 1998; Mackes and Lynch, this proceedings). This kind of active management is opposed by those who feel the rate of harvesting has been excessive on some national forests, that no additional roads should be constructed, and that the invasion of aspen by conifers is a natural process that very likely will be reversed by fires and other disturbances in the future.

In resolving this debate, it is important to recognize that aspen is a widespread species and that a decline in the cover of aspen forests has been documented only in a few areas, such as in parts of Utah and adjacent to some national parks (Kay, this proceedings; Smith, this proceedings; Weisberg and Coughenour, this proceedings). Also, while some aspen forests are seral to conifers (figure 2), others are self-perpetuating stands. The abundance of aspen forests in a landscape should be considered as well. In some areas, aspen is so rare that it might be classified as a sensitive species. Maintaining the species and its associates through active management could be the logical alternative, especially if the stands are seral in nature. Elsewhere, aspen may be so common that having

Figure 2—An aspen grove in the Sierra Madre, Wyoming, with an understory of lodgepole pine (*Pinus contorta*). Aspen may be seral to other conifers as well, but aspen forests in some areas are self-perpetuating and have no conifers (Mueggler 1985).



a portion of the forests change to conifers would not have significant effects for most people—ecologically or aesthetically.

As important, managers should consider the prevailing sentiment with regard to the interested public's desire for the future condition of the landscapes in which aspen occurs. The building of additional roads is now a big issue. Will new roads be required to sustain aspen in specific areas through the harvesting of conifers, or to better control prescribed fires? Similarly, will the shooting of elk in national parks be required to reduce browsing pressure? Will the number of domestic livestock have to be reduced in the vicinity of aspen groves? If the answers to such questions are affirmative, then the arguments for active management in each case must be convincing and site specific. Extrapolations from other areas will not be adequate.

Therein lies the controversy. Some groups simply want aspen forests that are green in the summer and yellow in the fall, preferably with a minimum of “wasted wood” in the form of dead trees and coarse woody debris. For them, fires should be suppressed, partly to protect the second homes that are located adjacent to federal lands (the presence of such structures greatly complicates forest management activities). Others place high value on roadless areas,



Figure 3—Aspen grove affected severely by elk browsing near Yellowstone National Park. Small rootsprouts can be found among the dying ramets, indicating that the genet is not dead. However, the habitat provided by a stand of mature ramets (aspen trees) is no longer available. Placing a fence around this clone probably would allow the restoration of this stand.

dispersed recreation, rare species, and the biodiversity that can be sustained in wildlands. Such amenities have become so uncommon during the last 50 years that they are now considered scarce resources.

Notably, roadless areas already have been influenced by management activities such as fire suppression and changes in the natural fluctuations of large herbivore populations. This is just another expression of what Garrett Hardin has termed the first law of ecology—we can never do merely one thing. Actions taken on a specific area will affect adjacent areas. Similarly, if fires are suppressed, conifers will continue to overtop the aspen in some areas. And, with more evergreen conifers growing where the deciduous aspen once occurred, there will almost certainly be less streamflow because transpiration from the conifers occurs for a longer period each year. Fewer fires may not be simply the result of extinguishing lightning- or human-cause ignitions, when we are able, but also the result of fuel load reductions, such as through livestock grazing.

And if the abundance of carnivores such as wolves and cougars are reduced, then elk populations could increase, or move less frequently from one place to another, with the effect that there is more browsing on aspen. This in turn could cause more disease because of wounds to the bark. Supporting this hypothesis,

Larsen and Ripple (this proceedings) concluded that aspen seedling establishment became less frequent at about the time when wolves were removed from Yellowstone National Park. The interactions are further complicated with timber harvesting. When wood is removed, there surely will be fewer downed trees, thereby providing less-dense patches of tangled timber where aspen are protected from browsing long enough to enable growth into new trees. As in other kinds of forest, the removal of timber creates an ecosystem that is different from one that burns (where most of the large wood remains after the disturbance event).

Natural fluctuations in ecosystem variables such as downed wood and aspen abundance are natural and important, yet it is human nature to look for consistency from one year to the next. A striking example is the desire to have a consistently high number of elk hunting permits year after year. This is accomplished in some areas by feeding elk in the winter, routinely or only during harsh winters, and making determinations on the number of elk that can be harvested each fall. The result can be unusually long periods of continuously high levels of browsing that prevent the growth of aspen saplings into trees (DeByle 1979; figure 3).

Fortunately, aspen continues to persist in the western states. It may be declining in some areas, possibly for reasons related to human activity. Alternatively, climatic changes beyond human control may be the cause. Aspen is still very abundant over much of its range and it could rebound in the future where it is now becoming less common. The interactions affecting the dynamics of aspen are worthy of continued investigation. Much has been learned since the 1985 review edited by DeByle and Winokur, but additional, spatially explicit information is required on the history and causes of episodes of recruitment and mortality for both aspen genets and ramets in specific areas. Many will be interested in the results.

References

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