Great Basin Aspen Ecosystems

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The health of quaking aspen (*Populus tremuloides*) in the Great Basin is of growing concern. The following provides an overview of aspen decline and die-off in areas within and adjacent to the Great Basin and suggests possible directions for research and management. For more detailed information, please see the list of references and recommended links below.

Aspen Distribution and Value

Quaking aspen is widespread throughout North America and is found in the Rocky Mountains from Canada through the United States and into northern Mexico. In the western United States, aspen is most abundant in Colorado and Utah. In most of its western range, aspen is a mid-elevation, shade-intolerant species that is a relatively minor component of more widespread conifer forests. Aspen occurs in clones, which are a group of genetically similar stems originating from a seed that germinated some time in the past. These clones are perpetuated through vegetative reproduction.

Aspen does not occupy a large area of the west; however, it is a very important tree species on the landscape. It is one of the few broad-leaved hardwood trees in many western forests. Aspen is a valuable ecological component of many landscapes, occurring in pure forests as well as growing in association with many conifer and other hardwood species. While aspen provides desirable scenic value, the diversity of understory plants that occur in the filtered light under the aspen canopy supply critical wildlife habitat, valuable grazing resources, and protection for soil and water. Although aspen is a crucial component of many western landscapes, it may be even more valuable in the Great Basin Region where it is less common or extensive than elsewhere. The most current literature pertaining to aspen has been summarized by Shepperd and others (2006) for the Sierra Nevada area. Most of this information is applicable to Great Basin aspen.

Key Issues

Aspen thrives where somewhat regular and frequent disturbance promotes regeneration (DeByle and Winokur 1985). Aspen generally sprouts profusely (up to 500,000 stems per 0.4 ha or per 1 acre) following disturbance. These high numbers of aspen suckers typically self-thin following a negative exponential decay model, with most losses occurring in the first few years (Shepperd 1993). Most root suckers arise on roots within 15.2 cm (6 inches) of the soil surface. Numerous issues related to the status of aspen in the Great Basin are unresolved. These include:

Decline—Successional processes in aspen communities result in replacement of aspen by more shade tolerant species. This process is disrupted by disturbance that resets the system to an earlier seral stage. Lack of regular disturbance has resulted in the deterioration of aspen in many areas of the west (Bartos and Campbell 1998a). This phenomenon is quite pronounced on the east side of the Great Basin, along the Wasatch Front in Utah and the adjacent Colorado Plateau, and extends across western Utah and Nevada. This decline of aspen has been a major concern of land managers for many years.

Die-off—The more recently reported aspen die-off differs from normal aspen vegetative succession in that mature trees die quickly within a year or two and no new sprouting occurs, indicating that the lateral roots may also be dead (fig. 1). If that is the case, then aspen will not re-occupy the site. Die-off seems to begin in epicenters and spread radically through an affected aspen stand. Stands on all topographic positions, moisture regimes, and soil types are affected and the phenomenon has been reported throughout the west from Arizona to Alberta. Die-off can affect one clone and leave adjacent clones untouched. Younger age classes and advanced regeneration are often not affected to the same extent as mature overstory trees in the same clone. Cytospora cankers, poplar borers (*Saperda calcarata* and *Agrilus liragus*),

Figure 1—Die-off of aspen seen in western Colorado in 2006. Note gray area in top third of picture.

and other damage or stress agents are often associated with die-off epicenters; however, the possibility of a yet-unknown invasive disease or insect cause still exists.

Aspen die-off has been reported for several years in Utah and Arizona, but only recently has become apparent in Colorado, where aerial surveys flown in 2006 indicate 55,800 ha (138,000 acres) are affected. The apparent death of roots is disturbing, as aspen cannot resprout if roots are dead. Since this phenomenon has not been reported in the literature, we are unable to predict how long the die-back will persist or how much area will be affected. Current estimates are that approximately 10 percent of the aspen stands are at risk of elimination (fig. 2).

Figure 2—Die-off of mature aspen with sufficient regeneration to restore the stand.

Climax aspen—Mueggler (1989) states that approximately a third of the aspen in the west would be considered "climax" or not successional. The die-off phenomena mentioned above is also occurring in this type of aspen and is prevalent in southern Utah (figs. 3 and 4).

This is not as rapid a progression as observed in Colorado, but it does raise major concerns about the functioning of aspen stands. There are similarities between what has been described as a quick die-off and what is occurring in what appears to be stable aspen elsewhere in the west.

Water—It has been speculated that late successional aspen (for example, conifer dominated) use more water than systems that are still dominated by aspen (Bartos and Campbell 1998b). If this holds true, then conifer encroachment may be causing increased water loss from these systems that would otherwise be available for ground water recharge or stream flow.

Figure 3—Dying aspen clone in the summer of 1990 on Cedar Mountain, Utah. (Photo by James Bowns).

Figure 4—Same clone as in figure 3 the summer of 2002. Few living trees remain and no regeneration is present.

Management Challenges

Die-off and decline of aspen are two specific issues that are currently of concern in the Rocky Mountains, including the Great Basin. Recently, public awareness of this issue has increased and considerable attention has been given in the press to the problem of aspen die-off. A most often asked question is "What can be done to limit the impact it might have on the landscape?"

There is a need for a multidisciplinary research effort to identify casual agents and environmental factors contributing to aspen die-off and determine whether pro-active management can reduce the risk of die-off caused by the loss of parent roots.

The USDA Forest Service, Rocky Mountain Research Station sponsored an Aspen Summit December 18 and 19, 2006, in Salt Lake City, UT. This meeting brought together aspen experts and top land managers to discuss the die-off problem and to define a course of action. As an outcome of the Summit, this group has begun to detail a research program that will be a coordinated, multi-year effort involving ecologists, climatologists, pathologists, and silviculturists.

Research and Management Questions

Die-off

Are aspen roots really dead in affected stands? If so, what killed them?

What invasive insects and diseases are present in dead or dying trees?

Can die-off epicenters be associated with climatic conditions other than drought, for example snow pack, temperature extremes, and atmospheric gases?

Can die-off be predicted by stand age, growth rate, stocking, or other metrics?

Can establishing new sprout stands prevent or reduce mortality?

Is there any relationship between die-back and animal impacts such as browsing or barking of trees?

Decline, stable aspen, water yields

What are the ecological ramifications of declining or decadent aspen stands?

How can declining or decadent aspen stands be restored?

Do conifer dominated stands of aspen use more water than aspen dominated stands?

Is the die-off in stable aspen stands similar to what is happening in mixed aspen/conifer stands?

Existing Programs and Resources

USDA Forest Service, Rocky Mountain Research Station. Aspen Restoration in the Western United States. http://www.fs.fed.us/rm/aspen/ [2007, July 17]

An interdisciplinary research program has been initiated between the USFS Rocky Mountain Research Station (RMRS) and Utah State University (USU) to better understand aspen die-off and decline, the ecological consequences of aspen conversion to conifer forests, and vegetation manipulation to restore aspen. http://www.fs.fed.us/rm/aspen/ and http://extension.usu.edu/forestry/ [2007, July 17]

An "Aspen Alliance" (Center of Excellence) is being developed between RMRS and USU to address aspen issues that occur in the west including the Great Basin. http://extension.usu.edu/forestry/ and http://www.fs.fed.us/rm/aspen/ [2007, July 17]

USDA Forest Service, Rocky Mountain Research Station, Congressional Briefing Paper on Aspen Die-off. http://www.aspensite.org/pdf/Die-off/aspen-die-off.pdf [2007, July 17]

USDA Forest Service, Rocky Mountain Research Station, Aspen Die-Off Summit Meeting held in Salt Lake City, December 18 and 19, 2006. http://www.aspensite.org/pdf/Die-off/Aspen-Summit-Summary.pdf and http://www.aspensite.org/research_dieback.htm [2007, July 17]

Aspen Delineation Project. http://www.aspensite.org/ [2007, July 17]

Utah State University, Forestry Extension, and USDA Forest Service Rocky Mountain Research Station Restoring the West Conference held at Utah State University in Logan, Utah, September 12 and 13, 2006. http://extension.usu.edu/forestry/UtahForests/RTW2006/RTW2006.htm [2007, July 17]

Utah State University, Forestry Extension, Managing Aspen in Western Landscapes Conference 2004. http://extension.usu.edu/forestry/UtahForests/ForestTypes_04AspenConference.htm [2007, July 17]

References

Bartos, D. L.; Campbell Jr., R. B. 1998a. Decline of quaking aspen in the Interior West – Examples from Utah. Rangelands. 20(1): 17-24.

Bartos, D. L.; Campbell Jr., R. B. 1998b. Water depletion and other ecosystem values forfeited when conifer forests displace aspen communities. In: Potts, D. F., ed. 1998 Proceedings of AWRA Specialty Conference, Rangeland Management and Water Resources. American Water Resource Association. Herndon, Virginia. TPS-98-1. 474 p.

DeByle, N. V.; Winokur, R. P., eds. 1985. Aspen: Ecology and management in the western United States. Gen. Tech. Rep. GTR-RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 283 p.

Mueggler, W. F. 1989. Age distribution and reproduction of Intermountain aspen stands. Western Journal of Applied Forestry. 4(2): 41-45.

Shepperd, W. D. 1993. The effects of harvesting activities on soil compaction, root damage, and suckering in Colorado aspen. Western Journal of Applied Forestry. 8(2): 62-66.

Shepperd, W. D.; Rogers, P. C.; Burton, D; Bartos, D. L. 2006. Ecology, biodiversity, management, and restoration of aspen in the Sierra Nevada. Gen. Tech. Rep. RMRS-GTR-178. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 122 p. Available: http://www.fs.fed.us/rm/pubs/rmrs_gtr178.pdf [2007, July 17].