

# What's Happening in Colorado's Aspen Forests?

-- Gradual, long-term changes and recent widespread death of aspen trees --

The normal development of forests includes changes, with most trees growing larger while other trees die as a result of natural processes of competition. Just like the day-to-day development of plants in a summer garden, these annual changes are barely noticeable until years have passed. Gradual changes are sometimes interrupted by sudden changes, when forests experience fire, insect outbreaks, severe winds, or major droughts. All the aspen forests in Colorado are changing; most of the forests are developing through periods of gradual change, but in recent years many landscapes have experienced rapid changes including the death of many large, old trees. Why are so many trees dying now?

## Aspen forest development

Most of the aspen forests in Colorado developed after a stand-replacing disturbance such as fire. The root systems of aspens usually survive fires, sending up thousands of new stems (suckers) to regenerate the forest. Only a few of these suckers will survive more than a decade or two, as competition weeds out the smaller stems. In many cases, conifers such as lodgepole pine and Engelmann spruce establish as seedlings soon after the same fires, but faster growth

of aspen suckers allows aspen to dominate the forest for decades (Figure 1). The continued growth of understory conifers reduces the opportunities for new aspen suckers to develop, and conifers may replace aspens in the overstory as the old aspen trees eventually die.

Not all aspen forests have conifer seedlings and saplings, and these forests may remain dominated by aspen for more than a century.

A wide variety of insects and diseases occur in aspen forests. Canker (fungal) diseases and stem borer insects often are more common as trees become more stressed; they are often present when trees die, even when the primary cause of death is drought or some other factor. Forest tent caterpillars and large aspen tortrix eat aspen leaves, and periodic outbreaks may defoliate entire aspen canopies in early summer (Figure 2).

Aspen trees commonly live for more than 100 years, with the oldest trees reaching 200 or more years. Forests with large numbers of conifers mixed with aspens will shift to conifer dominance, often around 75 or 100 years after the last major disturbance. More than 95% of Colorado's aspen forests are now older than 80 years, so a large portion of the forests are maturing, or shifting to conifer dominance.



Figure 1. Some stands have few conifer trees, and aspen trees remain dominant for a century or more (left). Other stands have large numbers of conifer trees establishing, reducing the number of new aspen trees and gradually leading to conifer dominance. Both types of aspen forests are common in Colorado.



Figure 2. Forest tent caterpillars form webbed nests in aspen trees, and during major outbreaks can defoliate entire canopies in early summer. Aspen usually survive even severe defoliation, although several years of caterpillar outbreaks will kill some trees.



Figure 3. Death of many century-old aspen trees is changing the appearance of some Colorado landscapes

**Recent death of aspen trees**

The gradual development of some aspen forests changed dramatically in recent years, with widespread deaths of old aspen trees (Figure 3). The loss of these old trees does not mean the aspen forests will disappear; some stands have younger trees that will survive, and some are sending up new suckers.

It's difficult to assign a single cause of death for aspen trees; trees that are stressed from severe drought

will also tend to have cankers and stem borers, contributing to a "syndrome" of factors killing the aspen.

The current widespread death of aspen trees (Figure 4) is causing great concern among foresters, communities, and businesses. How extensive is the sudden change? Will it continue or is it over? How will the forests change as a result of the death of old trees?

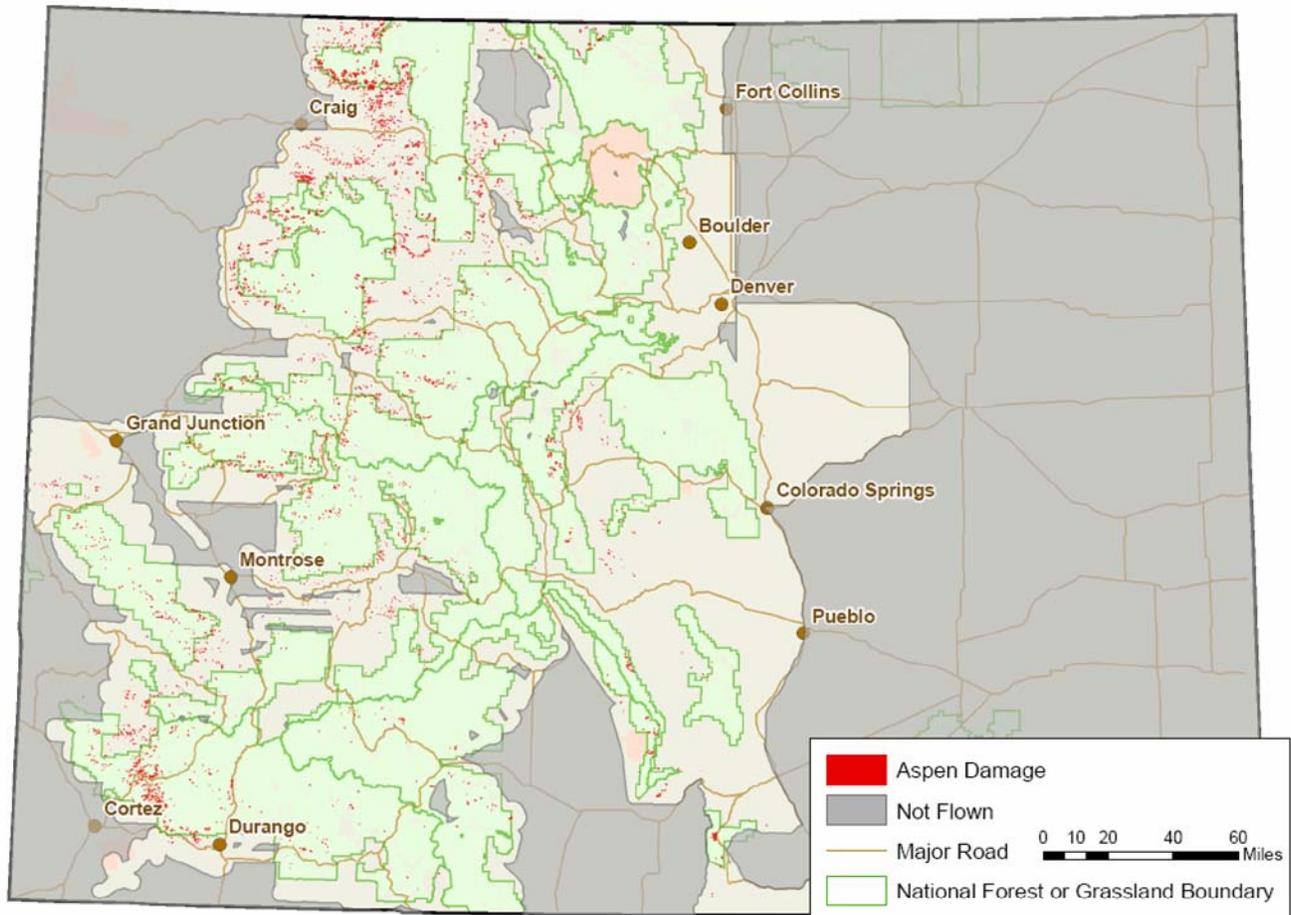


Figure 1. Aerial surveys by the USDA Forest Service in 2006 showed widespread death of overstory aspen trees in many parts of western Colorado. In most cases, younger trees remained healthy. Many of the root systems of dying trees were sending up new sprouts (called suckers); in some cases, heavy browsing by animals will prevent these suckers from developing into trees. (Map courtesy of Jennifer Ross, USDA Forest Service-Rocky Mountain Region)

Aerial surveys completed in 2006 show that 138,000 acres of aspen forests had been affected. In some aspen stands, more than 60% of the mature trees died between 2003 and 2006. The pattern of tree mortality varies within landscapes and across the state. Lower-elevation forests generally have higher mortality than upper-elevation forests; it's not yet clear if forests on moister sites experienced less mortality than drier sites. In many cases, trees younger than about 50 years have survived.

The severe droughts of recent years may have played a large role in triggering the widespread death of aspen trees. Colorado had its lowest precipitation in more than a century in 2002, with only 60% of the long-term average of rain and snow. The Rio Grande Basin received only about 40% of its normal snowpack in 2002, and snowmelt was complete 6 weeks sooner than average. June was 6 degrees hotter than average. Temperatures were also 2 to 3 degrees above average from 2000 through 2003, with these 4 years among the hottest 6 years in more than a century. We can't be certain that this warm, severe drought triggered the aspen tree deaths, but many experts think it played a strong role.

### What will happen next?

It's too early to know if the current period of rapid death of aspen trees will continue. If the drought in 2002 was a major trigger of the tree deaths, then most of the old trees that remain healthy after 2006 will likely

remain healthy for some time, as the aspen forests return to a period of slow, normal development and change. Trees that currently appear weakened, with sparse, small leaves, may die within a year or two.

The future of forests with dying old trees will depend on a variety of things. A well-developed understory of sapling-size aspen trees will likely develop into an aspen forest that will eventually look much like it did in the late 20<sup>th</sup> Century. Where substantial numbers of conifers are present, the future forest will typically develop as a conifer-dominated forests.

Perhaps the largest uncertainty is what will happen in aspen stands that currently lack aspen saplings. Some of the root systems of the dying overstory trees were still sending up suckers in the summer of 2006, demonstrating the potential for rapid recovery of the forest ecosystem. However, a large portion of Colorado's aspen landscapes experiences very heavy browsing of aspen suckers by elk, deer and livestock. Browsing of aspen suckers may be a major problem because of high animal populations, and the small proportion of landscapes burned in recent decades. Severe browsing may prevent suckers from developing into trees, and we don't know how long the root system of old dying trees will continue to survive and produce suckers. Unrelenting browsing pressure for several years after the death of overstory trees will lead to the death of the root system, and conversion of the aspen forest into another type.



Figure 2. Severe browsing by elk, deer and livestock leads to short, multi-stemmed aspen suckers (left) that do not grow into trees. After 30 years of protection by a fence (left side of right photo), young aspen trees are abundant, but are absent without protection from high elk populations.

## What can be done?

Continued research and monitoring by foresters will remove some of the current uncertainty about this current episode of aspen tree death, and how the forests will respond. For example, we know that cutting or burning healthy, mature aspen trees leads to such a proliferation of suckers that browsing pressures are less likely to prevent regeneration of the forest; but we don't yet know if cutting or burning trees that are weak and dying would have the same beneficial effect.

Trees that are weakened to the point of showing fewer, smaller leaves probably cannot be saved by any management activity. Weakened aspen trees often take a few years to finally die, but once they're substantially weakened, they don't recover. The future possibilities for the forest then depend on the surviving trees, and the new trees that may establish.

The value of aspen trees for wood products is typically high within the first year or two after trees die, but wood quality then deteriorates rapidly. Retaining standing dead trees may have some wildlife value (particularly for cavity-nesting birds), but dead aspen trees typically fall within a few years. Alternatively, cutting dead trees so they fall together and form a barrier may help protect new suckers from heavy browsing.

The best protection for new suckers would be fencing, but this is economical only in relatively small

areas. Large-scale changes in browsing pressure would be possible only by changing elk and deer populations, or altering livestock management. Changing the behavior of elk appears to have helped aspen regeneration in Yellowstone National Park, where reintroduction of wolves discouraged leisurely browsing of aspen in areas of high visibility and predation risk.

## Future changes

The only thing certain about the future is that it will be different from the present. Healthy forests will continue to change in response to annual patterns in weather, and disturbances such as wildfire and outbreaks of tent caterpillars will occur some time. Given that most of the aspen in Colorado are already more than 80 years old, we can expect that aspens forests mixed with conifers will gradually become conifer forests. Aspen forests without conifers may continue for decades or longer, but mature trees will eventually die. The natural disturbance regime of aspen forests includes major events (especially wildfire) that reset landscapes to young forests; without major intervention from natural fires or forest management, some future landscapes will have much less aspen. Forest management can also create opportunities for young aspen stands to develop, without the risks associated with wildfires. We have the opportunity to make some decisions about the future of Colorado's aspen forests; the only option that is not possible is to keep aspen forests from changing at all!

