Decline of Quaking Aspen in the Interior West—Examples from Utah

Dale L. Bartos and Robert B. Campbell, Jr.

Quaking aspen (*Populus tremuloides*) are unique because, in contrast to most western forest trees, they reproduce primarily by suckering from the parent root system. Generally disturbance or dieback is necessary to stimulate regeneration of aspen stands. These self-regenerating stands have existed for thousands of years. If they are lost from the landscape, they will not return through normal seeding processes as do other tree species.

Aspen landscapes in the West provide numerous benefits, including forage for livestock, habitat for wildlife, watershed protection, water yield for downstream users, esthetics, sites for recreational opportunities, wood fiber, and landscape diversity.

Loss, or potential loss, of aspen on these lands can be attributed primarily to a combination of successional processes, reduction (or elimination) of fire, and long-term overuse by ungulates. Existing conditions indicate that most aspen stands will eventually be replaced by conifers, sagebrush, or possibly other shrub communities. The decline of aspen results in loss of water, forage, and biodiversity. Numerous landscapes throughout the West that were once dominated by aspen are in late successional stages dominated by mixed-conifer. If restoration treatments are to be successful, action must be taken soon.

Fig. 1. *Aspen clones on the Fishlake National Forest have sparse regeneration (upper third) and show aspen being replaced by conifer (middle third). Photograph, Kreig Rasmussen.*

Aspen Decline

Figures 1–4 illustrate aspen decline as it currently exists in southern Utah.

Authors are Ecologist, U.S. Dept. of Agriculture, Forest Service. Bartos is with the Rocky Mountain Research Station, Logan, Ut. 84321 and Campbell is with the Fishlake National Forest, Richfield, Ut. 84701.

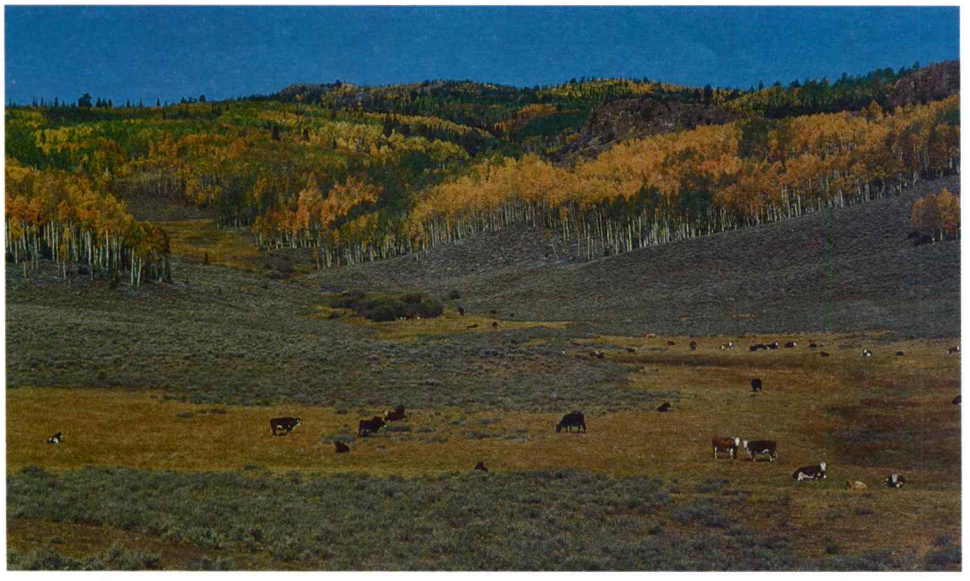

Fig. 2. *General aspen landscape. Numerous dead aspen logs are on the ground. There is no aspen regeneration and conifers are penetrating the aspen canopy. Dense conifer in the understory at the upper reach of this watershed has diminished stream flows. Conversion of historical aspen to sagebrush has occurred on the lower slopes. Photograph, Bert Lowry.*

Fig. 3. *Aspen stand showing heavy conifer understory and no aspen regeneration. Photograph, Kreig Rasmussen.*

Fig. 4. *Winter scene of aspen on Monroe Mountain. Most aspen clones are being replaced by conifer. Pure aspen at the top of the hill is a result of a more recent fire. Photograph, Kreig Rasmussen.*

Sixteen sites were evaluated to determine fire history of Monroe Mountain (Data on file with Linda Chappell, Fishlake National Forest. A fire history study conducted on the Monroe Mountain Demonstration Area, 25 p., 1997). In the lower Box Creek site near the Burnt Flat Analysis Area, two ponderosa pine trees (Figs. 5–7) were sampled in a stand of mostly Douglas fir. Although only two trees were sampled, both were excellent fire recorders with 9 and 10 fires respectively. Prior to 1838, the area burned on average about every 19 years. No fires have been recorded on the sample trees since 1838. Over 156 years of fire exclusion has created an unnaturally high fuel load. A fire in the area now would be much more intense than the more frequent fires of the past. Fire history data obtained from the two trees at this one site are:

Master Fire Chronology: 1593–1838
Number of Fires: 14
Mean Fire Interval: 19 years
Interval Range: 6–31 years
Years Since Last Fire: 156 years

Cover Type: Douglas fir/aspen
Habitat Type: Subalpine fir/Oregon grape

Elevation: 8700 feet
Aspect: Northeast

Fig. 5. *Fire scars on 413 year-old ponderosa pine. Photograph, Robert Campbell.*

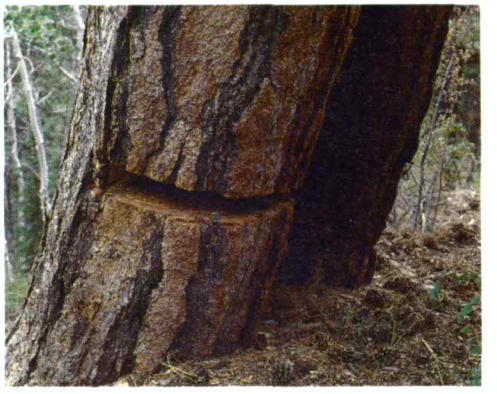

Fig. 6. *A slice was taken from the tree in Figure 5 in such a way that only a small portion of the holding wood was removed. Photograph, Robert Campbell.*

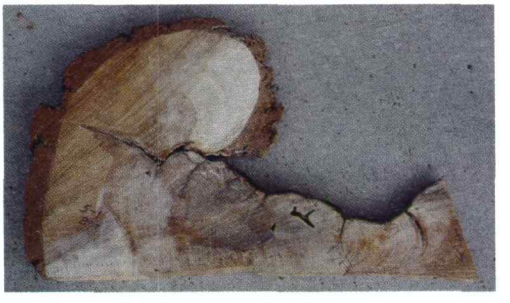

Fig. 7. *The sample removed from the tree in Figure 6 contains nine fire scars. Photograph, Robert Campbell.*

Two photos (Figs. 8 and 9) were taken from nearly the same point in 1902 and again in 1995. These pictures show that the vegetation has changed considerably. Aspen declined over the 93-year interval. The remaining aspen is heavily invaded by conifers which have increased in height and density. The stream in the meadow has down cut at least 20 feet and willows have largely been eliminated. As a result, the meadow dried out and sagebrush has invaded. The meadow is now fenced to exclude livestock and the Forest Service has seeded the area and built numerous erosion control structures. The original photo point was not used because the trees in the foreground had increased in height necessitating that the repeat photo be taken from a slightly different perspective. (Repeat photo and interpretation provided by Dr. Charles Kay, Adjunct Assistant Professor, Department of Political Science, Utah State University.)

Fig. 8. *Photograph taken in 1902 in Pole Canyon, Thousand Lake Mountain, Flshlake National Forest, Utah. Photograph, USDA Forest Service.*

Fig. 9. *A 1995 repeat photograph taken in Pole Canyon, Thousand Lake Mountain, Fishlake National Forest, Utah. Photograph, Dr. Charles Kay.*

The Burnt Flat Ecosystem Analysis Area (Fig. 10) is the Fishlake National Forest's prototype for a process to implement ecosystem management. The analysis is part of the Forest's participation in the Monroe Mountain "Seeking Common Ground" Demonstration Partnership (Fig. 11). The 14,000-acre analysis area lies between 8,200 and 10,300 feet and is dominated by three general cover types: sagebrush (42%), aspen (20%), and mixed-conifer/aspen (34%).

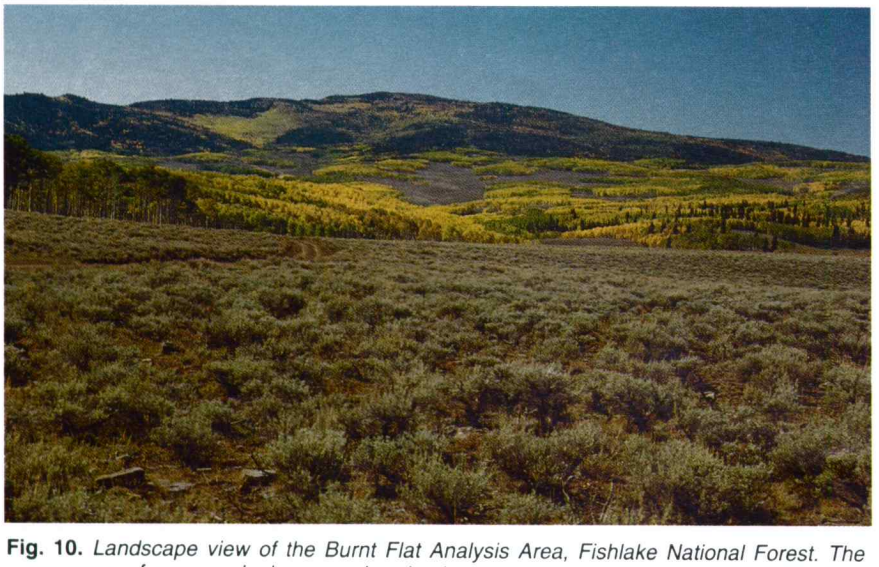

Fig. 10. *Landscape view of the Burnt Flat Analysis Area, Fishlake National Forest. The presence of even a single aspen in mixed-conifer indicates that an aspen cover type once occupied that point on the landscape. Photograph, Robert Campbell.*

Fig. 11. *Map of Utah showing the location of Burnt Flat Analysis Area, Fishlake National Forest. Map, Doug Weaver.*

Fire-history data from the area extend back 400 years. The analysis team considered and projected ecosystem needs in the area for at least the next 100 years. Opportunities and actions proposed for the next 100 years are tied to the capabilities of the soils in the area. The aspen ecosystem is a key element for the area. The analysis team estimated over 75% of the area had supported aspen in the past (Figs 12 and 13). This information is expanded and shown in Geographical Information Systems (GIS) format for Monroe Mountain. The maps are a composite of 13 soil types from a 3rd order soil survey mapped to a 1:24,000 scale. (Soils were mapped by and data are on file with Michael D. Smith, Soil Scientist, Fishlake National Forest). Values associated with aspen dominated landscapes were lost or compromised in this area when aspen was replaced by mixed-conifer or sagebrush (Figs. 14–15). Existing conditions indicate that more than 50% of the aspen ecosystems are at risk in the Monroe Mountain demonstration area and will not be sustainable without intervention.

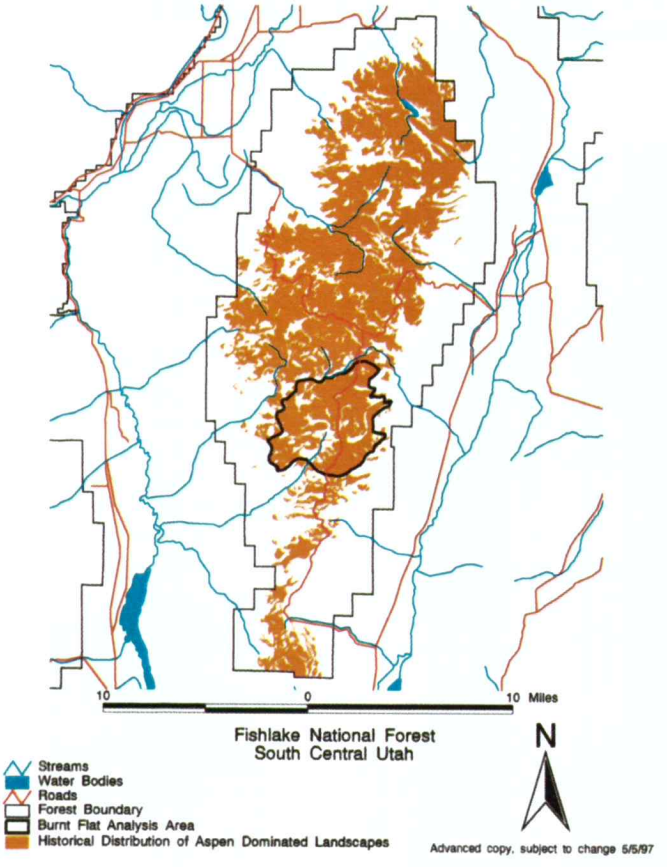

Fig. 12. *The historical distribution of aspen on Monroe Mountain. GIS map, Doug Weaver.*

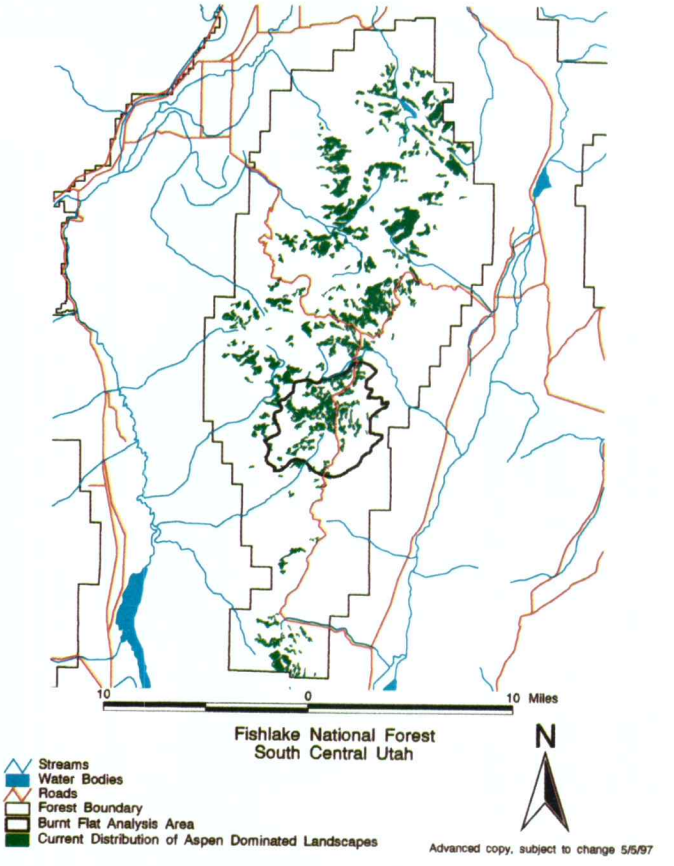

Fig. 13. *The current distribution of aspen on Monroe Mountain. GIS map, Doug Weaver.*

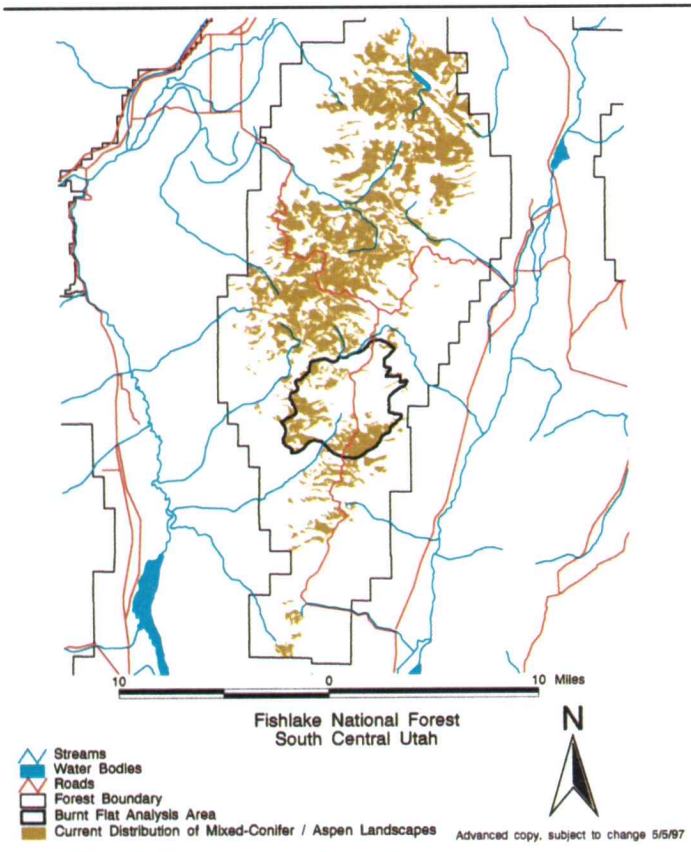

Fig. 14 *The current distribution of mixed-conifer/aspen on Monroe Mountain. GIS map, Doug Weaver.*

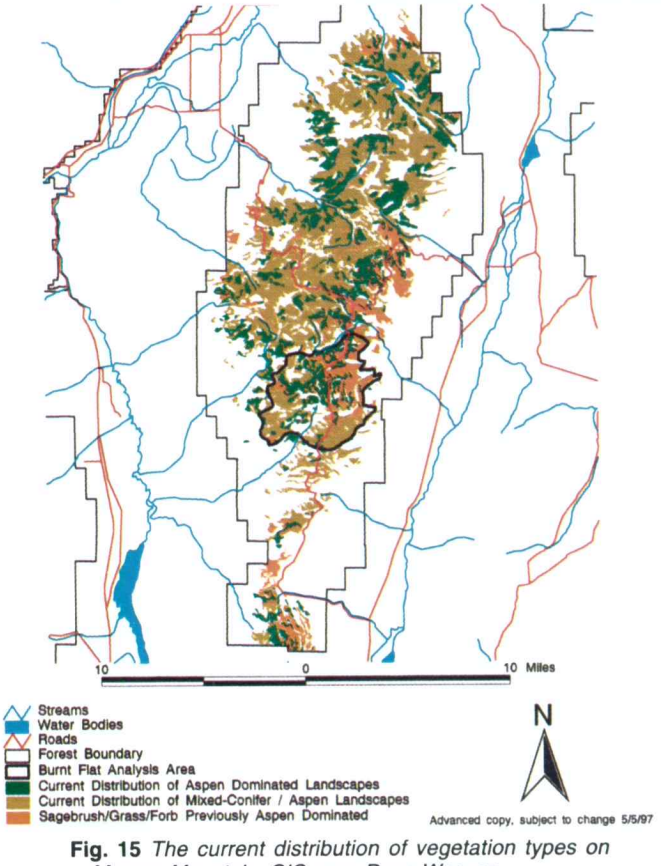

Fig. 15 *The current distribution of vegetation types on Monroe Mountain. GIS map, Doug Weaver.*

Aspen reproduce primarily by suckering from the root system. Understanding changes in root density as a result of succession is needed to help predict treatment results. During the summer of 1995, data were collected (Figs. 16 and 17) during a preliminary study to determine aspen root density under different overstory conditions on the Fishlake National Forest. (Study designed and implemented by Dr. Wayne D. Shepperd, Rocky Mountain Research Station, Ft. Collins, CO). Three trenches were constructed in twelve different clones (Fig. 16)—varying from pure aspen to almost pure conifer. All roots were counted and differentiated as being either conifer or aspen. These data should reveal patterns of clonal root development in mixed-conifer/aspen versus pure aspen stands and declining versus regenerating pure aspen clones. Additional research efforts to determine aspen root densities across a broader range of conditions are needed.

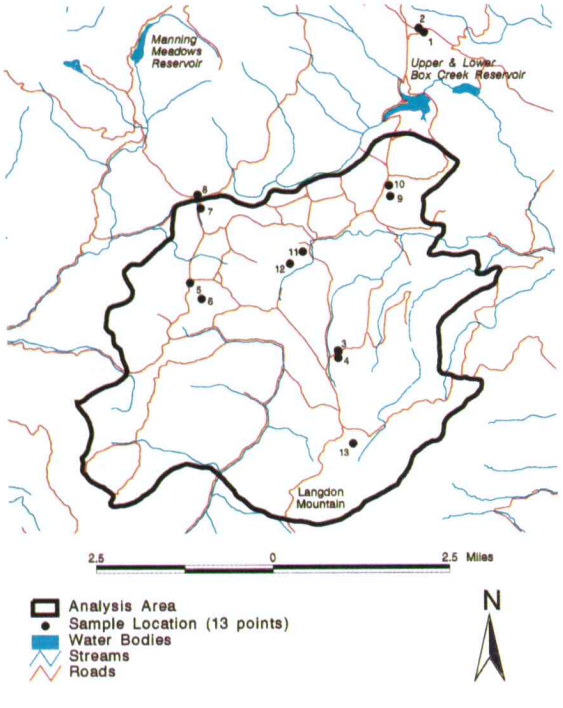

Fig. 16 *Burnt Flat Analysis Area, plot locations for root study. Map, Doug Weaver.*

Fig. 17 *Root density research in aspen and mixed-conifer/aspen stands on Burnt Flat. Photograph, Sylvia Dotson.*

Changes in the abundance of aspen dominated landscapes have occurred over the past 125+ years partly as a result of livestock grazing, wildlife use, and a reduction in fires. The historical fire regime was altered in the mid-1800's after European settlement. Fire exclusion resulted from a combination of excessive grazing, timbering, and people extinguishing wildland fires. Grazing removed the fine fuels which generally carried the fires. Most of the historical fires were low-intensity ground fires and were not stand replacing.

Combined information related to these changes in Utah is shown in Figure 18a. There are about 2.1 million acres of National Forest Systems land in Utah (1.1 million acres

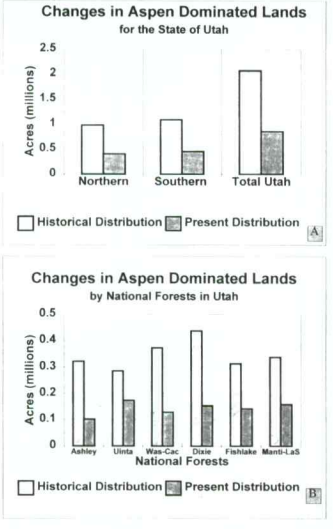

Fig. 18. *Loss of aspen in Utah from its historical distribution. Unpublished data supplied by the Survey Project (Renee O'Brien of the USDA Forest Service), Rocky Mountain Research Station, Ogden, Ut.*

in southern Utah) that contain aspen either living or dead. Most of this acreage was probably once dominated by aspen and has converted to conifer or sagebrush. Currently, of this total amount, only 800,000 acres (450,000 acres in southern Utah) is classified as aspen forest type. Figure 18b shows aspen decline for each of the six national forests in Utah. An approximately 60% decline in aspen dominated landscapes has occurred on National Forest System lands across Utah.

When aspen dominated landscapes convert to mixed-conifer losses occur. For every 1,000 acres that convert:

(1) Some 250 to 500 acre-feet of water is transpired into the atmosphere and not available for streamflow or undergrowth production. (Modified from Gifford,Humphries, and Jaynes 1984. A preliminary quantification of the impacts of aspen to conifer succession on water yield—II. Modeling results. Water Resources Bulletin 20(2):181–186).
(2) An estimated 500 to 1,000 tons of undergrowth biomass is not produced. Usable forage ranges between 40 and 70% of the undergrowth biomass.
(3) Numbers and kinds of plants and animals in the area decline appreciably.

Five risk factors for aspen dominated landscapes are:

(1) Conifer understory and overcover >25%
(2) Aspen canopy cover <40%
(3) Dominated aspen trees >100 years of age
(4) Aspen regeneration <500 stems/acre (5–15 feet tall)
(5) Sagebrush cover >10%

Any of these factors may indicate that the landscape is not in properly functioning condition.

Reversing the Trend

New research in aspen communities should have the following objectives:

(A) Evaluate the effects of various treatments to return late successional aspen stands to a composition that will perpetuate aspen's role in these ecosystems.
(B) Supplement our knowledge about what occurred on these various sites prior to European settlement.

Research should test the following hypotheses:

(1) Regeneration of aspen suckers differs with the management alternatives of burning, cutting, or a combination of the two.
(2) Soil characteristics change with treatments (burning and cutting) as well as with succession.
(3) Aspen root density has a direct relationship with regeneration success
(4) Pre-European settlement fire frequency within the mixed-conifer/aspen zone was generally uniform across various mountain ranges in southern Utah.
(5) Fire frequencies have significantly decreased in the mixed-conifer stands in southern Utah during the past 150 years.
(6) Landscape diversity has changed over the past 150 years.
(7) Use by livestock and wildlife limits the survival of aspen regeneration.

Successful aspen regeneration does not occur in some areas of the Interior West because of browsing by wildlife and/or livestock. Figure 19 is an example of the impact of cattle grazing on aspen regeneration. The entire area pictured was partially logged and broadcast burned several years earlier. Wildlife has equal access on both sides of this allotment pasture fence. Cattle also grazed these two pastures but with different intensities. Actions (treatments) to induce suckering must not be initiated until excessive browsing is controlled (Pamphlet from USDA-Forest Service, Southwest Region, 1994).

Fig. 19. *Fence-line contrast between allotment pastures showing effects of livestock usage. Photograph, Robert Campbell.*

Many treatment alternatives (fire, cutting, fencing, spraying, ripping, chaining, etc.) can be used by resource managers. Aspen has often been characterized as an asbestos forest type (one that is hard to burn); however, mixed-conifer in aspen stands will carry fire very well (Fig. 20).

Fig. 20. *Fire in mixed-conifer/aspen. Hens Peak Fire of 1996, Fishlake National Forest. Photograph, Kreig Rasmussen.*

Fig. 21. *Results following fire in mixed-conifer/aspen where a fire burned to the top of the ridge 30 years earlier. Photograph, Robert Campbell.*

Fig. 22. *Note aspen regeneration in foreground and in the understory on the upper slopes resulted following six year old burn in mixed-conifer/aspen. Photograph, Robert Campbell.*

Fig. 23. *Cutting of aspen for use in aspen mill, Fishlake National Forest. Photograph, Robert Campbell.*

Fig. 24. *Log deck of aspen on Fishlake National Forest near Burnt Flat. Photograph, Robert Campbell.*

Fig. 25. *Results following aspen harvest 4 years before. Photograph, Robert Campbell.*

Results of such action are shown for the use of fire (Figs. 21 and 22). Aspen can be used for wood products (Figs. 23 and 24) which can result in successful regeneration (Fig. 25). Communities with aspen needing treatment are ranked:

Highest priority:	mixed-conifer/aspen (particularly with subalpine fir)
High priority:	aspen/sagebrush transition
Action needed:	aspen dominated landscapes with risk factors present

Figure 26 illustrates results following fire treatment. The island in the upper left corner shows condition that mixed-conifer/aspen stand was in when the fire occurred about 40 years ago. After burning, there is abundant aspen regeneration that escaped use by animals. Results shown in Figure 26 would indicate success in future treatment of decadent aspen stands.

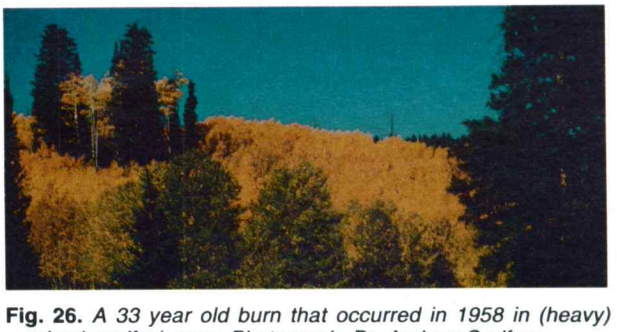

Fig. 26. *A 33 year old burn that occurred in 1958 in (heavy) mixed-conifer/aspen. Photograph, Dr. Andrew Godfrey.*

We stress the following points to resource managers concerned with maintaining aspen for landscape diversity:

Take Action Now!

Make Action Large–500 to 1,000+ acres/treatment

Take Action Often