

Aspen Response to Prescribed Fire and Wild Ungulate Herbivory

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Abstract—Land management agencies in northwest Wyoming have implemented an active prescribed fire program to address historically altered fire regimes, regenerate aspen, and improve overall watershed functions. Treated clones are susceptible to extensive browsing from elk concentrated on supplemental feedgrounds and from wintering moose. Previous attempts at fire-induced aspen regeneration in the area indicate various levels of success due to existing herbivory levels. Belt transects were established in fire-treated aspen clones along the Gros Ventre drainage, northeast of Jackson, Wyoming. Sucker heights and densities were compared between northeast and south/southwest exposures to determine fire-induced regeneration success and opportunities for future successful treatments. Overall stem density has not changed ($p < 0.05$) from 1996 to 1999. Mean stem height increased from 0.79 m in 1996 to 1.1 m in 1999. Due to differential snow accumulations affecting browse availability, northeast (NE) and south-southwest (SSW) aspects were compared. Mean stem densities are not different between these aspects ($p < 0.05$). However, mean stem height on NE aspects (1.4 m) was greater ($p < 0.05$) than SSW aspects (0.80 m). Our ability to detect a difference in regenerating aspen height between aspects was probably due to differential browsing levels of ungulates. Such information is important for prioritization of future vegetation treatments.

Introduction

Aspen (*Populus tremuloides*) communities are recognized for their multiple values, including recreation, scenic vistas, water yield, water quality, wood products, habitat for an array of wildlife species, forage for wild and domestic ungulates, and landscape diversity (Bartos and Campbell 1998; DeByle and Winokur 1985). The role of fire in perpetuating aspen forest has long been recognized, and without it many aspen stands are being replaced by conifers or shrubs and herbaceous vegetation (Jones and DeByle 1985). Many stands in the Intermountain West are mature, overmature, or decadent with a small percentage of the stands less than 60 years of age (Bartos et al. 1994; Mueggler 1989). Mueggler (1989) found that approximately two-thirds of the aspen stands in the Intermountain Region exceed 95 years of age.

Aspen communities must be rejuvenated by a disturbance event such as fire, or they will be lost to successional competition. Krebill (1972) sampled 100 aspen plots within the middle Gros Ventre drainage and concluded that parent tree mortality (3.6% per year) was excessive and that far too few aspen sprouts were escaping browsing and pests for successful replacement of overstory mortality. Adequate replacement was occurring in only three of the 100 sample plots.

Suckering generally increases substantially within the first 2 to 3 years post treatment (Bartos and Mueggler 1981; Bartos et al. 1994; Brown and Debyle 1989). The long-term viability and successful vegetative responses of prescribed burns are less understood. Impacts of wild and domestic herbivory on aspen

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suckers following prescribed burn treatments can be adverse and may quicken the demise of clones (Bartos 1979; Bartos and Mueggler 1979; Bartos et al. 1991, 1994; Krebill 1972).

The Gros Ventre drainage is a historical winter range for 4,000–5,000 elk (*Cervus elaphus*) and 200–300 moose (*Alces alces shirasi*). Wild ungulate herbivory can be significant in localized areas, with 2,500 supplementally fed and 1,500 elk remaining on native winter range. Previous aspen investigators working within the Gros Ventre drainage have expressed concern that regenerating aspen with existing levels of herbivory would be difficult. Aspen monitoring in an adjacent drainage, Dry Cottonwood Creek, indicated typically 75% of the regenerating suckers have one or more of the leaders browsed each year. Approximately 90% of the browsing occurs during the fall/winter season and 10% during the spring (Wyoming Game & Fish Department 1999).

Kreibill (1972) concluded that if current browsing and parent tree mortality continued, most of the aspen type in the Gros Ventre would ultimately be eliminated from these winter ranges. Bartos et al. (1994), after monitoring sucker response 12 years post burn in the Breakneck Ridge area, questioned the continued use of fire to regenerate aspen stands that are subject to heavy ungulate use. Such management action could speed the elimination of aspen stands.

Bartos et al. (1994) and Bartos and Mueggler (1981) also evaluated the effects of prescribed fire on decadent aspen stands within the Gros Ventre drainage. The primary purpose of the prescribed burns was to produce more aspen suckers than the local wintering elk population could consume and thus perpetuate aspen stands. Initial suckering response, approximately 20,000 stems per ha, was adequate to regenerate deteriorating aspen stands. Densities 6 years post treatment, 4,300 to 10,300 stems per ha, were approximately the same as pretreatment. Bartos et al. (1994) reported sucker densities 12 years post treatment ranging from 1,500 to 2,400 stems per ha, which was 29 to 38% less than pre-burn densities. The control also had a 39% decrease in production, which was attributed to elk use.

It has been hypothesized, however, that some burned aspen stands are capable of successful regeneration despite heavy elk use (Despain et al. 1986; Gruell and Loope 1974; Houston 1982). Evidence of successful prescribed fire-induced aspen regeneration amid large wild ungulate populations on other sites in the Gros Ventre drainage and elsewhere in northwest Wyoming has encouraged managers to continue treating aspen. An additional 15,000 acres of sagebrush/grassland and aspen have been treated with prescribed and wild fire within the Gros Ventre drainage since the 1974 burn evaluated by Bartos et al. (1994). Managers continue to monitor the effects of fire-induced aspen regeneration and ungulate herbivory to determine site opportunities for successful regeneration. Browsing impacts are usually the greatest on trees less than 13 feet (4 m) tall. DeByle and Winokur (1985) recommend 400 well-formed stems per acre (1,000 per ha) at 13 feet (4 m) for clone establishment. This paper reports on density and height of 8- to 11-year-old fire-induced regenerating aspen stands on opposing aspects.

Setting and Methods

Aspen belt transects were monitored from 1996 to 1999 within the Bacon Creek drainage, a tributary of the Gros Ventre River. It is located approximately 50 km northeast of Jackson, Wyoming, and approximately 10 km southeast of the Bartos et al. (1994) study. Elevation is approximately 2,500 m and is located

near the upper end of the Gros Ventre drainage. Multiple prescribed burns were conducted in the Bacon Creek drainage from the spring of 1989 through the fall of 1991. General objectives were to recycle sagebrush communities and regenerate decadent aspen stands. Successful clone establishment objectives were: (a) mean stem density >12,355 stems per ha, and (b) mean stem height >3 m.

The closest supplemental feeding site is 3 to 4 km from the monitoring sites and has an attendance of approximately 1,000 elk. Supplemental feeding of elk generally begins around January 1 and continues into April of each year. Supplementally fed elk are not confined to the feeding sites and frequently forage various distances from feeding sites, depending on snow depths. An additional 15 to 30 moose also utilize the Bacon Creek tributary.

Monitored clones were burned during the springs of 1989 and 1990 ($n = 4$), and fall of 1991 ($n = 2$). General burning conditions, fuel loads, and fuel moistures varied, resulting in different burn severities and intensities. Post treatment sucker densities appeared adequate for clone reestablishment throughout most treated sites, but herbivory levels appeared to be impacting successful regeneration of some clones, especially those with a southerly exposure. Managers began monitoring clone regeneration on opposing exposures to determine fire-induced regeneration success. Comparing treatment exposures may assist in prioritization of future treatment sites and enhance the odds of successful regeneration.

Six (6) permanent belt transects (0.91 x 30.48 m [3 x 100 ft]) were established during 1996 in previously burned aspen clones and monitored annually (1996 to 1999) for height and density. Sites were located within 300 meters on both sides of Bacon Creek and monitored September or October each year. Four sites were located on the north side (south and southwest aspects) and two sites were located on the south side (northeast aspect) of Bacon Creek. All are within designated winter range for elk and moose. Sucker heights and densities were compared.

Results and Discussion

Mean annual sucker growth rate ranged from -0.03 to 0.21 m and averaged 0.12 m per year. Percentage of stems in lower height classes has decreased while percentages in the upper height classes have increased (figure 1). A 44% reduction of stems in the 0.6–0.9 m (2–3 ft) class occurred from 1996 to 1999. This is the first year (1999) that stems exceeded the 2.7 m (9 ft) height. Bartos et al. (1991) reported sucker growth rates of 0.02 and 0.22 m per year on burned sites in the Breakneck Ridge area of the Gros Ventre drainage.

Mean sucker height 8 to 11 years post fire for all six sites was 1.1 m (3.6 ft) (figure 2). Browsing by elk and/or moose was evident but quite variable, ranging from slight (5–20% use of available leaders) to heavy use (60–80% use of available leaders). Bartos et al. (1994) reported suckers to be only 0.5 m in height 12 growing seasons post burn at the nearby Breakneck Ridge site and attributed the short growth form to repeated browsing by elk. On other sites within the Gros Ventre drainage and Jackson area, Bartos et al. (1991) documented greater mean sucker heights 6 years post burn: Russold Hill—1.0 m, Uhl Draw—0.8 m, and Burro Hill—1.0 m. Browsing level and sucker height responses at the Bacon Creek site appear to be intermediate between the more severely browsed sites at Breakneck Ridge and the less severely browsed sites at Uhl Draw, Russold Hill, and Burro Hill.

Figure 1—Aspen sucker height classes 8 to 10 growing seasons following prescribed burning. A 44% reduction of stems in the 2 to 3 foot height class occurred from 1996 to 1999.

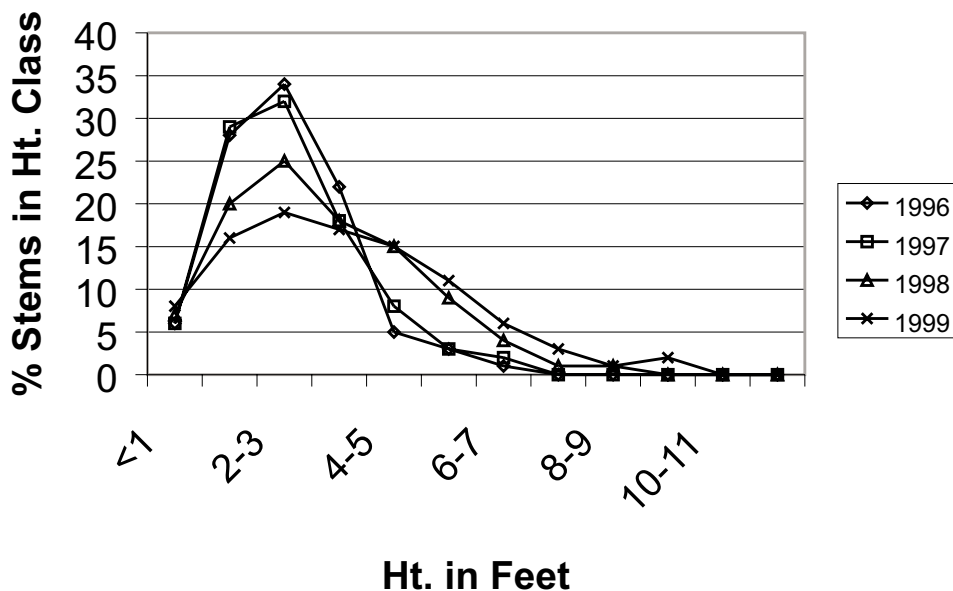
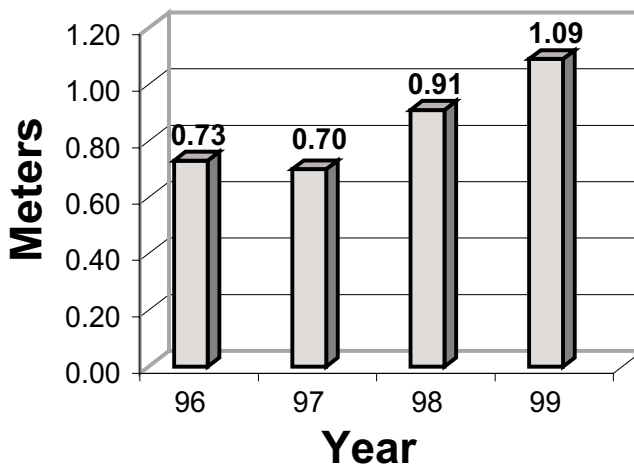


Figure 2—Aspen sucker heights following 8 to 10 growing seasons following prescribed burning.



Height comparisons between suckers on northeast and south/southwest aspects were made. Mean sucker height on south/southwest aspects (0.79 m) was significantly less than mean sucker height on northeast aspects (1.4 m) ($p < 0.05$) (figure 3). Clones on south/southeast aspects receive higher levels of use and are being maintained at shorter growth forms than adjacent clones on northeast aspects. Even though monitoring sites were close to each other (<1 km apart) and were within 300 m of the drainage, herbivory levels were quite different. Differences in sucker heights and herbivory levels were attributed to differences in snow depths and browse availability on opposing aspects.

Sucker heights within the Bacon Creek tributary appear to be slowly approaching the objective height of 3 m. Some suckers on the northerly exposures exceeded 2.7 m (9 ft) and are near the objective of 3 m. They may meet or exceed it within the next year if past growth trends continue. Suckers on southerly exposures are gaining height more slowly. No suckers on southerly exposures exceeded 1.8 m (6 ft). They are more available and are receiving additional herbivory but are slowly gaining height. It may be several more years before they reach the objective.

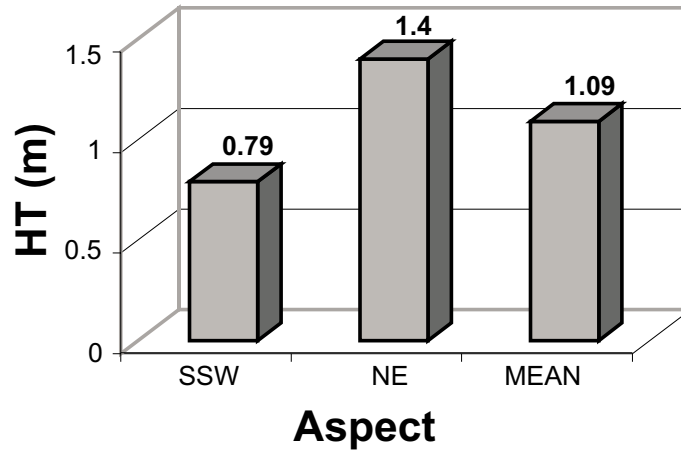


Figure 3—Comparison of aspen sucker heights between aspects (SSW = south/southwest; NE = northeast). Height differentials between aspects were significantly different ($p < 0.05$).

Mean annual sucker densities for all sites ranged from 13,983 to 26,889 stems per ha (5,666 to 10,890 stems per acre) and averaged 19,299 stems per ha (7,816 stems per acre) in 1999. There was no significant decrease in sucker density between 1996 and 1999 ($p < 0.05$) (figure 4). Sucker mortality was noted within clones, but annual production of new suckers appears to be compensating. Sucker mortality is mostly attributed to shepherd’s crook while mortality due to herbivory appears minimal to date.

Mean sucker densities on south/southwest aspects (21,160 stems per ha [8,567 stems per acre]) were greater but not significantly different ($p < 0.05$) from those on northeast aspects (15,609 stems per ha [6,317 stems per acre]) (figure 5). Current levels of herbivory apparently are not impacting sucker densities since they have not changed significantly over the past 4 years on either aspect and are actually greater on southerly aspects where herbivory is greatest. This is in contrast to the adjacent Breakneck Ridge study where sucker densities ranged from 1,500 to 2,400 stems per ha 12 years post burn (a 90% reduction in sucker density when comparing year 1 to year 12) (Bartos et al. 1994).

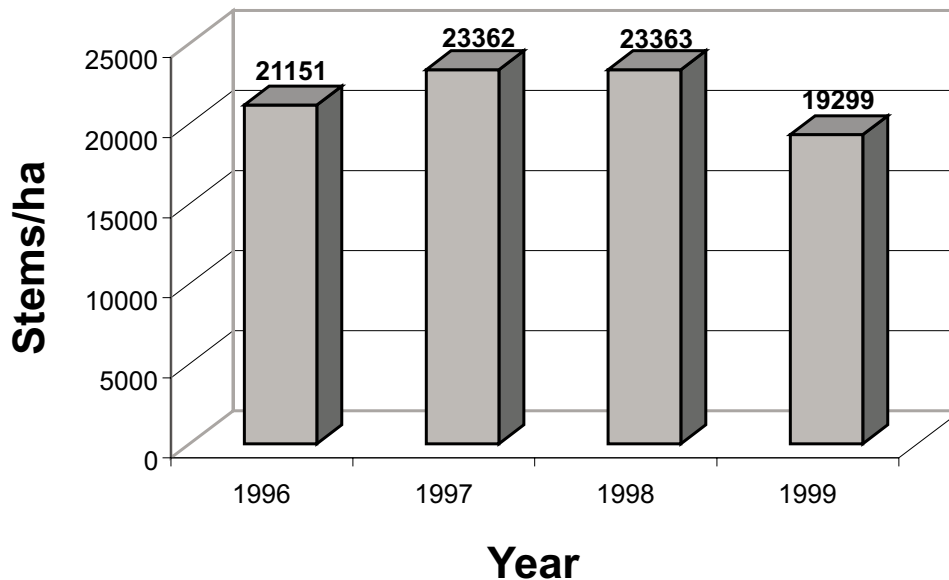
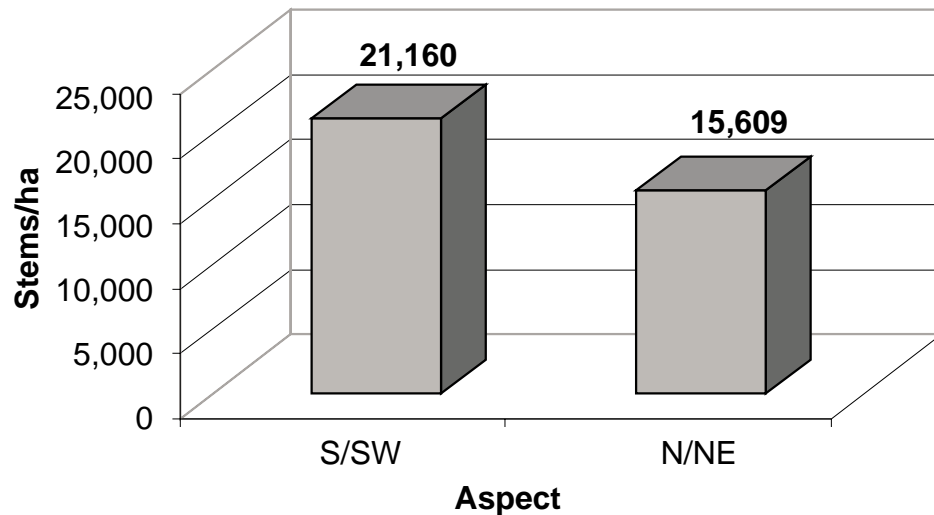


Figure 4—Aspen sucker density 8 to 10 growing seasons following prescribed burning. There was not a significant difference between years ($p < 0.05$).

Figure 5—Aspen sucker density 8 to 10 growing seasons following prescribed burning. There was not a significant difference between aspects ($p < 0.05$).



Summary and Conclusions

Aspen communities are generally seral to conifer climax communities in northwest Wyoming. Through successional processes, aspen communities along with their many ecological and social values are in decline. With drastically altered fire regimes and fuel conditions, managers must take aggressive management action toward restoring these important communities or potentially lose them for good. Success of fire-induced aspen regeneration appears to be quite variable across the landscape. While there are some apparent failures using fire to regenerate aspen, there are also many definite successes in northwest Wyoming. Many of the successful sites are within areas of high winter ungulate populations and even near supplemental elk feedgrounds.

Many factors such as clone vigor, community type, fire intensity/severity, herbivory by wild and domestic ungulates, aspect, elevation, soil type, moisture regimes, etc., will determine the successfulness of our efforts in maintaining aspen on the landscape. Managers' control over these factors ranges from complete control to no control. Selecting potential aspen treatment sites based on aspect appears to be one of many factors managers can control and should be considered in areas of high wintering ungulate populations. Monitoring results in the Bacon Creek tributary indicate northerly aspects have a better chance of escaping suppressive levels of herbivory. Sucker growth rates, heights, and densities indicate successful clone establishment 8–11 years post treatment. Clones on southerly aspects appear to still have vigor, are maintaining adequate densities, and are slowly gaining height. Southerly aspect will require continued monitoring before drawing conclusions on success/failure.

Detailed knowledge of wintering ungulate distribution and concentrations is also critical to successful aspen regeneration and is something managers can obtain. Although the Breakneck Ridge area and Bacon Creek are close to each other and adjacent to supplemental elk feedgrounds, herbivory levels differ considerably. Historic observations of winter elk use indicate much larger numbers using the Breakneck area for wintering, migration, and loafing. Combining the knowledge gained from Bartos et al. (1994) with what we now know about elk distribution, managers would emphasize the Breakneck Ridge site for potential aspen regeneration. More detailed information on numbers of

animals, timing of use, and duration of use will be helpful in selecting potential treatment sites.

The time of initiation of supplemental elk feeding can be managed and may affect aspen herbivory levels. Herbivory appears to be reduced during years when abrupt accumulations of snow trigger earlier supplemental feeding in the Gros Ventre. The potential exists for early initiation of feeding to attract elk away from treatments until stems are more browse resistant.

Locating treatments a certain distance from elk feedgrounds may or may not help to protect suckers from browse pressure. Localized wintering elk and/or moose populations can easily suppress aspen regeneration. Determining seasonal use patterns for wild ungulates is critical. Fire-induced aspen regeneration within summer and transitional ranges appears to be very successful in northwest Wyoming.

Fire-induced aspen regeneration has also been successful in human-impacted areas. Areas receiving higher levels of human use usually preclude wintering wildlife use, thus reducing the probability of suppressing herbivory levels. While winter browse for ungulates is not realized, all other values associated with aspen communities will still be realized.

Other factors such as selection of aspen community type, stand vigor, soil type, and fire intensity/severity can be controlled by managers. We must combine our knowledge of such factors and apply it to future aspen treatments—to increase our odds of success and to increase the efficiency of our limited resources in light of ongoing plant community succession.

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