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Big Game and Cattle Influence on Aspen Community Regeneration Following Prescribed Fire

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ABSTRACT

Aspen (*Populus tremuloides* Michx.) is a major component of Intermountain forest ecology and relies on periodic disturbance, such as prescribed fire, to perpetuate. On the Manti-LaSal National Forest in central Utah, both big game and cattle depend on forage growing on forested lands, which has contributed to intense conflict. Understanding the effects of browsers on recently burned aspen stands is critical to managing the regeneration of these communities. This study measured the effects of cattle and big game foraging on regenerating aspen communities. Three study sites were selected from a 142-ha prescribed burn conducted in an aspen-conifer stand on the Ferron District of the Manti-LaSal National Forest in 1989. Each of the three study sites was subdivided into four areas and randomly assigned one of the following treatments: big game and cattle exclusion (No Use), big game exclusion (Cattle Use), cattle exclusion (Big Game Use), and open access (Dual Use). Vegetation was sampled in 1991–1994, 1999, and 2005. Density, biomass, height, nested frequency, and cover of aspen suckers were measured. Nested frequency and cover were measured for all other species encountered. Aspen cover, density, and biomass showed a significant year-by-treatment interaction ($P < 0.05$). Aspen and understory regeneration responded similarly to No Use, Cattle Use, and Big Game Use. Dual Use resulted in lower ($P < 0.05$) aspen regeneration and more annual, weedy species in the understory. In 2005, Dual Use aspen cover (4%) was lower ($P < 0.05$) than the other three treatments: Big Game Use (25%), Cattle Use (31%), and No Use (34%). Controlled burning to regenerate aspen will be most successful under light stocking rates for both big game and cattle to allow suckers to develop beyond the browse line (>2 meters).

Introduction

Aspen (*Populus tremuloides* Michx.), the most widely distributed native North American tree species (Little, 1971; Sargent, 1890), is a major contributor of forest resources in the Intermountain Area (Bartos, 2001). In Utah, Colorado, Nevada, southern Idaho, and western Wyoming, it occupies over 2.02 million ha (Bartos, 1979; DeByle et al., 1989). Aspen communities provide important habitat for a wide variety of wildlife (Chong et al., 2001), summer range for domestic livestock (Bartos et al., 1991; Brown and DeByle, 1989; Gullion, 1977), critical watersheds, wood, recreation resources, aesthetics (Sheppard et al., 2006), and other ecological goods and services (Constanza et al., 1997). These resource-rich communities are also important indicators of ecosystem ecological integrity (Kay, 1997; White et al., 1998).

Aspen reproduce primarily through root suckering stimulated by major disturbances such as burning or clear-cutting (Bartos et al., 1991; Sheppard et al., 2006). Lack of disturbance and overutilization has interrupted the cycle of aspen regeneration, causing their decline in western forests (Bradley et al., 1992; DeByle et al., 1989; Kay, 1997) and reducing valuable resources (Bartos et al., 1991; Bradley et al., 1992; Canon et al., 1987). In Utah, there has been at least a 60% decrease in aspen since the arrival of Europeans (Bartos, 2001). On the Manti-LaSal National Forest in central Utah, it is estimated that aspen stands decreased 34% between 1915 and 1965 due to conifer invasion (USDA-FS, 1986). This decrease diminished many valuable resources, including understory forage production (DeByle et al., 1989; Julander, 1955; Kleinman, 1973; Stam et al., 2008), negatively affecting the carrying capacity for resident wildlife and livestock.

Prescribed burning is now widely used to promote aspen regrowth and increase productivity of understory species (Bartos and Mueggler, 1981; Brown and DeByle, 1989; Smith et al., 1972). Stand-replacing prescribed fire effectively kills the overstory, warms the blackened soil, damages shallow lateral roots providing hormonal stimulation, releases nutrients, and provides favorable growing conditions for aspen suckers (Sheppard et al., 2006). The high-quality forage in initially low quantities following fire makes the burned areas both highly preferred by livestock and wildlife and highly susceptible to overuse, furthering the decline of aspen (White et al., 1998). In some areas, the animals that

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compete most for these resources are cattle and big game, primarily elk and mule deer, and some moose. Free-ranging beef cattle and big game diets include grass, forbs, and browse in varying proportions depending on selection factors such as site quality and season of use. When forage is plentiful, cattle and big game are generally not in competition for food (Stevens, 1966; Vavra, 1992). However, when highly preferred resources such as postburn aspen stands are scarce, intense competition and damage due to overutilization may result.

Big game/livestock conflicts are a major resource issue on rangelands and have a significant impact on the livestock industry in the 11 western states (USDA-FS, 1992), a situation exacerbated by increases in the number of elk and mule deer (USDA-FS, 2001). Although the damage done by livestock overutilization has long been documented, there is growing evidence that expanding big game populations may be significantly responsible for range overuse and riparian degradation (USDA-FS, 1990). This research is designed to contribute to critical resource information that can aid in the sustainable management of aspen forests. Despite the succession of aspen and understory regeneration following fire being extensively studied, the long-term effects and interactions of cattle and big game foraging on succession are poorly understood. This study was designed to determine the effects of cattle and big game on aspen community regeneration and productivity in burned aspen stands.

Study Area

In the fall of 1989, the Ferron District of the Manti-LaSal National Forest completed a prescribed burn on an aspen-conifer stand located in the 1 863-ha Willow Lake cattle grazing unit of the Ferron C&H Allotment. Roughly average precipitation fell the summer preceding the burn, including 6.5 cm of late July to early August rains. Soil moisture was sufficient to protect the roots of the aspen trees during the burn. The target area was approximately 405 ha, but only 142 ha actually burned, which is approximately 8% of the management unit. The fire created a mosaic of burned and unburned overstory on the North side of Ferron Mountain at the head of Wrigley Creek where the elevation ranges from 2 865 to 2 926 m. The topography of the study area is mountainous with flat meadow areas and undulating shelves that lie along the mountain side. Springs and streams are abundant and provide water for a number of ponds. The high elevation and rain shadow effect of the mountains create a cooler, drier site, resulting in somewhat dwarfed vegetation, including trees. The prefire vegetation consisted of mixed aspen–conifer forest interspersed with mountain big sage (*Artemisia tridentate* Nutt.) and silver sagebrush (*Artemisia cana* Pursh)–grass meadows. The principle conifers were white fir (*Abies concolor* [Gord. & Glend.] Lindl. Ex Hildebr.), Engelmann spruce (*Picea engelmannii* Parry ex Engelm.), subalpine fir (*A. lasiocarpa* [Hook.] Nutt.), and Douglas fir (*Pseudotsuga menziesii* [Mirb.] Franco).

Foraging Pressure

The Ferron C&H Allotment encompasses the burned area and has historically been used by 764 head of cattle from 21 June through 8 October. Following the fire (summer of 1990), no cattle were allowed, but no attempts were made to discourage big game use of the newly burned areas. In 1991, foraging was again permitted to facilitate this study. The study site is located on the Willow Lake Unit of the allotment where the 764 head of cattle (2.5 head per ha) were placed for one month each summer. The month the cattle were in the Willow Lake Unit rotated each year (e.g., September 1991, August 1992, July 1993, September 1994).

Although moose are also found in the area, the big game animals of major concern for this research were primarily elk and, to a lesser extent, mule deer. The study area is located within the Utah Division of Wildlife Resources (UDWR) Manti Elk Herd Unit, which is home to the largest elk herd in Utah. Results from aerial counts of the herd showed 7 700 in 1991, 9 100 in 1997 (USDA-FS, 2001), 11 100 in 2003, and 9 400 in 2005 (UDWR, 2010). Our study site is located in a critical-use calving and calf-rearing area for some of the elk that winter on Sage Flat, southwest of Ferron, Utah. Approximately 450 wintering elk are on Sage Flat (UDWR, 1990) and one-third (150 head) of them migrate to the Ferron Mountain, Wrigley Hill spring calving range. Observations made in the study area suggest that elk numbers were about 250 head. Each year, elk arrive at the study area just after snow melt in the spring, make use of it sporadically throughout the summer months, and leave around mid-October. Thus there are about 250 × 4 months = 1 000 elk units each growing season. Although we do not have any estimate on the number of mule deer in the area, they were observed to be present during the study.

Study Sites

Within the burned area, three 0.4-ha locations (study sites) were subjectively chosen to be comparable in exposure, understory vegetation, size, slope, tree density, and burn intensity (Site 1: lat 39°08.222′N, long 111°21.852′W, elevation 2 884 m; Site 2: lat 39°07.779′N, long 111°21.764′W, elevation 2 897 m; Site 3: lat 39° 07.560′N, long 111°20.920′W, elevation 2 921 m). Tree density across all sites averaged 2 427 trees per hectare, or one tree per 4.1 m^2, of which approximately 25% were aspen and 75% were conifer. All sites were severely burned where all understory vegetation was removed and all overstory trees were killed, leaving standing dead trunks. All three sites had gentle slopes less than 5% but were adjacent to steeper areas greater than 40% that maintained heavy tree overstory cover. The soils of the study sites had a clay loam texture, pH ranging from 6.2 to 7.4, and a color of 10YR 2/1 to 2/2. Precipitation for the sites during the 15 years of the study along with the 30-year average was obtained from the NRCS Buck Flat SNOTEL located at lat 39°08′N, long 111° 26′W (about 6.5 km from the study sites), elevation 2 874 m. Precipitation roughly followed the monthly 30-year average for a total of 80 cm per year during the study, except for slightly below average precipitation during the first 3 years and a spike of 40 cm in 1994 during January to March.

Methods

Each study site was subdivided into four 0.1-ha units, and each unit was randomly assigned one of the four treatments: 1) exclusion of both big game and cattle (No Use), 2) big game exclusion (Cattle Use), 3) cattle exclusion (Big Game Use), and 4) open access to both browsers (Dual Use). Treatments were accomplished by the following: No Use—a permanent 2.1-m tall woven wire fence was maintained year round; Cattle Use—a 2.1-m tall let-down woven wire fence remained up throughout the year except when the cattle came on the management unit; Big Game Use—a 1.2-m tall woven wire fence, which remained down through most of the year to allow free access by big game, was put up to exclude the cattle when they were on the unit; Dual Use—had no fence, allowing open access year round. The Cattle Use treatment technically also allowed big game access during the time that cattle were on the allotment. However, it is unknown how many big game used the Cattle Use areas when cattle were present in the study areas. It is assumed the confounding was reduced because the researchers and UDWR personnel observed that big game tended to avoid allotments occupied by cattle. However, because elk can become habituated to cattle, some of the elk may not have been deterred, resulting in an overestimated impact by cattle. Fences were maintained two or more times per year as needed to prevent any further treatment confounding including during years between data collections.

Vegetation within each treatment was sampled in August of 1991, 1992, 1993, 1994, 1999, and 2005. Data collected consisted of density, biomass, height, cover, and frequency of live aspen suckers. Nested frequency and cover estimations for all other species encountered were also recorded. Using stratified random sampling, five 25-m line