Habitat Selection, Foraging Behavior, and Dietary Nutrition of Elk in Burned Aspen Forest

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Abstract

Prescribed burning is frequently used to enhance regeneration of aspen. The effects of burning aspen on wild ungulates are poorly understood. We used free-ranging tame elk to assess diet composition and quality on a site containing a 40-ha aspen burn, pure unburned aspen, mixtures of aspen and conifers, and other habitats. Foraging preferences of elk among the habitats were also investigated. Overall, no dietary nutritional differences were found between burned and unburned aspen habitats. Diet composition by forage class varied somewhat, due primarily to an abundance of very palatable post-fire forbs on the burn. Time spent feeding was significantly different among habitats. The burn was substantially more attractive for foraging probably because preferred forages were consistently available and greater foraging efficiency was possible than in other habitats.

Key Words: diet selection, elk, fire, burning, aspen, nutrition, forage quality

Aspen (*Populus tremuloides*) is generally regarded as a seral species that requires major disturbance, such as fire or clearcutting, to reduce competition with other tree species and to stimulate growth of aspen suckers (Bartos and Mueggler 1979, Mueggler 1985). Because fire was formerly the predominant influence on plant succession on most aspen sites, fire control (DeByle et al. 1987) has allowed forests to reach advanced succession, usually to conifers in the West, at the expense of herbaceous plants and deciduous shrubs and trees (Gruell 1983, Jones and DeByle 1985). Changes in understory production in the aspen type, following fire, can greatly enhance the desirability of an area to foraging ungulates. Production of palatable annuals often increases dramatically after burning the aspen type (Bartos and Mueggler 1979). Tall shrubs, that resprout from root crowns following burning (Lyon and Stickney 1976), may further improve the habitat of a burned aspen type. Large areas of summer range for mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus nelsoni*) should provide increased forage for ungulates if the forest canopy is opened to promote understory growth (Julander and Jeffrey 1964).

The Forest Service and other land management agencies have recently begun prescribed burning of aspen communities in the West to prevent succession to conifer species of low commercial value, to regenerate aspen, and to improve forage production and wildlife habitat. The purpose of this study was to compare composition and quality of elk diets in burned and unburned aspen areas, and to determine foraging preferences among the burned aspen type and surrounding habitats.

Study Area and Methods

The experiment was conducted on the Caribou National Forest in southeastern Idaho during the summers of 1983 and 1984. The study site consisted of a 40-ha area burned in September 1981, located in the midst of pure aspen and aspen-Douglas fir (*Pseudotsuga mensiesii*) mixed forest.

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The prescribed fire was relatively severe; it immediately killed most of the aspen overstory (Brown and DeByle 1987) and caused marked changes in the understory. From preburn in the summer of 1981 to postburn 2 years later (1983), forbs increased fifteen-fold, to 1,245 kg/ha; grasses increased 56%, to 504 kg/ha; whereas shrubs decreased to one-fourth of their preburn biomass, to 360 kg/ha. Total biomass in all 3 components had increased 19%. The 1984 survey of the same plots indicated a slight decrease in forbs and grasses, to 904 and 490 kg/ha, respectively, and an increase in shrubs to 628 kg/ha. Total understory biomass was still 14% greater than before burning.¹

Where conifers were not dominant, the understory vegetation, both before and after burning typically was very lush, and consisted mainly of serviceberry (*Amelanchier alnifolia*), snowbrush (*Ceanothus velutinus*), snowberry (*Symphoricarpos oreophilus*), chokecherry (*Prunus virginiana*), and myrtle pachystima (*Pachystima myrsinites*) in the shrub component; Englemann aster (*Aster engelmannii*), sticky geranium (*Geranium viscosissimum*), Fendler meadowrue (*Thalictrum fendleri*), and silky lupine (*Lupinus sericeus*) in the forb component; and pinegrass (*Calamagrostis rubescens*), blue wildrye (*Elymus glaucus*), and elk sedge (*Carex geyeri*) in the grass-sedge component. Pachystima was killed by fire and, therefore, seldom occurred in the burn. Wild hollyhock (*Iliamna rivularis*), fireweed (*Epilobium angustifolium*), and prickly lettuce (*Lactuca serriola*) were fire-induced forbs dominating the post-burn understory by the 2nd and 3rd years. Other plant communities near the study area included dry meadows, Douglas fir forest, clearcuts, sagebrush grass, and lodgepole pine (*Pinus contorta*) stands.

Mean annual precipitation is approximately 500 mm. Precipitation in 1983 was above normal and 1984 precipitation was slightly below normal. July through September temperatures vary between 0° C and 30° C. Slopes average 45% with a maximum of 53% and minimum of 30%. The elevation ranges from about 2,200m to 2,350m.

Four 6- to 7-year-old tame elk, trained as yearlings in 1977 (Collins et al. 1978), were used for diet composition comparisons. Approximately 500 hours were spent familiarizing the animals with the observer's presence prior to the first summer's data collection. The animals were released into a 2-ha enclosure which encompassed about equal areas of burned and unburned aspen, which were adjacent to both dry meadow and conifer habitats. They were kept in the enclosure for 8–10 days to allow them to acclimate to the site and the forage before releasing them for sampling purposes.

The study site was divided into 4 equal-sized replications (REPs) within each treatment (burned and unburned aspen with only scattered conifers). Treatment comparisons were largely confined to burned and unburned aspen even though some data were recorded from other vegetation types as well. Such use of replicates divided within a single treatment can be viewed as "pseudoreplication" (Hurlbert 1984). Thus, statistical inference is limited to the applied areas, not to the vegetation types represented. But, see Hawkins (1986) for an alternative view of this problem.

Diet composition was determined using bite-counts (Wallmo and Neff 1970). For each grazing trial, 2 animals were released

¹From unpublished data on file at USDA Forest Service Intermountain Fire Sciences Laboratory, Missoula, Mont.

simultaneously from the enclosure through a gate bordering burned and unburned areas. The animals were allowed to range freely during observations. Bites were counted while the observer was close (1-2 meters) to the animal, thereby assuring accurate identification of forage being consumed. Plant parts and estimated amounts consumed were also recorded to insure a similar distribution when these plant species were later collected for laboratory analyses.

Time spent feeding and traveling within each replication and within other vegetation types was recorded. Length of grazing trials varied, generally from 30 minutes to 3 hours, due to the unpredictable behavior of the animals. When possible, bite counts were taken for 30-minute periods per animal, rotating between the 2 released animals. The objective for each 2-week period was to have an approximately equal number of bites for all 4 animals, taken during morning and evening trials.

Following each 2-week period, the percentage of bites of each species in each treatment was calculated. Principal dietary species (>2% of bites) in each treatment were collected for laboratory analysis. Simulated bites were hand-plucked from the same areas (often the same plants) as those where foraging occurred; care was taken to select the same plant parts as those selected by the animal. Bite weights were determined by dividing the total dry weight of the collected sample by the number of "bites" collected.

Forage samples were analyzed for crude protein (CP) according to A.O.A.C. (1965) techniques. In vitro dry matter digestibilities (IVDMD) of species collected were estimated via the two-stage procedure (Tilley and Terry 1963, as modified by Moore 1970) using rumen fluid from a fistulated elk maintained on alfalfa hay.

Nutritional contribution of principal dietary species, based on dry-weight consumption per 2-week period per REP, was calcu-

lated by multiplying the proportion of each species by its IVDMD or CP value. Total dietary IVDMD or CP per period in each REP was determined by adding the nutritional contribution values of all principal species.

Data acquired in 1983 were less extensive than those in 1984. Experience gained the first year facilitated data collection in the second year. Earlier snowmelt and greater effort resulted in a longer data gathering season in 1984; we began a week earlier (July 4) and ended a month later (September 29) than in 1983. Consequently, 1983 data were used primarily for between-year comparisons while the 1984 data were used for both between-year and extensive within-year comparisons.

A randomized-block design (RBD), split plot in time, with 4 blocks (REPs) was used for analysis of the 1984 data. Dietary IVDMD and CP (per REP) were separately analyzed to compare treatments. Between-year nutritional comparisons incorporated these same variables in a RBD, with split plot in time (repeated measures). Similar analyses were used for diet composition comparisons. Percent bites of separate forage classes (shrub, grass, forb) were variables used for a general comparison of diets in burned and unburned areas. A RBD (split plots) was used to analyze within years while between-year comparisons employed a RBD, split, split plot by time and forage class (repeated measures). Least Significant Difference (LSD) tests were run to compare responses within periods.

Results

Diet Composition Comparisons

Overall, 92,901 bites were observed. Of these, 59,072 were taken in the burned aspen, 32,748 in the unburned aspen, and 1,081 in other habitats. In both years significantly more bites ($P<0.05$) were

Table 1. Percent of bites taken by species, class, period and treatment in 1984.

	Period												Mean	
	7/4-7/8		7/10-7/22		7/24-8/7		8/10-8/24		9/1-9/13		9/15-29		B	U
	B	U	B	U	B	U	B	U	B	U	B	U		
Browse														
<i>Amelanchier alnifolia</i>	14	14	30	20	29	23	58	42	57	55	52	40	40	32
<i>Ceanothus velutinus</i>	T	2	1	4	1	2	1	1	1	T	T	1	1	2
<i>Pachystima myrsinites</i>	0	T	T	6	T	14	T	9	T	5	T	11	T	8
<i>Populus tremuloides</i>	1	7	T	1	T	1	T	1	1	1	T	1	T	2
<i>Prunus virginiana</i>	0	T	0	0	T	T	T	T	T	T	T	T	T	T
<i>Salix scouleriana</i>	1	3	5	3	2	10	2	4	2	1	3	2	3	4
<i>Symphoricarpos oreophilus</i>	3	2	T	T	T	1	T	1	2	2	T	1	1	1
Other shrubs	T	2	T	T	T	T	T	T	1	T	2	4	T	1
Total	19	30	36	34	32	51	61	58	64	64	57	60	45	50
Grass														
<i>Calamagrostis rubescens</i>	1	1	T	2	1	1	T	1	T	T	2	3	1	1
<i>Elymus glaucus</i>	17	14	2	5	2	3	2	4	4	2	3	4	5	5
Other grasses	7	7	T	8	T	1	T	3	T	T	T	4	1	4
Total	25	22	2	15	3	5	2	8	4	2	5	11	7	10
Forb														
<i>Aster engelmannii</i>	9	13	13	17	6	9	3	7	3	9	3	6	6	10
<i>Castilleja miniata</i>	1	1	3	3	2	8	T	3	T	T	T	T	1	3
<i>Collomia linearis</i>	0	0	0	T	T	0	0	0	0	0	0	0	T	T
<i>Epilobium angustifolium</i>	0	0	3	1	4	T	3	T	2	T	2	T	4	T
<i>Geranium viscosissimum</i>	21	17	10	9	6	7	1	2	2	2	T	1	7	6
<i>Iliamna rivularis</i>	2	0	17	0	24	0	12	T	8	0	16	0	13	T
<i>Lactuca serriola</i>	0	0	T	0	7	0	10	0	7	0	3	0	5	0
<i>Lupinus sericeus</i>	0	0	0	0	T	0	T	T	T	T	T	T	T	T
<i>Taraxacum officinale</i>	10	5	1	4	1	1	1	1	1	T	T	T	2	2
<i>Thalictrum fendleri</i>	9	4	11	10	11	16	5	17	7	18	8	20	8	14
Other forbs	2	5	2	6	2	2	1	2	1	T	T	1	1	3
Total	54	45	60	50	63	43	36	32	31	29	32	28	47	38

Treatment B = burned aspen, U = unburned aspen. T = less than 0.5% of bites taken. Detailed data on relative abundances, preferences, and percentage bites taken in 1983 can be found in Canon (1985).

taken in the burned area. During similar time periods, in 1983 there were 13,628 (60%) bites taken in the burn and 9,013 in the unburned; in 1984 there were 27,144 (70%) bites taken in the burn and 11,780 in the unburned.

Diet consumption by forage class was very similar between years and treatments. Shrubs and forbs dominated the diet; grasses contributed only minor proportions (Fig. 1). Percent bites taken of each forage class did not differ ($P < 0.05$) among treatments or years.

Serviceberry dominated the shrub diet on both treatments (Table 1). *Pachystima* was often eaten in unburned areas, but it was killed by fire and essentially unavailable in the burn. Scouler willow (*Salix scouleriana*) was readily eaten but was seldom encountered in either treatment. Common forbs consumed in both treatments were Engelmann aster, sticky geranium, and meadowrue. Post-fire forbs occurring only in the burn contributed 15% of all bites taken on the burn in 1983 and 26% of bites on the burn in 1984. These forbs consisted of wild hollyhock, fireweed, slender-leaf collomia (*Collomia linearis*) (1983 only), and prickly lettuce. Prickly lettuce grew especially well in 1984, the third year after burning, and contributed heavily to the diet that year. In 1984, 48%

Fig. 1a. Percent of bites taken by year and forage class, totaled over both treatments, for the period 12 July to 24 August.

1b. Percent of bites taken by treatment and forage class, totaled over both years, for the period 12 July to 24 August.

Table 2. 1984 CP and IVDMD values for individual species by period and treatment.

Species		% CP						% IVDMD					
		7/7	7/22	8/9	8/24	9/13	9/29	7/7	7/22	8/7	8/24	9/13	9/29
Browse													
<i>Amelanchier alnifolia</i>	B	17.6	15.8	14.8	13.5	15.1	11.6	65.2	60.6	57.7	60.5	55.7	57.9
	U	19.2	14.9	13.6	15.2	14.2	12.7	65.7	60.9	58.0	57.6	54.2	52.8
<i>Ceanothus velutinus</i>	B	—	18.8	17.0	15.1	13.2	13.6	—	61.9	61.7	65.4	54.2	52.9
	U	—	19.7	17.1	15.9	13.7	14.4	—	63.8	63.3	58.3	52.2	54.8
<i>Pachystima myrsinites</i>	B	—	—	—	—	—	—	—	—	—	—	—	—
	U	10.8	10.0	9.2	9.7	10.5	10.8	55.2	53.6	48.8	52.6	47.7	61.3
<i>Populus tremuloides</i>	B	21.4	—	—	11.5	11.8	9.3	58.0	—	—	50.7	46.4	49.6
	U	22.6	—	—	16.8	12.2	13.4	72.7	—	—	56.9	50.9	54.0
<i>Salix scouleriana</i>	B	—	18.3	15.9	14.9	15.1	11.7	—	61.6	55.3	52.3	57.2	50.7
	U	16.7	15.7	19.7	15.5	14.4	9.9	62.2	60.9	57.5	60.7	51.9	53.8
<i>Symphoricarpos oreophilus</i>	B	16.6	—	—	15.1	11.2	9.4	71.5	—	—	69.1	64.1	59.9
	U	15.7	—	—	15.2	11.0	9.0	66.3	—	—	64.4	58.7	58.9
Grass													
<i>Calamagrostis rubescens</i>	B	14.1	—	—	—	—	8.8	66.0	—	—	—	—	56.6
	U	18.0	—	—	14.8	—	9.8	68.5	—	—	60.3	—	57.7
<i>Elymus glaucus</i>	B	23.8	15.2	16.4	13.9	13.5	10.9	75.3	67.6	66.1	62.7	66.4	62.5
	U	21.3	15.2	17.9	20.2	11.8	17.5	73.4	71.0	66.6	67.2	62.8	60.9
Forb													
<i>Aster engelmannii</i>	B	22.1	16.0	12.3	11.3	10.7	9.6	77.5	72.9	69.6	67.3	67.0	58.2
	U	23.8	17.4	15.1	14.4	13.1	14.1	75.6	75.2	67.4	68.5	69.2	71.9
<i>Castilleja miniata</i>	B	—	14.9	12.4	13.2	9.9	—	—	71.4	70.5	70.3	60.5	—
	U	—	19.6	13.3	15.7	13.6	—	—	74.2	71.1	72.4	66.9	—
<i>Epilobium angustifolium</i>	B	—	17.0	18.9	15.3	13.9	10.2	—	74.1	72.1	71.8	69.8	68.3
	U	—	—	—	—	—	—	—	—	—	—	—	—
<i>Geranium viscosissimum</i>	B	19.9	14.0	13.3	15.4 ¹	12.7	—	74.4	72.5	71.1	74.6	73.4	—
	U	23.6	14.6	15.2	19.0	15.3	—	75.6	71.1	69.2	77.4	74.2	—
<i>Iliamna rivularis</i>	B	22.4	16.8	13.4	12.1	16.9 ¹	12.8	84.4	78.4	69.9	64.9	75.9	75.7
	U	—	—	—	—	—	—	—	—	—	—	—	—
<i>Lactuca serriola</i>	B	—	—	14.7	14.8	13.3	9.4	—	—	81.6	75.6	74.9	65.9
	U	—	—	—	—	—	—	—	—	—	—	—	—
<i>Taraxacum officinale</i>	B	11.7	—	—	14.7	—	—	81.9	—	—	72.2	—	—
	U	13.5	13.5	—	—	—	—	79.9	78.0	—	—	—	—
<i>Thalictrum fendleri</i>	B	21.2	15.7	14.6	12.5	12.6	7.5	81.0	81.2	76.4	78.3	78.3	72.7
	U	22.3	16.8	14.5	17.6	12.5	12.5	80.1	78.5	78.3	78.4	75.5	77.0

¹Consumption shifted from flowering parts and leaves to leaves only with subsequent increase in CP and IVDMD.

LEGEND: % CP = Percent Crude Protein.

% IVDMD = Percent in vitro digestible dry matter

B = burned aspen

U = unburned aspen

of forb bites in the burn were wild hollyhock, prickly lettuce, and fireweed. The most consistently consumed grass was blue wildrye.

The longer 1984 season produced a clearer picture of dietary changes over time. The percentage of bites taken in the burn was substantially greater until late September, when earlier senescence of forage and leaf drop in the burn resulted in a shift of foraging activity from burned to unburned areas (Fig. 2). Relatively few bites were taken in other habitats except in early summer when grasses were particularly lush in meadows.

Fig. 2. Percent of bites taken by site and period in 1984. Early summer exploratory behavior is evident. (B = burned aspen; U = unburned aspen, M = dry meadow; L = lodgepole pine; R = roadside).

A seasonal shift from forb to shrub consumption occurred (Table 1). Forb consumption began to decrease on the unburned area on 22 July and on the burn on 7 August. Differences between treatments, however, were not significant for any period. Shrub consumption was similar in both treatments throughout the summer and into fall, with early summer fluctuations directly related to forb consumption. Grass consumption was relatively high in early July, especially on the burn, but dropped rapidly and remained low to the end of September.

Nutritional Comparisons

Mean dietary CP values were 14.5 ± 0.45 SE and 15.1 ± 0.41 SE for similar time periods (12 July to 24 Aug.) in 1983 and 1984, respectively. No differences were found between treatments. Mean dietary digestibility was 2% greater in 1983 (67.5 ± 0.44) than in 1984 (65.5 ± 0.75). No differences in dietary IVDMD values were found between treatments. Dietary crude protein remained above 13% and IVDMD above 60% in both treatments until the end of August during both years, thus providing excellent forage value.

Seasonal trends in nutritional values are most apparent in the 1984 data due to the longer field season. Dietary CP initially was high in early July and dropped gradually as the season progressed (Fig. 3). By 29 September, dietary CP was still above 10% in both treatments ($P < 0.05$), and the mean treatment values were less than 0.5% apart (burn CP = 14.55 ± 0.53 , unburn CP = 14.92 ± 0.46). Through September, significant treatment $\times$ period interactions also occurred with minor fluctuations ($< 2\%$ difference between treatments). Digestibility values remained high (above 57%) throughout the summer in both treatments (Fig. 3) with seasonal means being 65.6 ± 0.9 in the burned treatment and 63.7 ± 1.3 in the unburned treatment. No significant treatment effect ($P < 0.05$) was found; nor was the interaction of treatment $\times$ period significant. Effects of time (period) were significant for both nutritional parameters, but these changes were small, and crude protein and digestibility remained high to the end of September.

Fig. 3. Dietary nutritional values by treatment over six 2-week intervals in 1984. (B = burned aspen; U = unburned aspen).

Nutritional values of individual species declined gradually over the season (Table 2). Overall, crude protein values of forbs were highest initially, but tended to drop most rapidly. Crude protein values of shrubs were not as high initially but they did not drop as much during the season. Digestibilities of forbs remained high throughout the summer. Digestibilities of shrubs were consistently lower than those of forbs.

Foraging Efficiency

Comparisons between treatments were made for mean bites per feeding minute (BPM), mean traveling time, and mean bite weights. Feeding minutes were those times when the animals were not resting, grooming, or traveling. Searching locally for palatable forage was classified as foraging, not travel. Although there was no significant difference between treatments in bites per minute, the mean BPM per 2-week period was consistently greater on the burn until the final period of 1984. Overall mean BPM for the burn was 16.19 ± 1.39 compared to 13.81 ± 2.14 for the unburned areas.

The animals also traveled less between feeding bouts on the burn. In 1984, a total of 36 minutes per bout was spent traveling on the burn while 419 minutes of travel were recorded while in the unburned replications. Time on burned areas almost always was spent strictly feeding. Travel outside of replication boundaries was not included in this assessment.

Mean bite weight of principal dietary species (g/bite) was also consistently greater on burned areas with the overall 1984 mean being 0.71 ± 0.05 on the burn and 0.56 ± 0.03 on unburned sites. The heavier bite weights on the burn appeared to be the result of more robust plants producing leaves of larger size.

Discussion

The 4 tame elk expressed an obvious preference for foraging on the burned aspen area throughout the second and third summers following the autumn 1981 prescribed fire. An evaluation of their diets did not indicate that this choice was based on any nutritional improvements following burning. This supports the findings of Blank (1984), who detected small nutritional differences in vegetation on this and nearby burns in the first growing season after fire but not in the second. Hobbs and Spowart (1984) observed no consistent improvements in CP or IVDMD of forages consumed by mountain sheep (*Ovis canadensis*) or mule deer in spring in Colorado that could be attributed to fire. However, these animals were able to select diets of higher nutritional value on burned grassland and mountain shrub communities in winter, when high

quality forages were limited. Elk, being larger animals with greater rumino-reticular volume, are not likely to forage as selectively as mule deer or mountain sheep. Rowland et al. (1983) found that elk selected winter diets of similar nutritional value in burned and unburned ponderosa pine-bunchgrass communities in New Mexico. Elk are successful generalists, able to select diets of similar nutritional value in a variety of habitats with large variation in quality of forage resources (Pallesen 1979, Baker and Hobbs 1982).

Consistently eaten forage species in this study were similar in burned and unburned areas. Exceptions were pachystima that only occurred in unburned aspen, and 3 preferred forb species that occurred only on the burn. Since the same species were generally sensed as palatable by the animals in both areas, and few nutritional differences were found, other factors undoubtedly were involved in the animal's preference for the burned area. Preferred forages were more consistently available on the burn than in the unburned aspen forest. For example, serviceberry was very common in both burned and unburned areas; however, availability of serviceberry was greater on the burn because there was less interference from other shrubs of lower palatability. Serviceberry resprouts well from root crowns; it becomes prominent in early succession following fire (Lyon and Stickney 1976). Conversely, other shrubs, that make up dense shrub motts that restricted availability of preferred forages in the unburned area, did not resprout as well (Arnold 1964, Bell 1969).

The high frequency of preferred forage species on the burn translates into higher foraging efficiency. The combination of more bites per minute, heavier bite weights, and less traveling time between feeding areas supports this assessment. This is consistent with findings of others. Consumption rates of elk increased asymptotically with forage biomass in the aspen boreal forest grasslands in Alberta (Hudson and Nietfeld 1985). Kenney and Black (1984) found that sheep preferred forages that enhance intake rates over those which are consumed at a slower rate. In their study, selection of forage was more strongly related to potential intake rather than to digestibility. Collins and Urness (1983) concluded that elk prefer feeding in areas of the aspen ecosystem where they can obtain the most forage per unit time.

The observation that elk spent less time feeding and more time traveling in unburned aspen might be predicted by models of selected biomass and foraging time relationships (Wickstrom et al. 1984). However, the differences are functionally immaterial here because available biomass in both burned and unburned aspen is several orders of magnitude above the threshold at which a significant response would be expected. That is, both types would appear on the flat portion of the response curves in Figure 10, p. 1298, of Wickstrom et al. (1984) due to high quantity and quality (digestibility) of forage in these mixed plant communities. Foraging efficiency differences would assume significance only if animals in one situation were at or near the upper limit of foraging time (about 13 hours in ruminants generally). Time needed to meet energy requirements in either burned or unburned aspen at Manning Flat would likely fall below 5 hours.

Although nutritional parameters showed no improvement in quality of forage due to burning, the high forage value of the aspen type at this site exceeds many other vegetation types. This is particularly true because this preburn aspen community had a productive understory. High overall nutritional values were maintained throughout the summer. In a study of elk summer diets in 3 habitats in Colorado (willow park, krummholz ecotone, and alpine tundra), Baker and Hobbs (1982) found average dietary CP values of 13%. Crude protein value for a comparable time period averaged 15% in our study. IVDMD ranged from 60% in July to 50% in September in the Colorado study and 70% and 60%, respectively, in our study. Collins and Urness (1983) found elk dietary digestibility in subunits of the aspen type to be higher than in subunits of the lodgepole pine type. In a study comparing nutritive quality of forages on 3 burned and unburned aspen sites, Blank (1984)

reported similarly high CP and IVDMD values throughout the summer. Based primarily on the findings of McReynolds (1977) on early-maturing grasslands, Nelson and Legee (1982) suggested that nutritional value of elk forages becomes limiting by mid-September, especially for late-lactating cows. In contrast, nutritional value of elk diets in the aspen type remains high at least to the end of September. Thus the importance of aspen could be even greater late in the season, when other forage types, particularly grass-dominated ones (Urness 1985), become nutritionally inadequate.

Management Implications

Given the proper conditions, such as those occurring in this study, prescribed fire in aspen will provide a significant forage resource that is attractive to ungulates within 1 or 2 years after burning. For cervids, presence of serviceberry in the preburn understory is an important consideration because of its palatability and ability to resprout strongly from root crowns after fire. Post-burn forbs in the burned aspen community also supply a highly nutritious forage resource not found in surrounding vegetal types. Aspen sprouts were not themselves important as summer elk forage in this area. The major advantage of burning aspen, therefore, is in the ability of aspen itself to sucker extensively following fire, thereby perpetuating the existence of the highly nutritious forage resource found in this type. The alternative, in the majority of stands in the central Rocky Mountain Region, is a significant decline in forage quantity and quality as dominance shifts to conifers with advancing succession. General recommendations for managing aspen for elk and other wildlife are presented by DeByle (1985).

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