Responses of Elk and Mule Deer to Habitat Grazed by Livestock

-Michael Marsh-

Much of the work reported below, which was chiefly performed by range and wildlife scientists, was stimulated by a 1975 paper by Anderson and Sherzinger, in which they speculated on the relationship between an increase in Roosevelt elk populations and grazing by domestic livestock on lands used by both. These authors proposed that livestock grazing preconditions vegetation for wild ungulates, Roosevelt elk and mule deer. The project described became the basis for many more recent trials. Two postulates were derived in their study. The first is that elk will be more likely to use pasture that has been "conditioned" by domestic livestock; the second, that prior use by livestock will provide superior quality and/or more abundant forage for native wildlife.

Their study reports an increase in elk numbers after cattle grazing was first excluded, and then restricted to a late spring-early summer grazing period to increase forage quality for wintering elk. They write that "When the Wildlife Area was established in 1961, cattle grazing was excluded. Elk numbers increased to about 320 head, but forage became increasingly rank and of low quality." but in the 3 years before a managed grazing plan was instituted, restricting grazing to a late spring/early summer period. The study may simply report release of the elk herd from near starvation conditions in consequence of recovery of the range from a severely over-grazed condition. Nevertheless, the grazing management plan resulted in increases in "range condition" and considerable increases in carrying capacity for both livestock and elk.

1. Elk are more likely to use pre-conditioned foraging areas

Martin Vavra, who works at the Starkey Forest and Range Research Unit (the USDA Agricultural Research Service and Oregon State University operate the Unit) in La Grande, Oregon, wrote in a review, "In cases in which single-species management predominates (Greater Sage-grouse or elk winter range), grazing systems specific to species' needs can be implemented. Managed livestock grazing can have 4 general impacts on vegetation: 1) alter the composition of the plant community, 2) increase the productivity of selected species, 3) increase the nutritive quality of the forage, and 4) increase the diversity of the habitat by altering its structure. Implementing a grazing management plan to enhance wildlife habitat requires an interdisciplinary approach. Knowledge of plant community dynamics, habitat requirements of affected wildlife species, and potential effects on the livestock used are basic to successful system design. However, any habitat change made for a featured species may create adverse, neutral, or beneficial changes for other species. Management actions, other than development of a grazing system, are often required for habitat manipulations to be successful. More research efforts are needed to understand complementary grazing systems on a landscape scaIe." (Vavra, 2005).

While it is certain that managed (or unmanaged) grazing will alter the composition of the plant community, other studies show that three of his points should be modified as follows: 2) increase **or decrease** the productivity of selected species, 3) increase **or decrease** the nutritive quality of the forage, and 4) **alter and possibly decrease** the diversity of the habitat by altering its structure. In any case, it is unusual for the objectives of WNPS to include single-species management.

Season-long grazing was the practice on a Montana livestock range, resulting in deteriorated range conditions according to a 1953 Forest Service range surveys. Range condition improved, however, since 1953, after the private lands were included in a federal-state designed rest-rotation grazing system. Elk numbers increased from <200 in 1960 to 1075 in 1988. The alternating periods of rest and use resulted in increased forage quality and quantity, thus reducing conflict between elk and livestock and their respective interested parties (Frisina and Morin, 1991).

Here, again, the argument for use of livestock to improve forage quality for elk is based on an example where a limited grazing management scheme was implemented in place of season-long livestock grazing. This was apparently key to the successful improvement of elk habitat.

In east-central Idaho, the distributions of elk, mule deer, and cattle were determined year round from 1975-1979 on a rest-rotation grazing system established in steep mountainous terrain. Following implementation of the grazing system, elk preferred rested pastures during the grazing season (June-October) and avoided habitat frequented by cattle by using higher elevations and steeper slopes. Few mule deer used the allotment during summer, but during the winter, deer selected habitats grazed previously by cattle. Elk appeared to adjust to the grazing system by making greater use of pastures with cattle present, although preference for pastures without cattle continued. (Yeo and co-workers, 1993.). Wisdom and Thomas (1996) suggest that there were individual elk which were not troubled by the presence of cattle, and others which were.)

In the Walker Basin Allotment grazing system in central Arizona, a rest-rotation cattle grazing system was designed to promote biologically acceptable levels of forage use on the half of the allotment scheduled for cattle grazing and to rest the other half by attracting elk to pastures recently grazed by cattle. The grazing system did not provide half the allotment with complete rest; elk used all study pastures. Elk use was higher in pastures with heavier tree cover and steeper terrain in both years, regardless of where cattle grazing occurred. Elk grazing patterns were apparently more dependent on tree cover and topography than any changes in forage caused by the grazing system (Halstead and co-workers, 2002).

Three separate investigations at the Starkey Experimental Forest and Range in La Grande, OR yielded similar information about spatial relationships of elk, mule deer and cattle. Elk and mule deer tended to occupy separate areas, as did elk and cattle at all scales analyzed during spring and early summer. At the largest scale on the the Main Study Area, remarkable spatial separation was seen for elk and mule deer (no cattle present) in spring, so much so that maps of areas occupied by each species were nearly mirror images. The other studies concluded that elk avoid cattle during summer. Both studies also noted more overlap among all ungulates during late summer and fall. This overlap is indicative of possible competition for food between the three species of ungulates as forage resources become depleted later in the grazing season (Coe and co-workers, 2004).

Skovlin and others (1983) tested the hypothesis that spring pre-grazing by cattle will increase use of native grassland by elk. The study examined winter use by elk of Pacific bunchgrass foothill range in southeastern Washington with fertilizing and rangeland burning, with and without spring cattle grazing as variables. First-year response of elk to fertilizer applied in fall (56 kg N/ha) was a 49% increase in use; however, no significant carry-over effect was noted in subsequent years. Fall burning to remove dead standing litter and enhance forage palatability provided no increase in elk use in winter. Intensive cattle grazing in spring to promote regrowth did not increase elk use. In fact, cattle grazing decreased winter elk use by 28% in 1 of the 3 years studied. The cost effectiveness of increasing elk use by fertilizing appeared marginal except perhaps in special situations. A discussion of forage allocation to both elk and cattle is presented.".

This is the only study that I found, with replication and control plots, of the utility of pre-grazing by livestock to improve palatability of shrub-steppe for elk. It was carried out on the Wooten Wildlife area, on a ridge above the Tucannon valley, adjacent to and in the same environment as WDFW's Smoothing Iron pilot study.

While deer are not elk, (and crested wheatgrass is not bluebunch wheatgrass) a study by Austin and co-workers (1983) provides important information about the feeding behavior and habitat choices of native ungulates. The authors studied feeding preferences of mule deer on shrub-steppe grassland in northern Utah which had been seeded with crested wheatgrass (Agropyron desertorum) after a wildfire 14 years before the beginning of the study. The land was in Utah Division of Wildlife Resources' ownership and grazed only in spring for 4 years before the study began. Stocking intensity is described as heavy. Five one to two hectare plots were prepared by fencing one half of each plot to exclude cattle, then permitting spring grazing as before on the other half of each plot. Four of the plots were then fenced completely, while the fifth was left open so that wild deer could forage there. Tame mule deer were confined successively in each of the four fenced plots (they have access to both grazed and ungrazed halves) and their feeding choices were observed using a bite-sample technique. Forage utilization had been measured following the livestock grazing by taking clipped samples in both halves of the experimental plots. Deer feeding behavior was observed in partial snow (late fall), complete snow cover (mid-winter), and no-snow (early spring) conditions. Overall, deer consumed 2.3 times more green grass on the ungrazed areas ($p<.05$), and they consumed a slightly higher percentage (31%) of the more abundant grass on the ungrazed area than on the grazed area (27%). Cured growth was avoided..

The observations under three different snow conditions produced valuable information on forage selection by mule deer. Under complete snow cover, grass was only 3.9% of the diet on ungrazed areas, and less than 1% on grazed areas. Cured grass was 3-11 times more abundant on ungrazed land, and deer to maneuver around it to get to the new growth at the plant bases. Despite this, the percentage of grass selected under partial snow cover conditions was nearly 70% on the ungrazed areas but only 17% on the grazed areas. Snow cover on grazed areas was 82-92% on the grazed areas, but only 25-53% on ungrazed areas. The greater amount of cured grass on the ungrazed area "had considerable effect on snow melt, acting as a black body" according to the authors. During the partial snow cover trials, deer spend 80% of their time in the ungrazed, and more snow-free area. Under snow-free conditions, the percentage of grass in the diet was 86.1%

on the grazed areas and 82.4% on the ungrazed areas. Areas grazed by cattle the previous spring had significantly less re-growth remaining than protected areas ($p<.01$).

In a later study, Austin and Urness (1986) found that when deer numbers in shrub-steppe habitat in western Utah were low, they preferred to forage on areas ungrazed by livestock, but this preference rapidly decreased as deer use increased.

Mule deer use of pastures and habitats in relation to moderate cattle grazing was measured for 19 radio-collared desert mule deer (Odocoileus hemionus) in a southeastern Arizona grass-shrubland. For each deer, use of grazed or ungrazed pastures and habitats in relation to their availability within the deer's home range was tested on a seasonal and annual basis. Deer, especially females during summer, tended to use currently ungrazed portions of their home range and dry wash habitats more than expected. Most deer showed a strong preference for ungrazed dry wash habitats, followed by grazed dry washes and ungrazed uplands. Although deer used grazed uplands less than expected based on availability, deer were still observed frequently in this abundant type. It was unclear whether use of currently ungrazed habitats by deer was due to absence of cattle or to effects of recent cattle grazing in these habitats. During 2 years of favorable precipitation and forage conditions deer appeared to be adjusted to moderate rest-rotation cattle grazing. Leaving some areas periodically ungrazed might also provide a contingency for deer [to resist] impacts of cattle grazing during drought (Racotzkie and Bailey. 1991).

Grover and Thompson (1986) investigated preferred foraging locations of elk in a watershed after fall grazing by cattle. Cattle grazed the area from June 11 to October 15 in 1983 under a 3-pasture deferred grazing system that was established in 1970. Ungulate use, vegetation attributes, and topographic features were examined.. Quantities of rough fescue, Idaho fescue, and bluebunch wheatgrass utilized by elk was estimated on each plot during the first week of June 1984. Elk consistently chose areas characterized by dense stands of bunchgrasses previously grazed by cattle. The forage in previously grazed areas typically contains less residual vegetation such as dead standing stems. However, elk also selected areas that were no more than 274 m to dense cover, and at least 463 m to the nearest road, and 979 m to the nearest visible road.

Discussion

These reports offer a somewhat conflicted pattern of wildlife response to cattle. Most of the field studies are not replicated (the Scovlin and co-workers (1983) study stands out as the exception) and most have not separated the effects of livestock presence from the pre-conditioning of vegetation caused by their presence in the current or previous season.
The studies by Yeo and others (1993), by Halstead and others (2002), and by Coe and others (2004) provide evidence that elk avoid habitat occupied by cattle but fail to account for the influence of other significant habitat factors such as nearness of roads and of dense cover identified by Grover and Thompson (1986).. Elk, and especially mule deer also seem more willing than domestic livestock to use steep terrain.

As Grover and Thompson mention, there are some combinations of environmental variables where cattle grazing may have greater influence on elk feeding-site selection than others. For example, while cattle grazing may be used to improve forage quality, grazing will be most beneficial for elk if it maintains adequate forage density and is applied in areas near cover and within safe distance from roads..

2. **Prior use by livestock will provide superior quality and/or more abundant forage for native wildlife**

Anderson and Sherzinger proposed in 1975 that livestock grazing preconditions vegetation for wild ungulates such as Roosevelt elk and mule deer. The grazing plan that they proposed was designed around the growth cycle of the principle forage grasses on the Bridge Creek Wildlife Area in NE Oregon, Idaho fescue and bluebunch wheatgrass. Grazing was restricted to the boot-to-seed stage of these grasses, usually in May and June.

Several studies have been made of the effects of grazing or clipping vegetation on regrowth and nutrient levels. The results have implications both for management of rangelands for livestock, and for the nourishment of native ungulates.

Westenskow-Wall and others (1994) measured the effects of defoliating bluebunch wheatgrass by hand-clipping to increase the quality of regrowth available on Rocky Mountain elk winter range in northeastern Oregon from 1988 through 1990. Spring clipping did not affect the percentage of calcium and phosphorus, or available forage compared to the current year's growth in either November or April, and fall clipping increased digestibility and increased the phosphorus concentration, but decreased available forage compared to both the control and the spring-conditioned forage in November. “Fall conditioning may create a deficit of forage if regrowth is not achieved. Additional research is needed on defoliation during the early phenological time-period of bluebunch wheatgrass to improve the forage quality of elk winter ranges”.

A series of studies on forage quality of shrub-steppe vegetation are under way at the Eastern Oregon Forest and Range Experiment Station. In a study by Clark and co-workers (2000) Spring grazing at boot stage did not influence the number of standing reproductive culms per plant in bluebunch
wheatgrass, and crude protein and in vitro dry matter digestibility in grazed plots increased by 1.0 and 4.3 percentage points, respectively, over ungrazed plots. However, grazing reduced the standing crop of bluebunch wheatgrass by 116.9 kg ha-1 DM. Standing Idaho fescue reproductive culms decreased by 0.7 culms per plant under grazing. Crude protein of Idaho fescue in grazed plots was 1.3 percentage points greater than in ungrazed plots. Crude protein and in vitro dry matter digestibility responses of elk sedge were inconsistent between years and may be related to utilization or growth differences between years. The authors write: “The levels of forage quality improvement in bluebunch wheatgrass and Idaho fescue obtained in this study could benefit the nutritional status of wintering Rocky Mountain elk (Cervus elaphus nelsoni Bailey). More research is needed regarding the effects of grazing on the winter forage quality of elk sedge.”

Ganskopp and co-workers, (2004) carried out grazing trials to measure differences in standing crop, crude protein and digestibility of steppe bunchgrasses under two different grazing intensities. Compared with ungrazed stands, light and heavy spring grazing decreased September standing crop by 32 and 67%, respectively, but September/December crude protein (CP) of grasses in the heavily grazed sites averaged 6.9% exceeding ungrazed controls (average 3.9%) for 11 of 12 comparisons. Crude protein of lightly grazed grasses (average 5.2%) was also higher than ungrazed controls for 6 of 12 comparisons. Herbage was more nutritious during the drier of the 2 years sampled. Among grazed treatments, fall/winter CP measures were highest for bottlebrush squirreltail (x = 7.4%), intermediate for Idaho fescue (5.9%), and lowest for bluebunch wheatgrass (x = 4.9%). In fall/winter, herbage was most digestible in heavily grazed paddocks (x = 59%), intermediate in lightly grazed paddocks (x = 53%), and least digestible in ungrazed areas (x = 49%). The authors write: “Light and heavy spring cattle grazing can augment fall/winter forage quality of bluebunch wheatgrass, Idaho fescue, and bottlebrush squirreltail. Spring grazing reduces subsequent standing crop, but remaining forage will be nutritionally superior to herbage in ungrazed stands.”
While the percent reductions in standing crop appear to more than counterbalance the increases in crude protein and digestibility that were reported, other research suggests that elk and mule deer may require a minimum level of nutritive quality in their forage to maintain winter condition because of the rate at which they can consume and digest “raw material”.

In another northeastern Oregon study, Ganskopp, and co-workers (2007) measured crude protein (CP) and in vitro dry matter digestibility (IVDMD) of grass species clipped by hand in ungrazed paddocks and in paddocks grazed at vegetative, boot, and anthesis stages. The phenologically youngest regrowth always ranked highest in CP and IVDMD. Among grasses, respective 1997 CP and IVDMD means were 9.0% and 55% for regrowth following anthesis grazing. No regrowth followed anthesis grazing in 1998, but CP and IVDMD means from boot stage treatments were 5.5% and 47%, respectively. With CP measures, a species by treatment interaction occurred in 1997, when forage conditioning responses were lower for bluebunch wheatgrass and crested wheatgrass than other grasses. In 1998, all species except for Basin Wild rye reacted similarly to treatments. Late summer/early fall standing crop reductions following grazing at vegetative, boot stage, and anthesis grazing were 34%, 42%, and 58% respectively in 1997, and 34%, 54%, and 100%, respectively in 1998. Soil moisture content was a poor predictor of regrowth yields. The authors write: “Managed cattle grazing can successfully enhance late season forage quality.”

A 3 pasture rest-rotation grazing system and an exclosure on the Mt. Fleecer elk winter range in southwestern Montana were studied during 4 seasons over 3 years. Only nitrogen (N) and phosphorus contents were generally greater in the spring grazed regrowth pasture. However, regrowth from bluebunch wheatgrass grazed in the spring did not improve the species nutrient content for wildlife the following winter over non-grazed treatments. During winter when elk (Cervus elaphus nelsoni Bailey) are present, N, digestible N, and in vitro dry matter digestibility were not different among the 3 treatments. Elk were determined unlikely to consume enough bluebunch wheatgrass to meet protein maintenance requirements during winter. These findings resulted from analyses repeated over the 3 years for a complete cycle of a 3 pasture rest-rotation system: “however, our hypothesis needs to be tested at other locations before assuming the same results elsewhere”, write Wambolt and co-workers (1997).

Clark and co-workers (1998.) reported results similar to those of Ganskopp but using hand clipping rather than grazing, in that forage quality increased, but quantity decreased under clipping. The authors postulate that increases in forage quality resulting from forage conditioning treatments may be important to the viability of elk populations wintering on rangelands where forage quality, rather than quantity, is limiting. "The winter forage quality of bluebunch wheatgrass (Agropyron spicatum [Pursh] Scribn. & Smith) is generally inadequate for maintenance of wintering Rocky Mountain elk (Cervus elaphus nelsoni Bailey). Previous attempts to improve the winter forage quality of bluebunch wheatgrass by clipping and livestock grazing have achieved mixed results."

In a study conducted at Vancouver, BC with two year old bluebunch wheatgrass plants which had been grown from seed in pots and transplanted to a local field site, were clipped at 4 phenological stages to compare forage quality of subsequent regrowth relative to nondefoliated plants. Following 2 years of treatment, plants clipped at boot, emergence, flowering, and seed formation produced lower levels of acid detergent fiber (ADF) and higher values of CP and P than control plants at equivalent phenological stages. Clipping at boot and emergence for 2 years delayed flowering by 16 and 15 days, respectively, while subsequent flowering of plants clipped at flowering and seed formation occurred only sporadically. These delays in plant phenology altered forage quality on 26 October compared to nondefoliated plants. Clipping at boot, emergence, flowering, and seed formation reduced percent foliar ADF, while increasing relative proportions of CP, Ca, and P compared to untreated herbage. Crude protein in plants clipped for 2 years at emergence, flowering, and seed formation averaged 11.9%, 12.5%, and 13.7% respectively. Phosphorus in regrowth foliage of plants clipped at flowering and seed formation equalled 0.22% and 0.26%, respectively, on 26 October. These values exceed maintenance requirements of cattle and elk, indicating that judicious grazing management can improve nutritive values of bunchgrass vegetation (Pitt, 1986).
The location in which the study was performed is unfortunate, for Vancouver is a maritime rather than a Great or Columbia Basin environment. Rainfall amount and pattern, pattern of insolation and temperature are all decidedly different, and the study would be easier to support if repeated in the Okanogan/Similkameen district to which bluebunch wheatgrass is native.

The interesting part of this study was the report of responses in flowering abundance and timing in response to treatment. There is a clear suggestion that individual plants suffer and might succumb, and that their reproductive potential and competitiveness in a community situation may be reduced by the treatments that were used.

How much overlap is there in the diets of the coexisting ruminants?

Stewart and others (2003), tested the hypothesis that mule deer, elk and cattle would exhibit little overlap in diet and that mule deer, the smallest in body size of the three species, would forage more selectively than either elk or cattle. Diet composition was determined by microscopic analysis of fecal material. Fecal pellet collections for mule deer and elk wrere from a different portion (Northeast) of the Starkey Experimental Range (in NE Oregon) than the livestock fecal samples (Main portion of the Starkey). They sampled in summer, when they believed that the greatest spatial overlap among species would occur. They state that habitats and forage available were similar in both areas were similar, and that elk and mule deer were present in both areas. mule deer ate the highest proportion of sedges, but fed also on grasses, forbs, conifers and shrubs. Elk concentrated on forbs, with some grasses and shrubs, while cattle fed principally on grasses, with some sedges. Principal components analysis was used to assess dietary niches. They also assessed stable isotope ratios of carbon (13C) and nitrogen (15N) in fecal pellets of the three ruminant species. Principal component 1 represented a foraging axis based on plant classes, and principal component 2 represented a continuum from browsing to grazing, which revealed complete separation among these three herbivores. The 13C and 15N ratios also differed significantly among species, indicating moisture differences among habitats and types of forage used. Mule deer had the greatest diet variability and used more xeric foliage than either cattle or elk. "stable isotopes elucidated differences in dietary niche among the three ruminants that were not evident from dietary analysis alone." The original hypothetical null model, that because these three species are separated temporally and spatially, there might be little niche separation in dietary selection, was not supported. A criticism of the study might be that they collected elk and mule deer samples from a different area than that where cattle samples were collected.

Discussion

The papers seen in the second section of this review fail for the most part, to consider the future survival and reproductive potential of the grasses that are “treated” by grazing to improve their nutritive quality. There is agreement among the reports that grazing in spring increases nitrogen content and digestibility, and reduces forage abundance. Possible consequences of this are increased competition among livestock and elk for a scarcer resource-nutritious grass.
The reports are for the most part two or three year studies, and they fail to consider the long term effects of foliage damage to formerly dominant native grasses on their survival and reproduction, or on trends of change in relative abundance of species in relation to presence or absence of invasive exotics.

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