Improving Quality of Winter Forage for Elk by Cattle Grazing

E. WILLIAM ANDERSON AND RICHARD J. SCHERZINGER

Highlight: *The Bridge Creek Wildlife Management Area located in northeastern Oregon and owned by the Oregon Wildlife Commission, is a prime winter range for Rocky Mountain elk. On the average, about 120 head of elk were counted annually on the area during the winters of 1948 through 1960. 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. A resource management plan was put into effect in 1964, which involved various range improvements and a cattle-grazing system designed to increase forage quality for wintering elk. In 1974, elk count increased to about 1,190. Concurrently during these years, the ecological condition of the range improved noticeably and animal unit months of cattle grazing were increased by 2.6 times. Success of the project is primarily attributable to improved quality of winter forage. The rationale used in designing the grazing system to achieve winter-forage quality is explained. Although emphasis is placed on using livestock grazing to improve the quality of winter forage for elk, it should be noted that the same technique also produces high-quality autumn and winter forage for cattle.*

Competitiveness and compatibility between livestock and wildlife on range and forest lands have been vigorously debated, argued with emotional conviction, and written about in many articles designed to influence public opinion. Obligatory resource management decisions have been and are being made on both public and private lands as a result.

The many examples of obvious conflict between livestock and wildlife that have occurred over the years provide some proponents with their primary evidence for reasoning that the mere presence of one is detrimental to the other. A rational approach, on the other hand, includes recognition of the overwhelming number of examples where obvious compatibility exists, along with an ecologically healthy resource, under significant numbers of both livestock and wildlife. With the rational approach, the evidence is clear that intolerable competition or incompatibility connotes a degree of mismanagement of the livestock, the wildlife, or both.

It is the purpose of this paper to emphasize that livestock and wildlife can be compatible on the same range, provided that management of each is coordinated with the objectives of the area and the ecology and physiology of the resources. Furthermore, there are instances where the judicious use of livestock grazing is essential for maintaining good wildlife habitat. This paper reports the case history of an example where this was done and explains the rationale and experience used in designing the resource management system. In this rationale, certain plant physiological functions are related to system design solely by conjecture. This had to be done because textbooks and laboratory research reports on physiology do not point out the practical use of information they contain. Additional research is needed to clarify certain suppositions made in this paper.

The authors are state range specialist, Soil Conservation Service, U.S. Department of Agriculture, Portland, Oregon, and regional habitat biologist, Oregon Wildlife commission, LaGrande.

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Description of Area

The Bridge Creek Wildlife Management Area, located in northeastern Oregon, is owned by the Oregon Wildlife Commission and operated primarily as a winter range for Rocky Mountain elk (*Cervis canadensis*) and mule deer (*Odocoileus hemionus*). It is about 8,000 acres in size, lies at 45 degrees north latitude, at an elevation between 2,800 and 4,000 ft, and receives an average annual precipitation of 18 inches, 6 of which is received during the growing season of April through July. Most of the area consists of undulating plateaus and broad ridgetops at 4,000 ft elevation on which two range sites predominate (Fig. 1). The **Rolling Hills** site occupies about 60% of the area. Its climax plant community is a natural grassland strongly dominated by Idaho fescue (*Festuca idahoensis*). The soil, Waha silt loam, is moderately deep loess over basalt bedrock. The **Scabland** site occupies about 20% of the area, primarily on ridgetops. Its climax plant community is a shrub-grassland in which stiff sagebrush (*Artemisia rigida*) usually dominates the aspect and Sandberg bluegrass (*Poa sandbergi*) and onespike oatgrass (*Danthonia unispicata*) dominate the foliage cover. The soil, Rockly very stony loam, is about 10 inches deep to basalt bedrock.

The remaining 20% of the area consists of steep canyons and drainages about equally divided between two sites. The **Steep South** site is a natural grassland in which bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass dominate the foliage cover. Rose (*Rosa* spp.), common

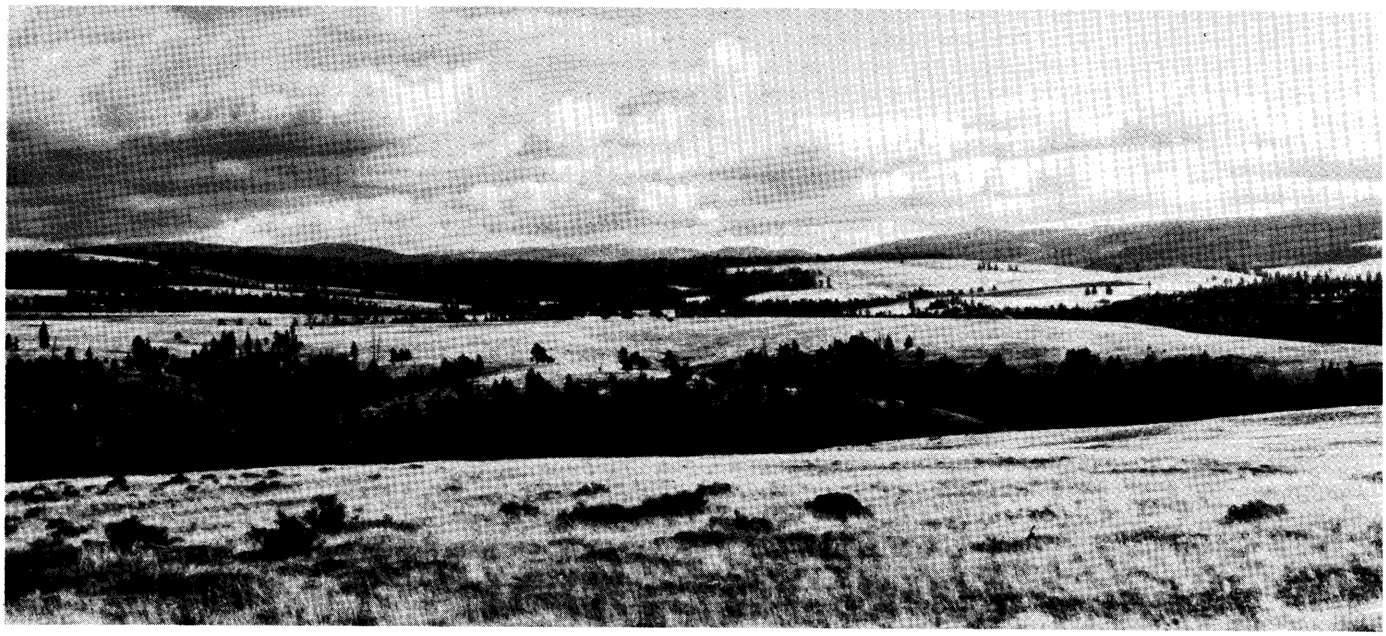

Fig. 1. *General view of the Bridge Creek Wildlife Management Area in Oregon.*

snowberry (*Symphoricarpos albus*), bitterbrush (*Purshia tridentata*), sumac (*Rhus occidentalis*), and elderberry (*Sambucus glauca*) are common forage shrubs that occur sparsely. The soil, Snipe stony loam, is shallow to basalt bedrock. The **Steep Fir-Pine Forest** site occupies north-facing (cool) slopes in the canyons. Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) dominate the aspect; ponderosa pine (*Pinus ponderosa*) is scattered throughout the stand. A good cover of elk sedge (*Carex geyeri*), pinegrass (*Calamagrostis rubenscens*), a variety of perennial forbs, and shrubs such as ninebark (*Physocarpus malvaceus*) and common snowberry occur in scattered openings in the stand. Under the forest canopy, the understory consists mainly of young trees, sparse herbaceous species and some shrubs, mainly common snowberry. The soil, Tolo silt loam, is moderately deep to deep volcanic ash.

Livestock grazed on Bridge Creek are yearling steers and heifers owned by Tom Colvin and his son, Tom, Jr., whose cow-calf operation includes deeded land adjacent to Bridge Creek.

Observations, mapped zones of utilization using the technique of Anderson and Currier (1973), and Oregon Wildlife Commission census data on Bridge Creek indicate that during spring and summer, when cattle are on the area, they graze mainly on the undulating sites and only slightly on steep areas. Steep areas have a scarce water supply and no salt is placed there. Elk, during winter when they are on the area, graze mainly on the undulating sites at nighttime and take cover in forested areas during daytime and winter storms. They graze mainly on the **Steep South** site when higher elevation plateaus are snow covered. Idaho fescue is the key forage species on undulating sites for both classes of animals. It is apparent that cattle and elk compete for forage on the undulating sites and to a lesser degree on steep sites, but not during the same season. This emphasizes the need for special caution, particularly in regard to season and degree of use, when designing cattle management on areas where there is direct competition with wildlife and the major objective is to produce forage for wildlife.

Case History

Before its establishment in 1961, the Bridge Creek Wildlife Management Area was grazed by cattle without a planned grazing system and, according to 13 years of census data (1948-60), an annual average of about 120 head of elk were counted on the area during winter (Fig. 2). Census data were obtained by riding the same horseback routes on Bridge Creek five times each winter. From these routes about 80% of the total area can be viewed. The highest count annually is cited.

For the first 3 years (1961-63) following establishment of the area, cattle grazing was not allowed. Elk counts increased to about 320 head, probably because of increased volume of available forage. However, mature grass became increasingly more rank, forage quality decreased, standing leached residues restricted availability of desirable forage; the area was developing a "wolf plant" aspect. This situation triggered development of a resource management plan to coordinate the uses of all resources of the area. Special attention was given to designing range improvements and a grazing system—that is, the sequency of seasonal cattle moves from pasture to pasture—that would help achieve the major wildlife objectives of the area.

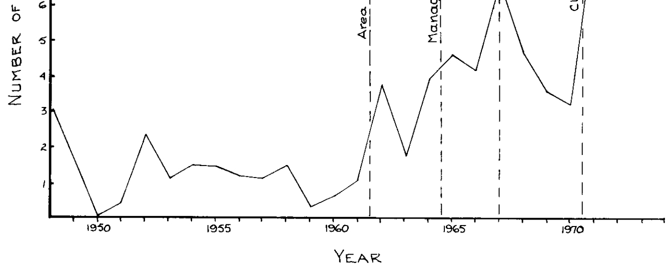

Fig. 2. *Census counts of elk wintering on Bridge Creek Wildlife Management Area, 1948 to 1974.*

In 1964, cattle grazing was resumed under the planned system that incorporated range readiness, safe degree of use, and several other principles explained in this paper. During the three years 1964-66 the average annual count of wintering elk increased to about 500 head.

In 1967, snowmobilers discovered these wintering elk herds. For three winters their enthusiastic pursuit of this exciting sight in a wintery outdoor setting increasingly harassed the elk. Benefits derived from the planned grazing system and range improvement were nullified. The value of the area as an elk sanctuary was affected seriously. Census counts dropped sharply to about 325 head in the winter of 1969-70. In 1970, the area was closed by administrative order to all vehicles, including those of the Wildlife Commission, from December 1 to May 1 of each year, which allowed the planned grazing system and range improvements to again become fully effective.

During the next 3 years (1971-73), the average elk count increased markedly and reached 1,191 head in 1974. The estimated number of elk-days on the area increased from 15,980 in 1963 to 168,957 in 1974, which, in addition to increased numbers of elk, reflects a 78% increase in the length of time elk use Bridge Creek during the winter.

A comparison of the trend in elk numbers from 1960 to 1974 on the Bridge Creek area with trends in four nearby big game management units distinctly shows the influence of planned resource management on the number of elk using Bridge Creek (Table 1).

Deer did not respond as did elk. Deer in this area primarily use steep canyon sites inaccessible to vehicles and virtually ungrazed by cattle under the planned system. In contrast to elk, deer counts during the 27-year period coincided with regional trends in which population lows follow prolonged severe winters and numbers of deer build up during interim years. It is important to note that in other situations where livestock grazing adversely affects the volume, kind, or quality of forage for deer on a prime winter range, a grazing system can be designed to alleviate this competition and improve the deer forage situation.

Concurrently with the upward trend in elk use, cattle grazing has increased and ecological condition of the area has improved. In 1965, cattle grazing amounted to 340 animal unit months (AUM's), which was close to the estimated initial stocking rate. In 1967, cattle grazing was increased to 700 AUM's because of the rapid response of forage species to the management program. In 1969, grazing was again increased to 900 AUM's, where it has remained. In 5 years, forage production improved enough to allow an increase of 2.6 times more cattle grazing.

Changes in ecological condition were not quantified by plot records. However, ocular estimates documented in 1964 as compared with those made in 1973 on the same locations substantiate the vegetational improvement. Four major sites illustrate these changes. In 1973, the **Rolling Hills** and **Pine-Bunchgrass** sites were rated as excellent ecological condition, whereas in 1964 they had rated as fair. **Scabland,** which rated excellent in 1964, remained in that class, though the cover and vigor of onespike oatgrass, a key indicator species, had increased noticeably by 1973. The **South Exposure** site improved only from fair to good, which was probably due to its droughty microenvironment, including the shallow, rocky soil. All sites still need improvement in stand density, particularly in the understory. To be classed as "excellent" ecological condition, as used here, the composition of the plant community is 75% or more of potential for the site; "good" is 50 to 74%; "fair". 25 to 49%; and "poor" is less than 25% of potential.

A variety of other benefits have been derived from the coordinated resource program. For example:

1) Populations of mountain bluebird (*Sialia eurrucoides*) have been increased from "seldom" observed to "common"; and western bluebirds (*S. mexicana*) from "never" to "occasional." This was aided by the installation of 122 cavity-type nesting boxes, of which 83% were being used regularly within 3 years.

2) Blue grouse (*Dendragapus obscurus*) were rarely seen in the grasslands before the program started yet this is their natural nesting habitat. Now they are a common sight.

3) The area is open to the public in vehicles for recreation, including hunting, except for the closed winter season. Average annual hunting harvest is about 25 buck deer, 100 blue grouse, and from 1 to 20 bull elk, depending upon early storms in higher country. Data on the estimated number of hunters and kill of bull elk during the regular elk season in nearby big-game management units show no correlation with the winter census counts on Bridge Creek.

Table 1. Number of wintering elk per mile of census route on Bridge Creek Wildlife Management Area 1960-74 compared with four nearby big game management units in eastern Oregon.

Year	Nearby big game management units				Bridge Creek
	Desolation	Heppner	Starkey	Ukiah[1]	
1960	6.0	1.2	7.7	4.8	7.4
1961	5.2	1.7	10.3	3.4	13.0
Bridge Creek Area established–livestock grazing ceased					
1962	6.4	3.4	12.0	10.4	20.2
1963	3.9	1.6	11.0	6.2	9.7
1964	6.6	1.0	11.7	13.2	20.8
Special livestock grazing began on Bridge Creek					
1965	6.8	1.9	11.1	28.3	24.3
1966	5.9	1.6	11.9	10.4	21.6
1967	4.4	4.3	9.9	20.8	35.6
Snowmobile harassment began on Bridge Creek					
1968	4.7	5.3	8.9	9.3	24.9
1969	5.1	8.0	8.3	20.8	18.9
1970	4.8	6.9	10.0	21.1	17.2
Bridge Creek closed to all vehicles during winter					
1971	5.7	6.7	14.9	22.9	42.4
1972	4.1	12.6	12.0	34.4	41.7
1973	6.9	6.8	22.5	28.8	61.7
1974	5.0	8.4	19.9	44.2	62.7

[1] Ukiah management unit includes Bridge Creek Wildlife Management Area.

Designing the Resource Management System

For ecological condition and volume production

Several features of plant physiology and morphology are more or less taken into account in the design of most modern grazing systems. It has become popular to emphasize that the health of the "grass" should be given as much consideration as the health of the grazing animal (Anderson, 1952). In statements of this kind, reference usually is made to the need for allowing plants to reproduce and to store food; these are often the only plant functions taken into account. When designing grazing systems, these functions are fulfilled by providing for seasonal periods of grazing, deferment, and rest.

Other functions that should also be considered include the need for maintaining green foliage to manufacture plant food, the location and kinds of growth buds, root-growth stoppage when foliage is clipped, and freezing of exposed growing tissues. These functions are fulfilled primarily through the degree of utilization allowed seasonally and the amount of residue left on the plant and surrounding ground. All of these features are important from the standpoint of improving or maintaining the ecological condition of the site and the volume of forage production (Anderson, 1969).

For quality of winter forage

The importance of forage quality and its manipulation on rangelands has been reported by many authors. Summary reports by Duvall (1970) and Hanson and Smith (1970) point out that measures taken to achieve forage quality include fertilization; prescribed burning, seeding, and planting; control of tree overstory; chemical curing of forage; manipulation of attractants and repellants; mechanical treatment of brush; use of herbicides; and pruning and cutting of trees. The use of livestock grazing as a tool for manipulating forage quality for wildlife is not discussed in these reports.

The most commonly recognized objective for using livestock to improve quality of forage for wildlife is the prevention of the formation of "wolf plants" or the accumulation of excessive amounts of leached residues. Wildlife then have ready access to succulent forage when it is available.

Livestock grazing can also be used to manipulate the physiology of forage plants to improve the nutritive value at maturity. This provides wildlife a supply of mature forage that is nutritionally above normal at a time when succulent forage is not available. Developing the rationale for improving forage quality by manipulating the physiology of forage plants through livestock grazing began by recalling and analyzing many personal observations in which certain areas of forage obviously were preferred by grazing animals as evidenced by the degree of utilization. The following have been observed:

1) In dry-land wheat stubble used for wintering livestock, shallow-soil areas are grazed closely, whereas stubble on deep-soil areas will be virtually untouched in the same field.
2) Sudden hot weather or a hot wind "burns" heading wheat and the kernals are "pinched" or shrivelled; growth is suddenly terminated. As with stubble on shallow-soil areas, "burnt" areas are grazed closely.
3) Harsh-environment range sites are often grazed more closely than better sites in the same pasture.
4) Wild and domestic grazing animals prefer regrowth forage; grazed areas and individual plants are regrazed repeatedly during the grazing season and regrowth forage is distinctly preferred when all available forage is mature.
5) A droughty spring season reduces volume of forage, yet livestock commonly show better physical condition than during wet spring seasons when forage volume is unusually high.

The question is, "Why do grazing animals prefer shallow-soil, burnt, poor-site, drought-affected, and mature-regrowth forage?"

Cook (1972) offers one explanation by pointing out that grasses, forbs, and shrubs are more leafy on poor than on favorable sites. He attributes the increased palatability to the presence of more leafy material than stems; that differences in stem-to-leaf ratios account for chemical differences because leaves are higher in certain nutritional items than are stems. This is only a partial explanation, however.

Smith (1966) reports metabolic changes which occur within a plant when heat is increased to include a decrease in free water content of tissues and an increase in bound water and water-holding colloids, an increase in sugar content, a conversion of starch to sugars, and a slowing down of metabolic activity.

In studies of wheat, Lamb (1967) found that in the individual plant, younger tissues are generally more drought-hardy than older tissues. Water may move from older to younger tissues when wilting occurs, thus permitting younger tissues to continue to grow longer. Lamb also reports that wilting is accompanied by a reduction in starch and an increase in total sugars. He says that this relationship is not surprising, because restricting moisture (wilting) may reduce growth markedly without having any great affect on photosynthesis. With wheat, there is an increase in sugars with no increase in other carbohydrates or, at least the sugar increase predominates. Lamb also states that when plants attain drought hardiness through a reduced water supply, they also attain frost hardiness.

Salisbury and Ross (1969, p. 174) comment that any treatment inhibiting cell metabolism stops the movement of assimilates through the cells and that this translocation is slowed, or stopped, by heat or drought. They also point out (p. 693-694) that rapid warming and desiccation of a plant results in a coagulation of protein and an increased viscosity of protoplasm, often to the point where it becomes brittle, which also influences the slow-down of translocation.

The following suppositions are based on the above ideas.

1) Termination of growth at an immature stage through heat or drought stops or greatly reduces translocation, thereby fixing the nutritional quality of green foliage in the mature forage.
2) Termination of growth due to heat or drought increases the palatability of foliage through the conversion of starch to sugars, provided they are sweet sugars.
3) Young-tissue regrowth following grazing may grow a bit longer into the hot dry season, thereby increasing the volume of nutritious forage.
4) Autumn production of green forage, when it occurs, may be more reliable and longer lasting on plants that acquired drought hardiness—therefore, frost hardiness—through a reduced water supply while in an immature stage of growth.

Personal observations and documented results obtained at Bridge Creek substantiate that something on the order of the above suppositions must surely occur physiologically within the plants to cause animals to display such distinct preference for mature regrowth.

The Bridge Creek system

Designing livestock grazing as a tool for improving the quality of winter forage on Bridge Creek began with an

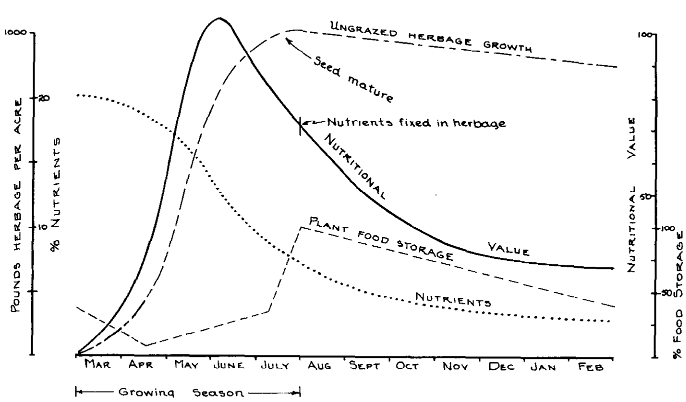

Fig. 3. *Generalized seasonal relationships between herbage growth of an ungrazed forage grass, plant food storage, percent nutrient content, and nutritional value of herbage.*

analysis of the seasonal requirements of the wildlife: Where will wildlife normally graze and what will they eat during different seasons and weather conditions while they are on the area. This was supplemented with a similar analysis of livestock habits so as to reveal potential conflicts. Then, in consideration for the health of the forage resource and in order to apply the rationale for manipulating forage quality, generalized seasonal growth curves of major forage species on important range sites were drawn and used for judging when to move livestock on or off an area to achieve desired results.

The Bridge Creek system incorporates several principles:

1) In the spring, forage species are allowed to recover from elk grazing and develop to a stage of range readiness before being grazed by cattle. This avoids continuous wildlife-livestock grazing pressure.

2) In late spring or early summer, cattle are moved to a fresh pasture soon enough to allow regrowth on key grasses to reach the early seedstalk stage by the end of the growing season. The high nutritional value of immature green foliage at this stage is thereby fixed in the mature foliage by heat and drought, which terminates physiological processes, including translocation. Forage given this treatment is high quality winter elk feed.

3) Particular attention is given to carrying out livestock grazing during the boot-to-seed stage of forage bunchgrasses. This is the most critical period in the growth cycle of bunchgrass in terms of the effect that clipping foliage has on the health of the plant (Pearson, 1964; Mueggler, 1967). If grazing is not carried out just right during this period, there will be little or no regrowth forage. For this reason, the livestock operator must understand the objectives and principles involved and strive to achieve them by his livestock management. Otherwise the effectiveness of the program will be reduced.

4) Two herds of cattle are grazed simultaneously on Bridge Creek. This is a practical convenience because the steers and heifers are grazed in separate herds. However, this is done mainly to top-off and allow regrowth in as many pastures as possible during the growing season, so as to produce a large area of nutritious forage for elk to feed on during winter.

5) The rate of cattle stocking is heavy enough to effectively top-off the grazed pastures, yet light enough to leave an adequate volume of elk forage on all pastures at the end of the cattle-grazing season.

6) The physiology of forage plants is manipulated by controlling the season, length of time, and intensity of grazing in each pasture grazed during the growing season. Figure 3 illustrates the generalized seasonal relationships between the growth curve of an ungrazed forage grass and storage of plant food (Anderson, 1952, 1967), percent of nutrients in the herbage, and the nutritional value of the herbage, which is the product of herbage volume and percent nutrients.

Manipulating the nutritional-value curve using livestock grazing as a tool is illustrated in Figure 4. Theoretically, the growth and related curves are deliberately interrupted by livestock grazing. Plant physiological functions are thereby postponed or reduced for a sufficient period of time so that, after livestock are removed, the leafy, nutritious regrowth is "burned" by the advent of hot weather and lack of soil moisture while it is still in an immature stage. A higher-than-normal level of nutrients is thereby fixed in the mature regrowth as indicated by the nutritional curve.

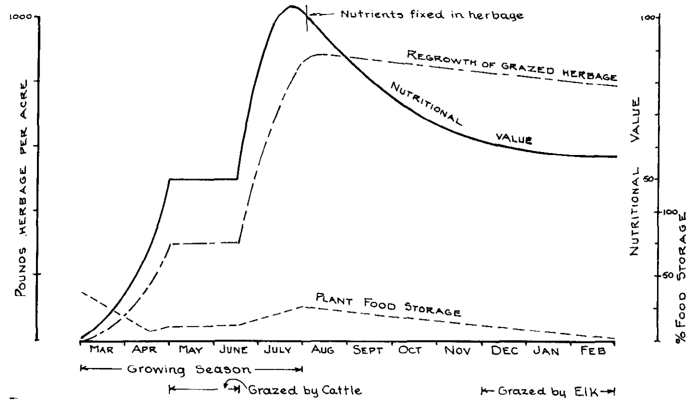

Fig. 4. *Hypothetical effect of using livestock grazing to interrupt and postpone plant physiological functions so as to improve the nutritional value of mature regrowth forage.*

It is important to note that grazing in this manner also postpones the process of plant food storage to the point where storage is greatly reduced. If this were repeated on an area several years in succession, it would result in reduced health of the resource. Therefore, this treatment should be rotated among several pastures so it is applied to a particular area only once every two or more years.

Leaching of nutrients and the physical loss of matured regrowth probably takes place the same as it does with matured ungrazed herbage. Based on the distinct preference wildlife and domestic animals have demonstrated for such regrowth in autumn and winter, it appears that whatever leaching takes place does not change the preferred category of regrowth forage. This might be because regrowth is nutritionally better at the time leaching starts.

Discussion

Success of the Bridge Creek project cannot be attributed solely to the system of seasonally moving cattle from pasture to pasture nor to complete closure of the area to vehicles during winter. Other contributing components of the coordinated resource program include:

1) Safe degree of use by cattle so as to provide an adequate volume of forage left for elk.

2) Development and better distribution of water—21 new ponds and 1 spring—which unquestionably was the key to success of the grazing system.

3) Properly located fences, which required removal of about 25 miles of fence to obliterate the old homestead patchwork and the construction of 14 miles of laydown and 9 miles of permanent fence to create five properly designed pastures.

4) About 120 acres of old farmland plowed and seeded to adapted grasses and forbs.

5) Salt for cattle placed away from water to help obtain a uniform pattern of utilization and thereby improve the forage quality for elk over most of the area.

6) Wildlife sanctuary created by setting aside one important canyon as a pasture for wildlife only and permanently closing about 10 miles of regular roads and all old logging roads and skidtrails on the area.

On the other hand, the grazing system designed for Bridge Creek, i.e., the seasonal sequence of moving the cattle, deliberately incorporates several principles that improve forage quality for winter elk grazing. Success of the project, therefore, is primarily attributable to this improved forage quality which enticed elk to Bridge Creek from other natural winter ranges, some of which are private land. Sanctuary exists on these other ranges as it does on Bridge Creek; it is likely that the same quality of forage does not.

If wintering elk numbers continue to increase, adjustments in cattle grazing eventually may be needed in order to have an adequate volume of high quality forage for elk. Reducing livestock numbers might seem to be the obvious solution, but it is not. Bridge Creek's records conclusively show the necessity for having judicious cattle grazing as a component of a successful elk winter range. With no cattle grazing, all forage is reserved for elk; however, elk numbers then decline because forage quality is low.

The solution probably lies somewhere between the present program and the ultimate. On Bridge Creek, the ultimate might be to double the number of cattle-grazed pastures to eight and increase cattle numbers to the point where six of the pastures can be properly topped off each year before mid-growing season. Two pastures would be rested each year—no cattle grazing—and this rest rotated so that each pasture would be rested once every 4 years. No cattle grazing would occur after mid-growing season; six out of eight pastures would produce nutritional regrowth for elk; and two pastures would produce a full forage crop each year.

Whether or not grazing during the early portion of the growing season for three consecutive years out of four would be detrimental to the health of the vegetation is debatable. It seems reasonable that this would work successfully because nearly all the area is in excellent ecological condition to start with. Whether or not this kind of cattle grazing would prevent the formation of undesirable rank residues remains to be seen.

With respect to increasing elk numbers, it should be noted that an elk winter range might become overstocked with elk in relation to the forage supply. In this case, no amount of adjustment in cattle grazing alone is likely to provide the feed supply required by the elk. Control of elk numbers might be required. Wildlife, like livestock, have maximum population potentials.

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