A Study of the Range Habits of Elk on the Selway Game Preserve

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Introduction

BECAUSE public demand is for increased big game production on wild lands, the U. S. Forest Service is now confronted with a problem of extreme importance—namely, what will be the ultimate effect of increased big game production on the vegetation of the National Forest ranges? Summer ranges that now adequately support both big game and livestock may become seriously damaged in a few seasons if big game is allowed to increase at the expense of the sustained carrying capacity yields of the ranges. Even today, in certain localities, big game winter ranges are taxed beyond their carrying capacities and any additional grazing by an increased big game population would introduce a most devastating condition. At the present time, we have attained a considerable knowledge concerning the forage habits of livestock under certain range environments, but, as yet, little information is available relative to such habits for elk and other big game.

Plant utilization studies have been carried on for the different classes of livestock rather intensively during the last decade by investigators in range management, but palatability values still remain uncertain for many plant species. Students of wildlife have been slow to recognize the value of plant utilization studies for big game and, as a result, this study has not kept pace with the range management investigations.

Considerable general information has been obtained regarding the character, development, and breeding habits of elk. However, additional information on these subjects would supply an apparent need.

The role that minerals play in the diet of the elk, as well as a factor in its distribution under natural conditions, is only generally known today. This subject needs further investigation in order to obtain the valuable information now available regarding the importance of minerals in livestock production.

Purpose

It is the purpose of this paper to present the results of a study, made during the summer of 1938, of the range habits of elk on the Selway Game

[1]The field research, carried on during the summer of 1938 was, in part, financially supported by Region 1, Forest Service, Missoula, Montana, for which the writers wish to acknowledge their indebtedness. We are also indebted to Ranger George Case, Moose Creek Ranger Station, and to Dr. A. B. Hatch, formerly Assistant Professor of Forestry, University of Idaho, for the interest they have manifested in the investigation.
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Preserve, with the major emphasis upon characters, development, breeding, salting, and forage utilization and minor emphasis of the role played by predators, insects, and parasites.

Literature Survey

Preble *(2)* in 1911 was among the first to focus the attention of students sharply upon the need for careful studies regarding the range food requirements of elk in the western United States. He based his conclusions principally on the range habits of elk observed in Jackson Hole, Wyoming, as well as the reports of reliable residents of that region. Since Preble's publication and especially during the past five years, considerable research has been carried on by investigators concerning the food requirements of elk on winter ranges. Their results are not pertinent to the present investigation.

In 1929 Seton *(4)* pointed out in considerable detail in his volume, *Lives of Game Animals,* the character peculiarities of elk as well as their range habits. Although Seton was unable in all cases to obtain quantitative data relative to certain elk habits, nevertheless, his generalizations were based upon fairly accurate observations and have added much to the growing interest in wildlife management. Seton gave a reasonable explanation of the wallowing habit among big game which, as yet, has not been discredited.

Rush *(3)* in 1934 reported the results he obtained from a detailed investigation concerning the range habits of elk in Yellowstone National Park. In his report he not only emphasized the general food and mineral requirements for elk under range conditions, but also stressed points associated with their development, breeding habits, and character peculiarities. His findings have been extensively drawn on in the present paper where comparisons seem desirable.

In 1934 Dixon *(1)* was able to show that mule deer in California grazed a large number of plant species. However, only a comparatively few species were classed as of "great relative importance" for deer. Today such species would no doubt be classified as key species. He also pointed out that the diet of the mule deer varied with the seasons.

The Forest Service *(6),* in their volume of 1937, have, by means of a scientific study carried on over a period of many years, been able to determine quite accurately the palatability values of plant species commonly taken by both livestock and wildlife. Their results have been a source of considerable value in this investigation. This is also true regarding the plant studies reported in the mimeographed *Range Management and Wildlife Handbook* of the Forest Service *(5),* Region 4, 1937.

Methods

In order to obtain representative data in the Selway region on the character, development, and breeding habits of elk, it was necessary to observe their movements under natural conditions during most of the daylight period of each day when possible during the investigation. These observations were made in localized areas that represented as nearly as possible the environment most desired by elk for a given action. Much time was spent locating desirable areas where the actions of elk could be clearly

observed without disturbing them. A field binocular of high magnification was used for observations beyond the natural vision. Records were made of the various elk actions. An attempt was made to correlate these actions with the time of day, time of season, and type of environment.

To determine the per cent of palatability of the more common plant species grazed or taken by elk in the Selway region, it was necessary to consider the season that the species were taken as well as the plant parts most desired. To secure this information, the two following methods were employed:

First, two plots of 1 acre each were laid out to determine quantitatively the species grazed and amounts taken of each during the seasons.

Second, random field observations were made of feeding elk in various localities to determine the species taken during the seasons included in the investigation.

In the first method, each plot was 1 chain wide and 10 chains long. These plots were located on slope sites in the vicinity of the Wounded Doe Licks drainage where elk normally graze throughout the late spring, summer, and fall seasons.

Densities, as well as species composition percentage, were obtained by the reconnaissance range survey method. Each plot was examined weekly to determine the percentage of each species taken by the elk the previous week. The amount of vegetation taken during this interval could usually be determined by the relative freshness of the remaining plant stubs. The freshness of the elk tracks in the plot were also used to determine the weekly visits of the elk.

The plots were introduced to supplement the field observations with quantitative data.

In the second method, field binoculars were used to observe feeding elk. This made it possible to identify plants at the time of grazing or by an immediate check-up after the animal had moved into another locality. Such a check not only revealed the species grazed, but also the parts of the plant most desired by the elk. In many instances, fresh elk tracks were followed to determine what species were being taken. In all cases, proof was established that elk and not deer or rodents had taken the vegetation.

The forage types favored by the elk varied during the season and these trends were carefully noticed.

To determine the palatability of a given species, it was necessary to consider many factors. First, palatability must be defined on a working basis. According to the Forest Service *(5)*, "palatability is the per cent of the total current year's growth, within reach of stock to which a species is grazed when the range unit is properly utilized under the best practical range management."[3] Since there was approximately three times more forage in the region studied than was needed by the elk during the summer, on the basis of determined carrying capacities, extreme variations in

[3]Since the publication of the *Range Management and Wildlife Handbook*, 1937, by Region 4, Forest Service, many range workers have substituted the term "proper use factor" for palatability, which more clearly represents the definition given above for palatability. Because "proper use factor" is a rather recently coined term and is not so clearly understood by the average individual interested in big game range problems for whom this paper should have a general appeal, it seems advisable to use the term "palatability."

the relative percentages of the various species taken were noted. For example, among the highly desired species, black-berried elderberry *Sambucus Melanocarpa*[4], and mountain ash *Sorbus scopulina,* were taken nearly 100 per cent by October, while elk sedge *Carex geyeri* and such grasses as mountain brome *Bromus carinatus,* bluebunch wheatgrass *Agropyron spicatum,* spike redtop *Agrostis exarata,* and pinegrass *Calamagrostis rubescens,* were not taken to exceed 10 to 15 per cent because of their abundance. If the range had been stocked to its carrying capacity, the sedges and grasses would be 80 per cent utilized, but the mountain ash and elderberry species would remain the same. Therefore, it was necessary to give weight in the palatability determinations to the relative frequency that each species was taken. Otherwise, "ice cream plants," such as elderberry and mountain ash, would give an untrue relationship relative to the palatability values as compared with *Carex geyeri* and *Bromus carinatus,* which are more staple species.

Another problem encountered in the palatability determinations was differences in desirability that an elk showed for a particular species of one forage type to that of another. This variableness is in a large measure due to the associates of the species in question. Evidence supporting this condition is found in areas supporting fool's huckleberry *Menziesia ferruginea,* where palatable browse is rare. Here this species is frequently cropped rather closely, but is not eaten in those areas where species of *Acer, Salix,* and *Amelanchier* are common. In addition, certain species of low palatability would be taken more heavily along elk trails and in the vicinity of licks than elsewhere. All variations, such as the foregoing, had to be considered in arriving at a per cent palatability rating. From elk feeding observations, it was noted they would frequently feed from 15 to 30 minutes on herbaceous vegetation before taking any browse. These animals would then feed exclusively on browse for a period almost equal to that of herbaceous grazing. Thus, if elk's tracks were followed for a short distance it might be observed that this animal took only herbaceous vegetation, although several clumps of palatable willow along the way were not touched. Therefore, it cannot be assumed from a given observation that elk do not graze species of *Salix.* It now becomes evident that many observations are necessary before the desirableness of a given species can be determined.

The methods used to obtain data relative to the mineral requirements of elk are as follows:

1. Block salt was placed in representative localities on the range where observations could be made of visiting elk without disturbing them. Data were recorded as to the number of animals that visited the salt, as well as the time in minutes spent in salt consumption by each animal. These data were collected in certain localities for the major portion of the investigation.

2. Observations were made in the Wounded Doe Licks to determine the period of greatest utilization on the basis of daily number trends of big game. Additional observations were made concerning how the big

[4]Henceforth the common name (when known) and the botanical name will be used interchangeably after the botanical name has been introduced.

game drank the water and the time required to drink a sufficient amount to satisfy the mineral requirement of the animal for a given visit.

General field observations were made to determine the role that predators, insects, or parasites might play in the development as well as the range habits of elk.

Topography, Climate, Wounded Doe Licks, and Biotic History of Region

Topography

The Selway Game Preserve is situated in the northeastern part of Idaho County, Idaho. This entire region is highly relieved with numerous V-shaped valleys, ravines, and creeks.

The elevations vary from 2,500 feet at Moose Creek Ranger Station to a maximum of 8,000 feet at the summit of the Crags. The general region studied, however, comprises an area with elevations varying from 4,000 to 7,000 feet.

Bare granite exposures are common throughout the region except in some of the valley bottoms. Precipitous cliffs are not common but nearly all slopes are very steep. Small lakes are common in the cirque-like valley heads.

Climate

The annual precipitation of the region as reported from reliable sources, approximates 45 inches a year. The largest amount of this comes in the form of snow during the winter months. There are usually several feet of snow at the higher elevations during February, March, and April. The melting snow in the spring swells the small rivers and creeks to many times their natural size. These subside in July to their normal flow. The precipitation recorded at the Moose Creek Ranger Station from May through October, 1938, was 9.01 inches. The precipitation decreased from May until August when the lowest monthly precipitation of .27 inch was recorded. After this date the precipitation began to increase. Moisture was sufficient throughout the summer to produce a luxuriant plant growt affording an abundance of forage for the big game of the region.

Temperatures during the daylight period were warm throughout most of the summer but only a few days would be classed as hot.

A heavy frost occurred every night during early June in the vicinity of Wounded Doe Licks. June 8 and 9 were characterized by snow flurries and very chilly weather while the temperatures at the Moose Creek Ranger Station indicated warm weather. The first frost of late summer occurred at Wounded Doe Licks the night of August 20. Subsequent frosts killed many herbaceous weeds and influenced the palatibility values of certain plant species.

The first snow of the season fell in the Wounded Doe Licks area October 11. Two inches of wet snow covered the ground October 14 at an elevation of 4,500 feet, but increased in depth with altitude in the region.

Inclement weather somewhat hampered the elk studies during the summer since these animals showed but little activity on rainy days.

Wounded Doe Licks

Camp was established during most of the investigation ½ mile from some large natural deer and elk licks known as the Wounded Doe Licks, which are situated at the junction of Wounded Doe Creek with one of its branches. The licks are located in a timbered area, one of the few areas escaping the ravages of the 1910 fire. Wounded Doe Creek divides the licks into two areas as it flows southeasterly.

Elk, deer, and moose have used the licks for many years as salt ground. As a result of the trampling, bedding down, and heavy grazing by big game, the immediate areas have been denuded of nearly all of their vegetation except trees 6 inches or more in diameter. A total of 15 acres has been denuded of all herbaceous and shrub flora except small patches of protected or resistant vegetation, while many additional acres are partially destroyed in the surrounding transitional zone. The transition zone is a belt surrounding the denuded area in which the vegetation has been retarded to a marked degree, but represents an intermediate stage of utilization between the heavily used lick vegetation and the relatively lightly used surrounding range. The fir and spruce reproduction has been browsed considerably but not sufficiently to kill it. The herbaceous and shrub vegetation likewise is more abundant in this zone than the lick area proper, but its growth is suppressed considerably.

The water of the licks, which the big game animals crave and use as fulfillment of their mineral requirements, arises from a few closely distributed springs in each of the two lick areas. These springs have been trampled extensively and appear so dirty and muddy that they resemble pig-pens. There is a steady flow of water from these springs throughout the summer.

Numerous elk trails, both old and new, converge at the lick areas. Many of these can be followed for 3 or 4 miles from Wounded Doe Licks. Moose were known to trail in from Fish Lake, 6 miles distant, attesting to the popularity of these springs with the big game of the region.

Biotic History of Region

The region naturally supports a climax type of ponderosa pine *Pinus ponderosa,* and Douglas fir *Pseudotsuga taxifolia* from the lower elevations up to 4,000 or 4,500 feet, depending on the exposure. Douglas fir predominates on the upper elevational sites, with an admixture of lowland white fir *Abies grandis,* Engelmann spruce *Picea engelmanni,* and subalpine fir *Abies lassiocarpa,* forming a climax type from 4,000 or 4,500 feet to 7,000 feet, with considerable white bark pine *Pinus albicaulis* being found at the upper limits of this type.

Small subalpine meadows are common and, because of their high water table, have never supported tree growth. Grasses, sedges, and some weed species compose the climax vegetation of these areas.

Mountain alder *Alnus tenuifolia* forms a climax type on many of the moist slopes. This tall shrub forms very dense thickets due to the abundance of moisture furnished by a high water table. The sites have better drainage, however, than the meadows. An abundance of herbaceous species grows in and near the alder areas. Among the more common of

these weeds are arrowleaf butterweed *Senecio triangularis,* mountain bluebells *Mertensia ciliata, Claytonia asarifolia,* false Solomon's seal *Smilicina racemosa* and spikenard *S. stellata,* and green-hellebore *Veratrum eschscholtzii.*

The timber areas, because of the open character of the stands, have an abundance of shrubs and herbaceous growth as a ground cover. Big whortleberry *Vaccinium membranaceum,* and *Menziesia ferruginea* are the dominant shrubs, while the more common weeds are bog wintergreen *Pyrola ulignosa,* one-sided wintergreen *P. secunda,* lesser wintergreen *P. minor,* gold thread *Coptis occidentalis,* queen cup *Clintonia uniflora,* piper's mitrewort *Mitella stauropetala, Senecio triangularis,* and bear grass *Xerophyllum tenax.*

Following the 1910 fire, lodgepole reproduction came in abundantly on some areas above 4,500 feet elevation, while others show only sparse growth. These poles average 4 inches in diameter and attain a height of approximately 30 feet in certain sites. Frequently they attain greater diameters on the better sites. The dominant herbaceous species of the lodgepole type are *Xerophyllum tenax, Carex geyeri,* and pine grass *Calamagrostis rubescenes. Vaccinium membranaceum,* grouse berry *Vaccinium scoparium,* and *Salix spp.* are the dominant shrubs common to this type.

The shrub type of the region is very important from the standpoint of ground cover and big game forage. Browse covers vast areas from 2,500 to 6,000 feet elevation. Shrub growth is often so dense that passage is made very difficult. The more important browse species are willow *Salix spp.* maple, *Acer glabrum,* red-stemmed ceanothus *Ceanothus sanguineus,*[5] snow brush *C. velutinus,*[6] ocean spray *Sericothica discolor,* nine bark *Opulaster malvaceus,* bittercherry *Prunus emarginata, Vaccinium membranaceum,* service berry *Amelanchier anifolia,* and lesser amounts of many other species. Various grass and weed species are common in the interstitial spaces.

The numerous sparcely covered lodgepole and open slope areas support considerable bear-grass and elk sedge, as well as smaller amounts of mountain brome *Bromus carinatus,* blue rye-grass *Elymus glaucus,* and pine grass. Besides these are the following weed species: Beard-Tongue *Penstemon pinetorum, Geranium viscossisimum,* and *Potentilla glandulosa.* Sites of higher moisture on the open slopes support a luxuriant growth of grasses with considerable amounts of bracken fern *Pteridium aquilinum,* nigger head *Rudbeckia occidentalis,* tall larkspur *Delphinium scopulorum,* and *Mertensia ciliata.* Other species of only minor importance are also present but for space reasons will not be listed. The great amount of highly palatable forage that has come in as seral communities as a part of the succession following the 1910 fire, plus the inaccessibility, has introduced an elk and deer "heaven" in this region. These animals are not required to compete with domestic stock because grazing is prohibited on the game preserve. As a result, elk have steadily increased during the last two decades. Completely forested areas, such as the Selway region prior to the

[5]Red-stemmed ceanothus is prevalent at the lower elevations up to 4,000 feet.
[6]Snow brush is found at elevations of from 4,000 to 6,000 feet.

fire of 1910, are not desirable as big game range because of the scarcity of forage. Such a condition may again prevail on the burned areas when plant succession has approached a climax.

Elk Characters, Development, and Habits

Characters

Since the morphological characters of the elk have been discussed in considerable detail by previous investigators, only the general characters will be emphasized in the present paper.

Gaits. The gaits of the elk that have been reported are walk, trot, and gallop. Another gait recognized by the junior author while watching elk calves at play is reported in the present paper as the bounding gait. This gait is most commonly associated with the mule deer and domestic sheep, especially lambs. An animal when bounding rises with all 4 feet in the air in the same position at the same time resulting in conspicuous bounds.

The bounding gait is quite closely associated with the immature elk and seems definitely correlated with play. The gait is primarily restricted to open areas where danger from ground irregularities is negligible. Bounding by calves or young elk is done principally in the early morning or early evening when they become playful. It was not unusual to observe three or four calves bounding about in a meadow for at least 30 minutes with their heads held high. All animals observed while bounding held their heads and noses high in the air.

Elk observed fleeing from danger gallop or trot, but were never observed to bound.

Jump. Elk were observed to jump a height of 5 feet. Several elk were able to jump over, without touching, the top poles of a corral built in the Wounded Doe Licks. This height is rather remarkable for such heavy animals, for they had a limited space for a running start.

Senses. Due to the numerous references available in literature that discuss elk senses and for space reason, the following statement is offered. The field observations definitely indicated that elk have a highly developed sense of sight and hearing; but the sense of smell is remarkably keen and is, no doubt, their greatest asset in the detection of danger.

Voice. The bark of the cows, and less frequently of the bulls, is occasionally heard. Elk usually bark when alarmed but not always definitely assured of the danger. When elk hear the bark of another elk, it is usually regarded as a danger or warning signal. However, it is quite possible that the tone of the bark may indicate the seriousness of the alarm.[7]

Bleating by the calves is a very common sound in the Selway from June until August. After that it is heard less frequently. A young bull was heard to bleat in early October during a friendly duel with a spike.[8]

Calf Development

Calving period. The general calving period in Yellowstone Park, as determined by Rush *(3)* is from May 15 to June 10. He reports May 13 as the earliest calving date on record and June 10 the latest. The data ob-

[7]The bugling by the bulls is treated under Breeding Habits.
[8]A Spike elk is a yearling bull and is characterized by single tine antlers instead of branched antlers.

tained in the present study would indicate that the calving period is the same in the Selway.

Calving in the Selway is predominantly on winter range where early forage growth affords much desirable succulent feed for the lactating mothers. After the calves are able to travel, the cows migrate to the summer ranges. It is possible that some late calving occurs on the summer range, since a few cows which appeared to be heavy with calf were seen in early June on summer range areas.

The summer elk range in the Selway lies generally above 4,000 feet, but varies somewhat with the exposure. It is apparent that all the elk do not migrate to the summer range since members at the Moose Creek Ranger Station saw three cows and calves practically every evening throughout the summer grazing on the Moose Creek airport.

Feeding. Calves depend entirely on their mothers' milk for food during the first 4 to 6 weeks. At this time, they start taking small amounts of the more succulent forage. Rush *(3)* states July 19 as the first date a calf was seen feeding on grass. The first date a calf was seen taking forage on the Selway was July 5. Two calves were observed eating *Vaccinium* leaves and grass the following day. After this date, it was a common sight to see calves foraging.

Nursing was not observed until July 5. Nursing periods after this date rarely exceeded 1 minute in duration. The longest period observed was 1 minute and 9 seconds, while the shortest period was only a few seconds. As the summer progressed and the calves began foraging, fewer and shorter nursing periods were noted.

On July 15, the actions of a certain calf were observed for a period of 2½ hours and are recorded as being those of a typical calf. This calf was one of small herd of elk composed of 9 cows, 8 calves, and 5 heifers. They were first sighted at 1:45 p. m. lying down in a small open meadow. The calf mentioned soon rose and after feeding 4 minutes lay down at 1:50 p. m. After 40 minutes rest, it rose again and commenced foraging. At 2:35 p. m., the calf's mother came and nursed it for 20 seconds. The cow immediately left and the calf, after watching its mother for a few seconds, resumed feeding. The calf fed until 3:03 p. m., or 25 minutes, when it lay down for another rest. The cow returned at 3:35 p. m. to again nurse the calf. The calf saw her approaching some distance away and jumped up and ran to meet her. This nursing period was 20 seconds. The cow, without stopping, returned to the meadow 300 feet away from which she had come. The calf followed the mother only a short distance, then fed until 4.02 p. m., when it again lay down. It was very restless, however, and started feeding 3 minutes later; and after feeding only 3 minutes, it lay down at 4:08 p. m. A thunderstorm at this time prevented further observations. During 2½ hours, the calf had foraged 44 minutes, rested 105 minutes and suckled 40 seconds, but it had not moved out of a 100-foot radius. It was also interesting to note that the calf did not follow its mother and was with her only while being nursed.

A check relative to the browse species taken by four calves on July 9 revealed that willow was preferred, with *Menziesia ferruginea* and *Vaccinium membranaceum* next in the order named.

A calf was observed to ruminate for a period of 10 minutes on July 10. Five calves were seen July 15 being nursed for periods of 20, 15, 27, 17, and 20 seconds. The average nurse time for each calf was 20 seconds. A calf nursed for 69 seconds on July 16, the longest time recorded during the investigation.

Two cows were seen nursing their calves on August 2. Both calves were obliged, because of large size, to drop on their knees in order to suck the cow. After this date, practically all of the calves observed nursing were doing so on their knees. The last nursing observed was on October 5 when a calf dropped on its knees in the mud and water of Wounded Doe Licks while its mother was drinking.

After the middle of August, calves were observed to feed as eagerly and as long as their mothers. Since nursing periods were rarely observed, and if so, the act was very brief after August, it may be logically assumed that weaning is accomplished in a few weeks. Weaning is not brought about by the cow suddenly, but instead is a tapering-off process. These observations point out conclusively that the cows continue to nurse the calves for some time after they commence foraging.

Calf growth and pelage development. The field observations indicate that elk calves are conspicuously spotted with numerous white spots *(Fig. 1)* on their tan or light brown flanks from the time of birth until the

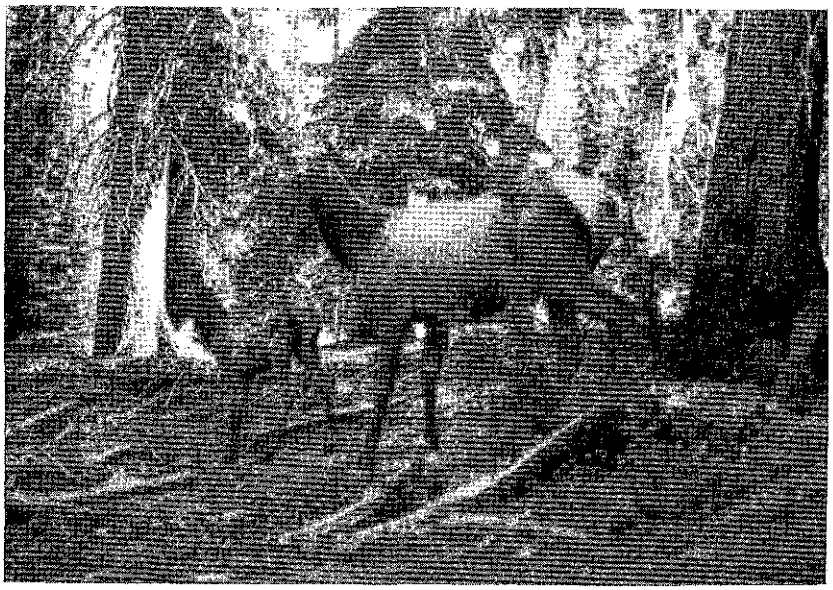

Figure 1.—Elk calf showing white spots as late as August 12.

middle of July. On July 9, two calves were noted whose spots were growing faint and whose rump patches were of noticeable contrast to the dark colored adjoining flanks and back. From this date, spots tend to fade out, and by the middle of August most calves have lost them. Accompanying

the disappearance of the spots is the growing prominence of the light buff rump patch and long scraggy growth of hair. Exceptionally late calves do not lose their spots and change pelage until after the middle of August. A calf seen on August 29 had pronounced visible spots. Seton *(4)* observed a calf on October 15 which was in full spots and less than a week old. In addition to the foregoing pelage changes, the hair on the head, neck, legs, belly, and back, following the loss of the spots, becomes noticeably darker than the flanks.

Many calves of the same size may be perceptibly darker in color than others. Dixon *(1)* states "that mule deer male fawns are darker than the females." This is also probably true of elk calves. The calf population was closely divided between the two color variations and among the six calves definitely identified as to sex. The two dark calves were males and the four light ones were females.

The calves undergo a molt from late August to late September. During this time they lose their long unkept hair to don their trim neat appearing winter pelage. Their flanks are olive-grey with dark legs, neck, head, and back similar to the pelage of the adult elk.

Calf habits. Limited information was gathered regarding the habits of elk calves less than one month of age.

No calves were seen on summer range until July 4, although a calf was heard bleating near Wounded Doe Licks on June 21. Calves are apparently left outside of the lick area in late June and early July because during this period many cows with well-developed udders came to the licks without their calves. July 11 was the first date a calf was seen in the licks. Calves spend most of their time lying down until they commence to forage. It is during this time that the cows are commonly seen without their calves. They may wander as far as ¼ mile from their calves while foraging.

On July 6, two calves were observed from 12:15 p. m. to 7:00 p. m. in order to determine if and when they became playful. It was not until 6:35 p. m. that these calves showed the first signs of playfulness. As the shadows began to fall on the footslopes, the calves became more active. During the play they would rear on their hind legs and make a few feeble sparring efforts with their front hoofs when approaching one another. Once during the play, one of the calves made a dash toward the other. As the calf approached, the other calf whirled quickly in a circle much as a cat does when chasing its tail. The first calf scampered away but returned, and as it approached the other calf, the same whirling stunt was repeated. This interesting action was repeated five times during the play of the two calves.

Insects are a great annoyance to calves during July and early August. The calves were often seen twitching their ears, swaying their heads or occasionally kicking to repel the insects. A calf was seen on July 25 to alternately snort and paw its nostril with its hind foot. Probably bot-flies were annoying the calf by attempts to lay eggs in its nostrils.

Some interesting calf antics were recorded August 2 at an old salt ground at lower Two Lakes. Here three cows, three calves, two heifers, and a bull were observed for some time. Two of the calves were feeling unusually frisky. For several minutes they played together and finally ran

and splashed in the shallow water of the nearby lake. Several times both calves would rear on their hind legs to spar with each other. During this romp a mule deer doe was seen approaching the lick, and one of the calves charged toward her, driving her away. The same calf repeatedly drove the doe away each time she came back. Following one of these sorties, the calf, while watching the doe flee, stopped to paw the ground vigorously as though a conquering hero. This calf later amused itself by chasing a large four-point male deer buck away. On one occasion the buck suddenly whirled and faced the calf. Such a reversed action bewildered the calf and it meekly backed away. A similar incident was also observed at the planted salt in Fish Lake Saddle where a calf chased a mule deer buck away. Adding to the antics of these calves, one attempted to "cover" a cow on three occasions.

On August 12, an elk "play" area was watched from a distance of 200 feet. Here, two calves crossed to this dirt "arena" at 10:28 a. m. The first few minutes were spent in investigating and smelling of urinated spots in the dust, just as a cow and bull had done just previously. Soon these calves sparred off and actually hit each other with their front hoofs. The darker calf was the aggressor and soon drove the lighter colored calf away. The darker calf continued to give vent, for some time, to his energy by running sideways, bucking, kicking, wheeling suddenly, and stopping stiff-legged when galloping. It confined most of these activities to the dirt arena, which is approximately 30 feet in diameter.

The excited actions of a mature elk were usually sufficient to cause a stampede of elk either in the licks or on the range. Little attention was given by older elk, however, to similar warnings given by calves. While in the licks one day, a calf observed one of the writers and galloped excitedly to its mother. The cow muzzled her excited offspring in wonderment, but she neither ran nor looked around for possible danger. Similar incidents were noted from time to time, and in no case was the calf given credit for discovering danger.

During the breeding season it is not uncommon to see many calves separated from their mothers.

Calf crop. An attempt has been made to arrive at a figure which might represent a reasonably accurate elk calf crop percentage for the region studied.

In arriving at a percentage, all calves and cows were totaled which were observed between July 9 and October 11. Cows and calves observed in the lick areas were not tabulated because accurate counts were not possible; hence, only those cows and calves observed on the open range entered into the determinations. The results show a total of 335 cows and 248 calves, which gives a 74 per cent calf crop.

Calf and cow numbers noted prior to July 9 were excluded because calf numbers observed were much too low in comparison to the number of cows. Calves prior to July 9 spent most of their time lying down; therefore, reliable counts could not be obtained until the calves began to follow their mothers. Although 74 per cent represents a close approximation of the calf crop, 80 per cent would, no doubt, more nearly approach the correct value, because the heavy browse growth and lodgepole reproduction screened out the calves in certain instances when the cows could be seen.

Breeding Habits

Bugling. Bugling by the bull elk during the breeding season is the outstanding characteristic of the period. The bugle is described as being flute-like and is considered by many naturalists as the most impressive sound heard in nature. Rightfully executed, the bugle starts at a low pitch, rising in a crescendo to a high pitch usually in three notes. It then drops suddenly, ending in the initial low pitch. Frequently the bugle terminates in a hoarse bawl or a series of y-y-y-y-y's which are anything but musical.

No spikes were observed bugling and it is believed that bugling is restricted to the older bulls which are interested in breeding.

Occasional bugling was heard throughout the summer, but it was not until the latter part of August after the bulls had shed their velvet that bugling became prevalent. Bugling became increasingly prevalent from August 27 until its height was reached about the middle of September.

Elk combinations before and during the breeding season. During early June, cows and bulls were frequently seen in company with each other. However, as the summer progressed the bulls preferred being alone or with one or two members of their own sex. Spikes were often seen in the company of an older bull until the approach of the breeding season. Spikes divided their attention between the cows and the bulls during the summer which would indicate they had no preference as to sex.

With the approach of the breeding season and even a week prior to velvet shedding, the bulls shift by themselves. This relationship continues until the termination of the breeding season. Spikes, however, because they are not a factor in the breeding, are often seen in groups of two's and three's during this period. The older breeding bulls give chase to the spikes, making it impossible for them to remain with either the cows or the older bulls.

Antler development. By the first of June most of the mature bulls had grown from two- to four-tine sets of antlers. A six-point set is considered a mature set, although seven-point antlers are not rare and freak sets of greater number have been occasionally reported. Seton *(4)* states the record elk head for the number of points had 29 points on both antlers.

A five-point bull was seen on June 1 with antlers approximately 2 feet in length. Another bull with a six-point set was recorded on June 13. These two bulls were exceptional in their antler development, since most bulls had but two to four points during this period.

On July 26, two bulls were observed shadow fighting. They stood a few feet apart shaking lowered heads at each other. One of the bulls quit the mock battle to press his head against a dead lodgepole sapling stub. He would push this sapling back and forth, but was careful that he did not injure his antlers. These actions would indicate the approaching maturity of his antlers and the accompanying desires to battle.

The first evidence of velvet shedding was noticed on August 20 when a small ponderosa pine was discovered that had been barked the previous day.

On August 21, a five-point bull was observed with velvet intact. Five days later, six bulls were seen which had shed their velvet and four of these had polished the points of their antlers. All the bulls observed after

August 27, except spikes, had shed their velvet. The bulls remained in the timber and dense browse areas prior to and during velvet shedding. Only a very few bulls were seen during this period. Soon after the bulls shed their velvet, they were seen more frequently because they began roaming and searching for cows.

Spikes, because of sexual immaturity, do not mature their antlers as early as the older bulls. Sometimes they do not shed their velvet until the following spring, according to Rush *(3)*. Approximately 50 per cent of the spikes observed in the Selway area had shed their velvet by October 10.

Spikes are very irregular in their antler development. A spike was observed September 6 with 18-inch antlers which had shed his velvet. Another spike with velvet intact and antlers 4 inches long was seen on September 17.

In shedding their velvet, bulls show a marked preference for small saplings varying from 1 to 3 inches in diameter for rubbing purposes. The bulls apparently show no preference as to species they antler, other than their abundance. The elk will, however, scar sizeable trees, such as a 14-inch lowland fir which was found skinned. During the season many bulls were observed "horning" saplings, and they were not especially unruly, since they scarcely moved out of their tracks during the procedure. An exception to this was observed August 27, when a large six-point bull antlered a small white bark pine sapling. He had shed his velvet previously but was polishing his antlers for they were still dark in color and stained. Prior to the antlering, this bull was seen following a cow and heifer and at times would charge them, but they managed to elude him. Being unsuccessful in his wooing, he commenced antlering the sapling. Although the bull did not move out of his tracks during the 20 minutes spent at the sapling he was rather vicious in swinging his head and bending the pine back and forth. To obtain added friction, the bull would place his head directly against the sapling and then turn his head sidewise so his antlers were directly above each other but on opposite sides of the sapling. Then he would rub his antlers up and down very vigorously, while at other times he would rub the back of them. The bull so mutilated the little pine that no bark or branches were left from 1 to 5 feet above the ground. Only one case was recorded where a bull moved about to any extent while rubbing his antlers.

From observations, it is evident that the period of antlering among the bulls varies from a few seconds to 20 minutes.

Rush *(3)* remarks that bulls rub their antlers on small trees for two weeks after shedding the velvet. Antler-rubbing was observed throughout September and as late as October 7, although to a much less degree than in late August and early September in the Selway.

Antler development is closely correlated with the breeding season. As soon as the velvet is shed and the antlers polished, the bulls start searching for cows. A few instances were noted where bulls were chasing cows even before the antlers had been polished.

The evidence obtained during the elk studies would indicate that the antlers serve to accentuate the dominance of the stronger bulls and aid in

scaring or fighting weaker ones away from the cows. This seems highly desirable as an aid to the betterment of the species.

Rush *(3)*, commenting on the habits of elk bulls states: "Fights are usually tame affairs, one bull giving up the battle after a few clashes of antlers." In the present study, no actual battles were seen although young bulls were occasionally observed fighting for apparent pleasure. Many cases were noted, however, when a large, fully matured bull would give up his cow without a struggle upon the approach of another bull of similar size.

A fight between two young bulls was observed during the early morning of October 5, but on the whole it was a tame affair.

Breeding season. Observations revealed that soon after the bulls shed their velvet they began to show marked attentions toward the cows. Rush *(3)* states: "The actual breeding season is from September 15 to October 10." Observations in the present study indicate that the period of greatest activity would place the breeding season from September 10 to October 5. There was a marked decline of bugling and general activity following October 5. Few bulls were seen with cows after October 10.

As early as August 12, a bull was observed to advance toward a cow with his nose held high in the air. This bull had not yet shed his velvet, but his antlers appeared to be practically mature.

A large, six-point bull was observed following a cow and heifer at dusk, August 27. The bull would occasionally make galloping dashes toward the cow and heifer, but they would always keep a short distance in front of him. When the bull reached the spot where the cow or heifer had stood he would stop and smell and raise his head high in the air, curling his lip up at the same time.

A bull which had been wallowing was observed pursuing a cow the evening of August 29. He chased this cow from one side of an alder thicket to the other, but was unsuccessful in his attempts to corner her. Another large, six-point bull was noticed feeding complacently behind two cows and two calves on August 31. He would stop frequently to bugle.

After August 31 until near the close of the breeding season, it became increasingly common to see from one to three cows being followed by a bull. Cows herded together by a bull during the breeding season are known as a harem. Rush *(3)* states: "The average number of cows in each harem is 6, the smallest number observed 2, and the largest 16."

The largest harem observed in the present study consisted of only five cows; however, the average was two, and a single cow with a bull was not uncommon. Evidence would indicate that a large breeding bull in the Selway collects a harem of one to four cows, breeds them and then leaves them to search for other cows. The following observation is cited to substantiate this belief as well as to describe some of the habits of the elk.

A large six-point bull emerged bugling from an alder thicket at 4:30 p. m., September 30. As he proceeded down the slope toward a small meadow, he met a five-point bull with a harem of two cows. The five-point bull reluctantly, but meekly, moved away, leaving his cows to his rival. The larger bull began to follow one of the cows, but without success since she always moved ahead of him. He then contented himself by either feed-

ing spasmodically or bugling in challenge to other bugling bulls. On one occasion he dug up the turf with his antlers. At 4:50 p. m. a cow and calf which were leaving a near-by area joined this six-point bull's harem on their own volition. The five-point bull during this time remained in a near-by thicket. If he wandered too near to his rival's feeding harem, the larger bull would need merely to walk toward the smaller bull to frighten him away. At 5:00 p. m. the young bull left and crossed the creek into the timber of the lick. He emerged 5 minutes later, however, chasing a cow and calf. As they neared the big bull's feeding harem, the six-point bull ran toward them driving the five-point bull away, thus adding a fourth cow to his harem.

During this same evening and at 5:43 p. m., a young four-point bull was observed pursuing a cow, calf, and spike from the timber to the vicinity of the harem. The spike, in his hasty escape from the four-point bull, further jeopardized himself by running near the large six-point bull and his harem. The six-point bull immediately gave chase to the already frightened spike, running him for 300 feet and a fifth cow was added to the harem.

This six-point bull, during a period of 1½ hours, collected a harem of five cows. It would seem logical to assume that this bull, who was able to collect a harem of five cows in such a short period, had likewise collected harems earlier in the breeding season and bred cows. It is quite possible that the bulls collect small harems of one to three cows, breed the cows, and then search for other cows.

Observations definitely indicated the breeding season was well under way by September 17 at the elk lick in Rhoda Creek, 5 miles west of Wounded Doe Licks. On this date as early as 7:30 a. m., everything was in confusion around the licks. Elk could be heard running every way through the timber, splashing across the creek, breaking sticks, calves bleating, and bulls bugling. Occasionally a bull could be seen pursuing a cow at the edge of the timber. During these activities a large bull was observed amusing himself by chasing three frightened spikes, while a six-point bull was seen pursuing a five-point bull.

It was not uncommon to find, during the breeding season, small areas approximately 4 or 5 feet in diameter in which the turf had been torn up by the antlering and pawing of bulls. Banks and old logs were often torn to pieces by bulls. Bulls were even seen charging little calves for short distances during the breeding season.

Few gestures of courtship were seen among the cows and bulls. Cows not in heat will not allow the bulls to come near them. During the early morning of October 1, a bull was observed to "cover" a cow four times with no gestures of courtship being shown.

Spikes, because of their sexual immaturity, show but little interest in the opposite sex. An 18-inch spike with velvet still intact was seen closely following a heifer on September 10. When she stopped on one occasion, he smelled her and prepared to "cover" her, but she moved away. This was the only instance observed where a spike showed any interest toward a female.

Activities among the elk during the breeding season are at a minimum throughout most of the daylight period. There is considerable activity,

however, during the early morning hours and just before dusk in the evening. These activities extend on into the night. During mid-day, the elk are shaded up in the coniferous timbered or alder areas. Bulls were noted to frequent natural lick areas and planted salt deposits during the breeding season. It seems only natural that the bulls should do so to satisfy their mineral requirements. However, the many observations made would indicate that their primary purpose for visiting these areas was to collect cows for their harems. They would remain near lick areas for hours and upon the approach of a cow would run after her. As many as 12 bulls were in the proximity of a small natural lick in Rhoda Creek at a given time as ascertained by their bugling. The larger bulls, when they had collected two or three cows, would leave the lick areas. It was clearly evident that the desire for mineral water was only incidental with them.

Wallowing. Wallowing is a peculiar phenomenon and very little quantitative data regarding the subject is found in the literature relative to the habits of big game.

The observations made relative to wallowing in the Selway tend to corroborate those reported by Seton *(4)* who restricted this phenomenon primarily to the males during the breeding season. Observations were

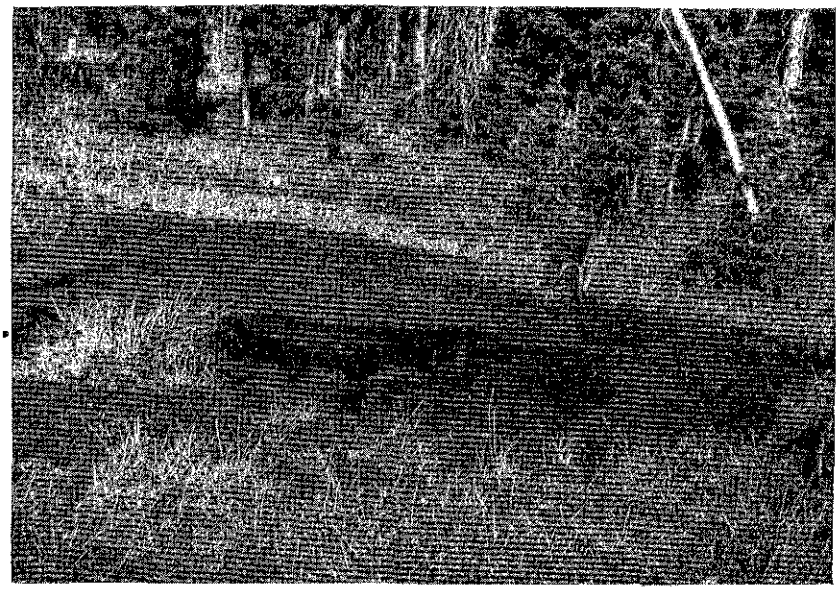

Figure 2.—A typical meadow wallow that has been recently used by elk bulls.

made each day in the field as to the appearance of old wallows *(Fig. 2)* and for clues of new ones throughout the study. No indications of wallowing were noted until August 29 when a bull elk was seen to wallow in a wallow fashioned a few days before. Evidence indicated that the last day

a bull wallowed was October 4. Furthermore, no wallows that had been recently used were observed after this date.

Many wallows were watched in order to record the actions of the wallowing elk, but only once were the antics from the beginning to the finish observed. A bull made possible the study, and his actions were as follows:

At 1:33 p. m., August 9, a five-point bull with velvet shed approached a wallow that had been made in a spring a few days previously by pawing and rolling in the mud and water. It was a shallow depression 1½ feet in depth and approximately 8 feet in diameter. He immediately waded into the wallow and lay down with the water covering half of his sides. The bull made a few feeble attempts to roll over but only succeeded in wetting his backbone. While still in this reclining position he would kick his hind legs back and forth and rest his head at times by anchoring one antler in the wallow.

At 2:01 p. m. the bull arose and appeared to be in a belligerent mood caused perhaps by the near-by bugling of a rival bull. He swayed his head back and forth, swashing the mud and water with his antlers. He then commenced pawing the mud and water viciously and, to further give expression to his emotions, would kick backwards. At intervals he would stand still to listen to the bugles of the other bull. Each bugle would serve to antagonize him more. With considerable zest he began antlering the bank adjacent to the wallow. Chunks of dirt and soil were tossed from 15 to 30 feet on each side of the wallow. The bull's zeal soon abated after some additional pawing, and at 2:05 p. m. he again lay down in the wallow. Five minutes later he arose and disappeared into a near-by alder thicket.

At 2:15 p. m. the bull returned and after wading for a short time he pawed and antlered the bank for 1 minute, then lay down. The bull was now very complacent and seemed content to lie still except for a brief period when he lay on his side and pawed the air with his hoofs. At 2:24 p. m. he arose and remained standing in the wallow for 1 minute before going into the alder patch.

Later in the afternoon at 6:30 p. m. the same bull was observed pursuing a cow in and out of the alders, but she did not allow him to catch her.

Practically every wallow that had been used during the breeding season presented the same aspect. Some were located in springs, others in swampy meadows, but all were circular depressions filled with mud and water. Invariably pieces of sod and dirt would be scattered from 10 to 15 feet around the wallow. Such evidence definitely indicates that the wallowing bulls are responsible for such a condition. Often browse and saplings adjacent to a given wallow were antlered, indicating the actions of a bull after wallowing. Only males were seen with mud on their sides, which was ample proof that the females did not use the wallow.

The data presented are strong evidence that wallowing is restricted to the male elk during the period the velvet is shed until near the close of the breeding season. Theories have been advanced that heat, insects, or scab might be responsible for wallowing by elk. If heat is the causal agent, one would expect elk to wallow from late June to early August, since this period, according to the temperature records, show as high or higher temperatures than the late August to early October period when wallowing

occurred. Bulls which had wallowed were noted on two of the coldest autumn days, namely, September 6 and October 4.

If insects are responsible for wallowing, one would expect both sexes of elk to wallow. Especially would this be true on the Selway Game Preserve from late June until the middle of August when insects prove to be the greatest nuisance to the elk. Such was proven not to be the case.

Scabies, which generally infects the older bulls, seems at first a plausible explanation, but again there is no reason why the wallowing season should coincide with the breeding season. Furthermore, no cases of scabies were seen among the mature elk during the summer. Yearling bulls, which are rarely infested with the scab mites, were observed to have wallowed on several occasions.

Why bulls wallow during the breeding season is difficult to explain. It is probably promoted by some physiological reaction in their body introduced by aroused sexual instincts as the breeding season approaches. The wallowing might serve as an appeasement of their sex desires.

Seton *(4)* draws no definite conclusion as to why elk wallow. He does generalize, however, that the cervid males are primarily responsible for wallowing, an activity restricted to the mating season.

This subject needs further investigation before definite conclusions can be drawn.

Observations of Elk Behavior in Wounded Doe Licks

Several days were spent studying the habits of elk, deer and moose, especially in Wounded Doe Licks, a small area of mineral springs described above, during late June and during July. In addition, the licks were visited daily for the purpose of determining elk numbers, except for occasions when the junior author was absent from camp for two or three-day periods.

Elk numbers in the licks increased from a few individuals in June to the maximum of approximately 150 on July 18. Following this date, the elk numbers decreased until only occasional elk were noted during September and early October.

It was found that few elk visited the licks at night. There was always a scarcity of tracks in the licks on mornings following nights when it had rained. Elk begin entering the licks as early as 8:00 or 9:00 a. m., increasing in numbers until a maximum was reached, usually at 1:00 to 2:00 p. m. These visits were in direct contrast to observations made at the planted salt in Fish Lake Saddle, where elk rarely visited this salt during mid-day, but confined their visits primarily to dusk, night time, or early morning.

It was not possible to determine how long individual elk would remain in the licks or how frequent their visits were because specific elk could not be identified. However, moose were found to spend an average of two days in the lick vicinity. The frequency of their visits remained unknown.

Observations showed that elk, upon entering the licks, immediately drink their fill and then retire a short distance to lie down and wait until they could drink more of the lick water. During this time they would ruminate, or, if hungry, nibble at any vegetation which might be present. Elk

spent, according to timing checks, from a few seconds to 40 minutes drinking the lick water at a single time. Continued observations on individual elk for two or three hours were impossible inasmuch as the elk scented the observer before observations of such length could be made.

Elk typically lap the lick water much as a dog might. In addition, they raise their heads at intervals, licking their tongues outward as though to taste the minerals of the water.

Bulls outnumbered the cows in the licks from May 31 to June 9, because the cows are calving at this time on the winter range. During July when the elk were most abundant in the licks, the bulls represent approximately one-fourth of the elk present at any one time. The bulls are especially clannish during July and the majority generally occupied a particular portion of the licks by themselves. Cows were observed on many occasions to immediately give up choice springs at the approach of a bull. If a cow was reluctant to move, the bull would make a motion as though to bite her, and she would move elsewhere.

The elk prefer the water as it emerges from the springs, but many were seen drinking from stagnant pools in the lick area. Moose especially would drink from such stagnant pools. It is doubtful that they do so by preference, but are held back by the more numerous elk that occupy the better springs.

Deer, likewise, are forced to drink from the less desirable portions of the licks unless there are only a few elk present.

Elk using the licks during the season outnumbered the deer 10 to 1. Deer are more prevalent in the licks during the periods when the elk numbers are the lowest—namely, June and September. Moose are infrequent lick visitors. They usually visit the licks singly, although pairs were occasionally noted, especially during the mating season.

Elk calves visiting the licks with their mothers take sparingly of the mineral water. However, they take more of it as they grow older.

The Forest Service constructed a platform in the licks during the last week of June to facilitate observations. Although the platform was well concealed from the view of the elk, it proved to be unsatisfactory. Elk were always able to scent the observer in a few minutes after entering the licks and once the scent was detected, they would stampede out of the licks. They would cautiously return at intervals, but, after repeated stampedes, the elk ceased to return.

It seems advisable to include at this place data relative to the corral constructed in the lick area by the Forest Service for the purpose of trapping elk calves to tag. The corral was constructed during the first week of July of logs averaging 9 inches in diameter. The corral was unequally five-sided, approximately 50 feet in diameter, with 5-foot sides which would allow the older elk to escape by jumping over. The salt blocks were placed inside the corral to lure the elk in, and by means of a long rope attached to a trip gate, the gate could be closed and trap any elk which might be present.

Elk, including many cows, were trapped on several occasions, but not once was a calf present. It was undetermined whether the cows left their calves on the outside of the corral because they sensed danger or whether

the calves preferred wandering about elsewhere while their mothers licked salt. Trapping elk calves by means of a corral has, no doubt, possibilities, but it is doubtful if the expense involved makes this method feasible. The corral, to be successful, should perhaps be considerably larger so that the

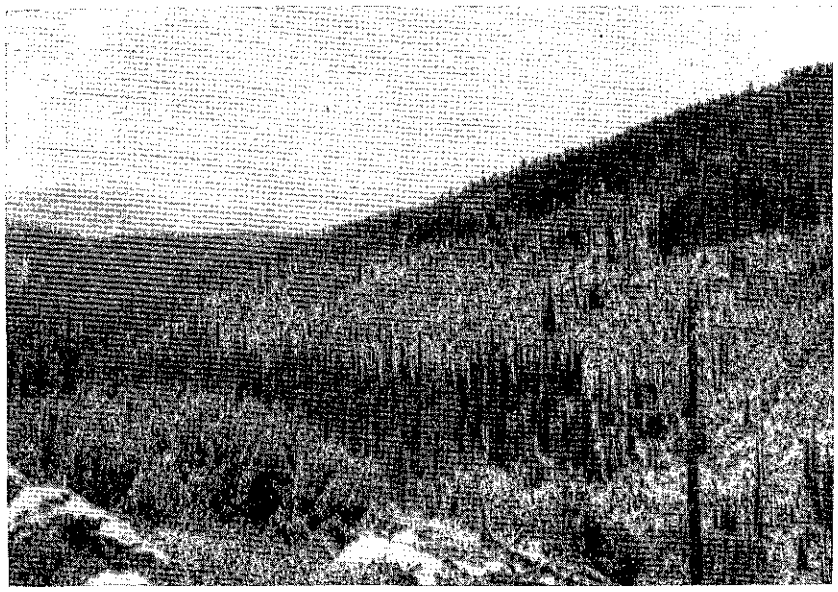

Figure 3.—Plot 1 is located in the large open browse area between the coniferous stands.

restless calves would not be too closely confined in their activities. They would probably spend more time inside the corral near their mothers under such circumstances. The corral constructed in the lick area was partially demolished by a bull moose on September 2 during the mating season.

Forage Studies and Palatability Determinations

Description of Field Plots

As stated elsewhere, the 1-acre plots were located in the vicinity of the Wounded Doe Licks drainage.

Plot 1 is situated on a 40 per cent eastern exposure *(Fig. 3)* at an elevation of 5,000 feet. The vegetation gave an average density of 45 per cent. Small patches of coniferous timber and alders were near the plot which were visited by elk practically every week during the period the study was made.

The species supported by Plot 1 are given in Table I. Also, the per cent of each species taken each week by the elk during the investigation are recorded in Table I.

Plot 2 is located on a 30 per cent western exposure at an elevation of 5,300 feet. It is characterized by many large boulders and with an average plant density of 35 per cent. Since there are no timbered areas near and

Table I. Plant species and per cent of ground cover, as well as per cent of utilization by elk each week from June 30 to October 6, 1938 in Plot 1 (1 acre) on an east exposure site.

	% of Total Ground Cover	Per Cent of Utilization														Final
		June 30	July 7	July 14	July 21	July 28	Aug. 4	Aug. 11	Aug. 18	Aug. 25	Sept. 1	Sept. 8	Sept. 15	Sept. 22	Sept. 29	Oct. 6	
Weed Species																
Achillea lanulosa Nutt.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Angelica lyallii Wats.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Aquilegia formosa Fisch.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Arnica latifolia Bong.		1	....	....	....	T[1]	....	....	....	....	....	T	T	....	3	....	5
Asplenium felix-femina (L.) Roth.		....	....	....	....	....	....	3	2	....	5	3	5	....	....	....	20
Calachortus elegens Pursh.		....	....	....	....	Dead	....	....	....	....	....	....	....	....	....	....	0
Chamaenerion augustifolium (L.) Scop.		....	....	....	....	....	....	....	....	....	10	....	....	....	....	....	10
Claytonia asarifolia Bong.		T	T	T	....	....	....	....	....	1	2	3	1	....	....	....	10
Delphinium scopulorum Gray.	1	½	T	T	T	2	T	....	....	2	....	....	....	....	....	....	5
Gaillardia spp. Foug.		....	....	....	....	....	....	T	....	10	....	5	....	....	....	....	15
Geranium viscosissimum Fisch. & Mey.		....	....	....	....	....	....	....	....	....	....	T	....	....	....	....	T
Hieracium albiflorum Hook.		....	....	....	4	5	3	2	5	T	....	....	....	....	....	....	20
Mertensia ciliata (Torr.) Don.		....	2	1	....	....	5	T	....	5	....	15	....	....	....	....	30
Phacelia heterophylla Pursh.		....	½	....	10	5	3	2	....	T	....	....	....	....	....	....	25
Penstemon pinetorum Piper.		T	2	....	T	T	1	5	10	5	5	5	3	1	15	1	55
Pteridium aquilinum (L.) Kuhn.	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Rudbeckia occidentalis Nutt.	4	....	T	....	....	....	....	....	T	....	1	T	....	5	5	....	(10 of heads)
Senecio columbianus Greene.		T	T	....	Dead	....	....	....	....	....	....	....	....	....	....	....	0
Senecio triangularis Hook.		½	T	....	1	T	T	....	T	....	3	5	2	....	3	....	15
Smilicina stellata (L.)Desf.		....	....	....	....	....	....	....	....	T	....	5	1	....	2	....	10
Thalictrum occidentale Gray.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Tiarella unifoliata Hook.		....	....	....	....	....	....	....	....	....	....	T	....	....	T	....	T
Valeriana sitchensis Bong.		....	....	T	....	T	....	T	....	5	T	T	....	5	T	T	10
Veratrum eschscholtzii Gray.		....	....	....	....	....	....	....	2	....	2	....	....	....	....	....	5
Xerophyllum tenax (Pursh.)Nutt.	20	½	T	....	....	....	....	....	....	....	T	....	....	....	....	....	T
Browse Species																
Acer glabrum Torr.		3	2	....	10	5	5	5	8	2	8	10	6	....	T	....	65
Alnus tenuifolia Nutt.	10	....	....	....	....	....	....	....	....	T	T	½	½	....	T	....	1
Amelanchier alnifolia Nutt.		3	2	T	2	T	T	4	7	5	5	10	3	....	T	....	40
Apocynum pumilum (Gray) Greene.		....	....	....	T	....	T	2	1	....	1	T	....	....	....	....	5

Table I. (Continued)

	% of Total Ground Cover	Per Cent of Utilization June 30	July 7	July 14	July 21	July 28	Aug. 4	Aug. 11	Aug. 18	Aug. 25	Sept. 1	Sept. 8	Sept. 15	Sept. 22	Sept. 29	Oct. 6	Final
Browse Species																	
Ceanothus velutinus Dougl.	3	10	3	3	4	2	1	T	T	T	T	T	....	....	T	....	25
Menziesia ferruginea Sm.	5	1	1	2	4	2	T	....	T	T	1	1	....	....	....	....	15
Prunus emarginata (Dougl.) Walp.		T	....	....	4	T	....	....	10	10	10	15	10	....	....	....	60
Ribes cognatum Greene.		....	....	....	3	3	5	....	7	T	3	2	3	....	....	....	25
Ribes viscosissimum Pursh.	1	2	3	1	10	5	3	2	10	3	5	10	5	....	1	....	60
Rubus parviflorus Nutt.	1	1	T	....	....	T	....	....	T	T	2	3	2	....	....	....	10
Salix sp.	1	....	2	T	10	5	8	5	5	3	7	10	5	....	T	....	60
Sambucus melanocarpa Gray.		2	1	1	9	5	5	10	15	5	15	25	T	....	....	....	95
Sorbus scopulina Greene.		3	3	T	10	5	....	....	....	....	10	....	....	....	....	....	30
Spiraea lucida Dougl.		....	....	....	....	....	T	....	5	2	1	1	1	....	....	....	10
Symphoricarpos albus (L.) Blake.		....	T	....	....	....	5	....	7	3	10	5	3	....	T	....	35
Vaccinium membranaceum Dougl.	8	8	1	T	2	1	....	....	....	1	1	....	....	....	....	....	15
Grass and Sedge Species																	
Grasses { Bromus carinatus[2] Buckl. Elymus glaucus Buckl. Calamagrostis rubescens Buckl.	15	5	½	½	½	½	T	½	1	1	T	½	½	T	1	T	10
Sedge—Carex geyeri Boott.	20	5	½	T	T	T	T	T	T	T	T	T	T	....	T	T	5

[1]T designates trace and is used for all quantities less than ½ per cent in Tables I & II. The final per cent of utilization for each species is given to the nearest multiple of five in these tables.

[2]Data on certain grass species were not obtained for they were not identified prior to the time of heading in the plot studies.

only a few alder patches and relatively little desirable browse, elk did not visit the plot from the middle of July until September 1. During this period the elk showed a marked preference for browse and consequently were found in areas where browse was common. It was also during this period that elk sought out dense thickets or patches of timber for shade during the day. About the first of September, the elk began to scatter, due, no doubt, to the approach of the breeding season; and by the middle of September until the close of the study, elk began to show a preference for grasses and sedges which would in part account for the late utilization of the vegetation in this plot.

The plant species carried by Plot 2, as well as the per cent of each species taken, are listed in Table II.

Discussion of Results

Plot studies. In palatability studies it is generally impossible to differentiate between the vegetation taken by rodents and deer from that taken by elk. There were, however, practically no rodents in the plots and count records obtained in adjacent localities showed there were 10 elk to 1 deer. Therefore, it was assumed that the vegetation taken other than by elk was almost negligible.

Although the final utilization per cents determined for many species in the one-acre plots do not give in every case a true index of the relative palatability, nevertheless sufficient quantitative data were obtained to warrant reliable values for most species. The final percentages listed in Tables I and II represent the per cent utilization of each species as it appeared at the close of the study. In most cases the utilization values approximate the weekly summations. Exceptions occurred, such as the evaluations of the species of *Aconogonum* and *Ceanothus (Table II)* where a certain percentage was cropped by elk early in the season and little was taken later. As a result, subsequent growth practically made up for all parts taken by elk.

Clarification of the data of a number of species in the acre plots listed in Tables I and II is needed. Many species are represented by only a few individuals and often these are growing in obscure places. Since forage was abundant, elk would seldom attempt to take such plants when other desirable plants could be easily reached. Thus the final utilization per cents listed in Table I for heartleaf arnica *Arnica cordifolia,* fireweed *Chamaenerion augustifolium, Geranium viscosissimum,* Columbia butterweed *Senecio columbianum, Tiarella unifoliata,* heliotrope *Valeriana sitchensis,* and *Sorbus scopulina* are too low in relation to their associates observed in the general field. *Rudbeckia occidentalis* showed 10 per cent of the heads gone at the end of the study. All evidence indicated that only a small portion of these were taken by elk. Rodents were primarily responsible. However, a cow elk was observed September 6 near the Rhoda Licks walking from stalk to stalk biting and eating the heads of a number of *Rudbeckia* plants. In addition to this, other proof was obtained that elk did take *Rudbeckia occidentalis* heads; but rodents were much more instrumental in taking them, for usually the partially destroyed heads could be found at the base of the plants. Only in lick concentration areas were "nigger head" leaves found to be taken by elk. *Veratrum eschscholtzii* is represented by only a few individuals in the plots and none were taken except the flower-

ing and fruiting stalks. It would appear that these parts are desired by elk, since they were cropped from many plants observed on the general range. Lyall angelica *Angelica lyallii* was not common in Plot 1; however, a few individuals grew along an elk trail in a very conspicuous spot. Nevertheless, they were never touched throughout the season. The general field studies showed *Angelica lyallii* to be of low palatability because it was seldom taken.

The results obtained from the browse studies in Plot 1 are, as a whole, interesting. Sticky currant *Ribes viscosissimum* although grazed slightly in excess of the average as determined by general field studies, is nevertheless more palatable than commonly reported. Common serviceberry *Amelanchier alnifolia* showed 40 per cent utilization as compared with 65 per cent for *Acer glabrum,* which is too low as based on general observations. Due to the high palatability of common serviceberry, it has been cropped heavily in the past and as a result only a stunted stubby growth remains. The unusually low final utilization value of 30 per cent for *Sorbus scopulina* has previously been explained above. White spirea *Spiraea lucida* shows a 10 per cent utilization value which is too low.

Grasses and sedges were grazed early in the season, but recovered quickly due to later light utilization at the end of the study. Grasses and sedges comprised the bulk of forage taken in the early summer to the middle of July. Browse species furnished the greater portion of the forage from July 15 to September 15. Sedges and grasses again became the desired vegetation from the middle of September to October 6 when the investigation ended. These facts were also verified by data obtained from Plot 2 and the general field studies.

Plot 2 was not grazed as uniformly as Plot 1, but the data introduced some interesting results. *Aconogonum phytolaccaefolium* and *Ceanothus velutinus* are examples of early usage and subsequent growth recovery. *Castilleja miniata,* because of its scarcity, was not grazed by the elk; but in surrounding areas, its inflorescense was often cropped. *Penstemon pinetorum* utilization is too low, but the 55 per cent utilization recorded in Plot 1 is more nearly correct for this species. The utilization values for *Phacelia heterophylla* and *Senecio triangularis* are lower than they should be according to the field observations. *Veratrum eschscholtzii* on the plot did not flower and remained untouched. *Eriogonum piperi* utilization was limited to a few inflorescenses.

Except for *Sambucus melanocarpa,* the browse utilization values are uniformly low, which may be accounted for by the absence of elk in the immediate vicinity during the period when browse formed the major portion of the elk's diet. The utilization value of zero obtained for snowberry *Symphoricarpos albus* is ridiculous, but the 35 per cent utilization value obtained in Plot 1 gives a fairly accurate value for this species.

Random Field Plant Palatability Studies

A discussion of data of individual species recorded in Table III seems advisable as some interesting facts were noted in the field observations, coupled with the plot studies. *Aster eatoni* and *A. canescens* were of little importance as elk forage until August although many flower heads were taken during late July and early August. The leaves become desirable for-

Table II. Plant species and per cent of ground cover, as well as per cent of utilization by elk each week from June 30 to October 6, 1938 in Plot 2 (1 acre) on a west exposure site.

	% of Total Ground Cover	Per Cent of Utilization															
		June 30	July 7	July 14	July 21	July 28	Aug. 4	Aug. 11	Aug. 18	Aug. 25	Sept. 1	Sept. 8	Sept. 15	Sept. 22	Sept. 29	Oct. 6	Final
Weed Species																	
Achillea lanulosa Nutt.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Aconogonum phytolaccaefolium (Meisn.) Small.	1	5	....	T	....	....	....	....	....	....	....	....	....	....	....	....	5
Agastache urticifolia (Benth.) Kuntze.	10	T	T	T	....	....	....	....	....	....	....	....	....	....	....	....	T
Aster canescens Pursh.		....	....	....	....	....	....	....	....	....	....	T	T	....	5	5	10
Aster eatoni (Gray) Howell.		....	....	....	....	....	....	....	....	....	....	T	T	....	5	5	10
Castellejia mimiata Dougl.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Delphinium scopulorum Gray.		5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Eriogonum piperi Greene.		T	T	....	....	....	....	....	....	....	....	....	....	....	....	....	T
Geranium viscosissimum Fisch. & Mey.		....	....	....	....	....	....	....	....	....	T	T	1	....	....	T	2
Mertensia ciliata (Torr.) Don.		6	....	....	....	....	....	....	....	....	5	....	5	....	T	7	25
Penstemon pinetorum Piper		T	....	....	....	....	....	....	....	....	3	3	2	T	5	7	20
Phacelia heterophylla Pursh.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Potentilla glandulosa Lindl.		T	....	....	....	....	....	....	....	....	T	....	1	T	....	1	2
Pteridium aquilinum (L.) Kuhn.	15	T	....	....	....	....	....	....	....	....	....	....	....	....	....	....	T
Rudbeckia occidentalis Nutt.	2	T	....	....	....	....	....	....	....	1	1	2	1	....	3	10	(20 of heads)
Senecio triangularis Hook.		....	....	....	....	....	....	....	....	....	....	....	....	....	T	5	5
Smilicina stellata (L.) Desf.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Veratrum eschscholtzii Gray.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Xerophyllum tenax (Pursh.) Nutt.	5	T	....	....	....	....	....	....	....	....	....	....	....	....	....	....	T
Browse Species																	
Alnus tenuifolia Nutt.	15	....	....	....	....	....	....	....	....	....	T	T	T	T	....	T	T
Amelanchier alnifolia Nutt.		3	T	....	....	....	....	....	....	....	1	T	10	....	1	T	15
Ceanothus velutinus Dougl.	12	8	1	½	T	T	T	....	....	....	....	....	....	....	T	....	10
Odostemon repens (Lindl.) Cockerell.		....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0
Populus tremuloides var. aurea (Tidestri.) Daniels.		2	....	T	....	....	....	....	....	....	1	T	1	....	....	....	5
Ribes viscosissimum Pursh.		3	....	....	....	....	....	....	....	....	10	15	10	T	5	2	45
Rosa spp.		1	....	....	....	....	....	....	....	....	5	3	5	....	T	2	15
Rubus parviflorus Nutt.	1	2	....	....	....	....	....	....	....	....	3	1	5	....	1	3	15
Salix spp.		T	....	....	....	1	1	....	....	2	5	7	10	....	5	8	40

Table II. (Continued)

	% of Total Ground Cover	Per Cent of Utilization June 30	July 7	July 14	July 21	July 28	Aug. 4	Aug. 11	Aug. 18	Aug. 25	Sept. 1	Sept. 8	Sept. 15	Sept. 22	Sept. 29	Oct. 6	Final
Browse Species																	
Sambucus melanocarpa Gray.		3	----	----	----	----	----	----	----	----	15	30	33	T	3	15	100
Sorbus scopulina Greene.		T	----	----	----	----	----	----	----	----	15	25	----	----	----	----	40
Spiraea lucida Dougl.		1	----	----	----	----	----	----	----	----	3	5	4	----	----	T	15
Symphoricarpos albus (L.) Blake.		T	----	----	----	----	----	----	----	----	T	----	----	T	----	----	T
Vaccinium membranaceum Dougl.	5	5	----	----	----	----	----	----	----	----	10	15	10	T	5	2	45
Grass and Sedge Species																	
Grasses (Elymus glaucus Buckl. / Bromus carinatus Buckl. / Agropyron spicatum (Pursh.) Scribn. & Smith. / Calamagrostis rubescens Buckl.)	15	5	T	T	----	----	----	----	----	----	T	T	T	----	T	½	5
Sedge—Carex geyeri Boott.	10	5	T	----	----	----	----	----	----	----	----	----	----	----	T	T	5

age during August and September. Lady fern *Asplenium felix-femina* was scarcely touched until late July, when a bull was seen taking it in considerable quantities. Numerous patches of lady fern were observed after this date with practically all of the upper fronds grazed by elk.

Arnica cordifolia proved to be a desirable forage during late summer and early fall. The basal leaves were readily taken where it grew commonly in timbered areas. The flower tops did, however, furnish some forage earlier in the season.

Aconogonum phytolaccaefolium is highly palatable and eagerly sought by the elk in late spring and early summer. Except for a few flowers and fruit tops, this plant was scarcely touched later in the season.

Angelica lyallii was seldom taken by elk. Some leaves, flowers and fruit were taken in the field, but, as stated above, not a single plant was grazed in Plot 1. These data do not support the statement listed in the *Range Plant Handbook* (5,W15) that *Angelica lyallii* is readily taken by deer and elk.

Astragalus sp., found to be common in certain restricted localities, was considered a delicacy by the elk. All parts of these plants were readily taken throughout the season.

Chamaenerion augustifolium, common only in certain areas, was scarcely touched by elk until early August. Its favor steadily increased until late September, when it became unpalatable due to some injury by frosts. This plant is one of the most palatable weeds in the region from about August 15 to September 15.

Claytonia asarifolia is a very common weed found growing under the alders and was taken frequently from late July until late September. Its leaves remained green and tender throughout the season and were especially palatable during the latter part of the summer.

Delphinium scopulorum was taken primarily in June while the young leaves were still growing. After the flower stage, it was taken but sparingly. It is doubtful if elk take *Delphinium* in sufficient quantities at any time to cause ill effects, especially with such abundance of other desirable forage.

Bird bill *Dodecathelon conjugens* is very common in the wet areas of mountain slopes and especially so by springs and along the small streams. This species is unusually palatable from early July until killed by frost.

Cow parsnip *Heracleum lanatum* was taken in very limited quantities by elk. This fact seems unusual in view of the statement in the *Range Plant Handbook* (6,W91) that this species is rated highly palatable to all classes of livestock. Several patches of cow parsnip were untouched within the boundaries of Blum's Licks (located 4 miles north of Moose Creek Ranger Station) as late as June 13. Numerous elk passed within a few feet of these plants for several days but did not graze them.

Ballhead waterleaf *Hydrophyllum capitatum* was eagerly sought by elk until it dried up by the middle of June.

Penstemon pinetorum was the most important weed species studied from the standpoint of total forage taken by elk. It is widely distributed and grazed throughout the season, but is especially palatable during August and September. The palatability of this species was not impaired by

frosts, which was not true for many weed species studied. The utilization of 55 per cent for *Penstemon pinetorum* on Plot 1 is indicative of its palatability.

Senecio was represented by three species: *serra, triangularis, and columbianus. Senecio columbianus* was taken heavily by elk during June but soon withered and was not available after this time. Because of the limited distribution of sawtooth butterweed *Senecio serra* no conclusion could be drawn regarding its desirability. *Senecio triangularis* is the most prevalent species, but of little importance as forage until August when it became increasingly important throughout the month as well as in September. This species grows in moist areas and is especially abundant under alders where it is protected from early frosts. Since *Senecio triangularis* remains green and palatable later than many weeds and browse species, it is grazed heavily during September and early October. The leaves and the upper third of the stalks are the parts taken.

Baneberry *Actaea spicata,* and *Smilicina stellata,* although not as high in palatability values as *Senecio triangularis,* nevertheless fall in the same category. Like *Senecio triangularis,* these species also grow in shaded protected sites. They are taken to considerable extent in late September and early October since their foliage remains green and palatable after frost.

Corydalis aurea is common and grows in the streams. Its lush succulent foliage is frequently taken during mid-summer. Often elk will devour the entire foliage of small patches, leaving only the larger basal stalks. This species was taken only occasionally after August.

Boykinia major is a highly palatable weed, being especially so from late June to August. It grows in profusion in moist mountain slope sites. The basal leaves of this species furnish most of the forage taken. However, the flowering stalks are grazed sparingly. Because of *Boykinia major's* common occurrence and high palatability, it is one of the more important early summer weeds in the diet of elk.

Conioselinum scopulorum and *Ligusticum tenuifolium* and sweet-anise *Osmorhiza occidentalis* are of moderate palatability. *Osmorhiza occidentalis* is considered more desirable as elk forage but is not available after July, while species of *Ligusticum* and *Conioselium* are available and taken until the middle of September. These species are neither common nor important as forage.

Xerophyllum tenax is unquestionably the most common herbaceous species throughout the region investigated. The exceedingly tough, coarse leaves of this plant were actually taken by elk during June. The logical explanation for the taking of such forage was the need of some roughage with the succulent grass and weed forage eaten at this early season. The flowering stage of bear grass ranges from June 15 to July 20 in the area studied. The flower stalks were a delicacy for both elk and deer, but since only a relatively few plants flowered as compared to other years, they were of little importance in 1938.

Pteridium aquilinum is very abundant, but taken only in June when the young tender fronds are unrolling.

The other weed species listed in Table III are of little importance as elk forage and for that reason will not be discussed.

elk by random field observations.

	Parts Taken	Seasonal June 1-July 15	Palatability July 15-Sept. 15	Per Cents Sept. 15-Oct. 15	Summer[2] Palatability Per Cents	Abundance	Relative Importance
Weed Species							
Achillea lanulosa Nutt.	flowers, leaves	0	10	10	10	medium	very low
Aconogonum Phytolaccaefolium (Meisn.) Small.	leaves, stalks	80	20	0	40	medium	fair
Actaea spicata L.	foliage	....	25	35	25	rare	low
Agastache urticifolia (Benth.) Kuntze.	flowers	0	20	0	15	medium	very low
Anaphalis margaritacea var. occidentalis Greene.	flowers	0	10	0	5	medium	very low
Anemone piperi Britton.	leaves	0	0	5	5	medium	very low
Angelica lyallii Wats.	leaves, flowers, fruit	0	20	10	15	medium	low
Antennaria rosea Greene.	flowers	....	10	0	5	rare	very low
Arnica latifolia Bong.	flowers, leaves	20	40	50	40	common	fair
Asplenium felix-femina (L.) Roth.	pinnae	....	55	45	50	medium	fair
Aster canescens Pursh.	flowers, leaves	20	45	60	45	medium	fair
Aster eatoni (Gray) Howell.	flowers, leaves	20	45	60	45	medium	fair
Astragalus spp.	flowers, leaves	40	70	30	50	rare	low
Boykinia major gray.	leaves	80	70	40	70	common	high
Castilleja miniata Dougl.	flower tops	10	40	10	25	rare	low
Calachortus elegans Pursh.	leaves, flowers	20	....	....	20	medium	low
Chamaenerion angustifolium (L.) Scop.	leaves, flowers	10	75	35	50	medium	fair
Claytonia sibirica L.	leaves	25	50	60	50	medium	fair
Claytonia asarifolia Bong.	leaves	25	50	60	50	medium	fair
Clintonia uniflora (Schult.) Kunth.	leaves	5	20	20	15	medium	low
Conioselinum scopulorum (Gray) C. & R.	flowers, leaves	20	30	25	25	medium	fair
Coptis occidentalis (Nutt.)	leaves	10	20	40	25	medium	low
Corydalis aurea Willd. & G.	flowers, leaves	10	40	10	30	medium	fair
Delphinium scopulorum Gray.	young leaves	40	10	5	25	medium	low
Dodecatheon conjugens Greene.	leaves	65	75	60	70	medium	fair-high
Eriogonum spp.	flowers	....	10	....	10	medium	very low
Erythronium spp.	none	0	....	....	0	medium	none
Fragaria spp.	leaves	10	10	15	10	rare	very low
Gaillardia spp.	flower tops	....	20	10	15	rare	very low
Gentiana oregana Engelm.	young shoots	....	10	0	5	rare	very low

Table III. (Continued)

	Parts Taken	Seasonal June 1-July 15	Palatability July 15-Sept. 15	Per Cents Sept. 15-Oct. 15	Summer Palatability Per Cents	Abundance	Relative Importance
Weed Species							
Geranium viscosissimum Fisch. & Mey.	leaves	10	25	30	25	common	low
Heracleum lanatum Michx.	leaves	5	15	5	10	rare	very low
Hieracium albiflorum Hook.	flowers, leaves	20	40	15	30	medium	low
Hieracium scouleri Hook.	flowers, leaves	....	25	10	20	rare	very low
Huechera glabella T. & G.	flowers, stalks, leaves	50	45	40	45	medium	fair
Hydrophyllum capitatum Dougl.	leaves, flowers	70	....	....	70	medium	fair
Ligusticum tenufolium Wats.	flowers, leaves	20	30	25	25	medium	fair
Mertensia ciliata (Torr.) Don.	flowers, leaves, stems	45	65	70	65	common	high
Mimulus lewisii Pursh.	flowers, young plants	....	10	5	10	rare	very low
Mitella stauropetala Piper.	leaves, flowers	15	25	30	25	common	fair
Osmorhiza occidentalis (Nutt.) Torr.	leaves	40	55	....	50	rare low	low
Pedicularis greenlandica Retz.	flower stalks, leaves	30	40	....	35	medium	fair
Pedicularis racemosa Dougl.	flowers, stem tops	10	30	20	25	rare	low
Penstemon pinetorum Piper.	leaves, flower stalks	35	75	80	70	common	very high
Penstemon confertus Dougl.	basal leaves	0	10	20	10	medium	low
Phacelia heterophylla Pursh.	flower tops, stems, leaves	10	25	30	25	medium	fair
Polemonium delicatum Rydb.	leaves, flowers	40	15	15	25	rare	low
Potentilla glandulosa Lindl.	leaves	10	25	30	25	common	fair
Pteridium aquilium (L.) Kuhn.	young shoots	20	5	0	5	abundant	low
Pyrola uliginosa T. & G.	leaves	5	10	15	10	common	low
Pyrola secunda L.	leaves	5	10	15	10	common	low
Pyrola minor L.	leaves	5	10	15	10	common	low
Rudbeckia occidentalis Nutt.	heads, leaves	5	10	5	5	abundant	low
Senecio columbianus Greene.	flowers, leaves	50	....	....	50	medium	fair
Senecio triangularis Hook.	leaves, flowers	20	30	60	40	common	high
Smilicina stellata (L.) Desf.	leaves	5	10	40	20	medium	fair
Smilicina racemosa (L.) Desf.	leaves	5	10	40	20	medium	fair
Sphaeralcea rivularis (Dougl.) Torr.	leaves	....	70	50	65	rare	low
Thalictrum occidentale Gray.	leaves	0	5	10	5	common	low
Valeriana sitchensis Bong.	flowers, leaves	50	65	60	60	medium	fair
Veratrum eschscholtzii Gray.	flower, fruit stalks	....	15	....	10	medium	low
Viola spp.	leaves	5	10	5	10	rare	very low
Xerophyllum tenax (Pursh.) Nutt.	flowers, leaves	30	5	0	15	abundant	low

	Parts Taken	Seasonal June 1-July 15	Palatability July 15-Sept. 15	Per Cents Sept. 15-Oct. 15	Summer Palatability Per Cents	Abundance	Relative Importance
Browse Species							
Acer glabrum Torr.	leaves	40	80	50	75	common	very high
Alnus tenuifolia Nutt.	leaves	10	40	35	35	very common	fair
Amelanchier alnifolia Nutt.	leaves	60	80	60	75	medium	fair-high
Apocynum pumilum (Gray) Greene.	leaves, flowers	0	10	0	10	rare	very low
Azaleastrum albiflorum Rydb.	leaves	0	0-5	0	0-5	rare	none very low
Ceanothus sanguineus Pursh.	leaves, stem tips	70	80	65	80	rare	low
Ceanothus velutinus Dougl.	flower, young leaves, twigs	70	30	15	40	very common	fair-high
Cornus stolonifera Michx.	leaves, twig tips	50	60	40	55	rare	low
Kalmia polifolia Wang.	none	0	0	0	0	rare	none
Ledum glandulosum Nutt.	none	0	0	0	0	medium	none
Lonicera utahensis Wats.	leaves, twig tips	40	55	20	45	medium	fair
Lonicera involucrata Banks.	leaves, twig tips	10	40	10	25	rare	low
Menziesia ferruginea Sm.	leaves, twig tips	50	30	10	35	very common	fair
Odostemon repens Lindl.	none	0	0	0	0	rare	none
Opulaster malvaceus (Greene) Kuntze.	leaves, shoot tips	20	45	20	40	medium	fair
Phyllodoce empetriformis (Sm.) D. Don.	none	0	0	0	0	common	none
Populus tremuloides Var. aurea. (Tidestri.) Daniels.	leaves	45	20	10	25	rare-medium	low
Prunus demissa (Nutt.) Dietr.	leaves	20	15	5	15	rare-medium	low
Prunus emarginata (Dougl.) Walp.	leaves	50	80	50	75	medium	fair-high
Rhammus purshiana DC.	leaves	0	5	0	5	rare-medium	very low
Ribes cognatum Greene.	leaves	40	60	40	55	medium	fair
Ribes petiolare Dougl.	leaves	5	15	5	10	rare-medium	very low
Ribes viscosissimum Pursh.	leaves, twig tips	25	65	40	60	medium-common	fair-high
Rosa Spp.	leaves	25	55	30	50	medium	fair
Rubus parviflorus Nutt.	leaves	20	50	30	40	common	fair
Salix spp.	leaves, shoot tips	50	80	60	75	very common	very high
Sambucus melanocarpa Gray.							
Sambucus caerulea Raf.	leaves, flowers	65	100	100	100	medium	high
Sericothica discolor (Pursh.) Maxim.	leaves, flowers, shoot tips	15	40	20	35	medium	fair
Sorbus scopulina Greene.	leaves, fruit	65	100	75	100	medium	high
Spiraea lucida Dougl.							
Spiraea menziesii Hook.	leaves, flowers	25	45	30	40	medium	fair
Symphoricarpos albus (L.) Blake.	leaves, flowers	25	60	35	50	rare-medium	fair
Vaccinium membranaceum Dougl.	leaves	70	30	15	35	very common	fair-high
Vaccinium scoparium Leiberg.	leaves	15	0	0	5	common	very low

Table III. (Continued)

	Parts Taken	Seasonal June 1-July 15	Palatability July 15-Sept. 15	Per Cents Sept. 15-Oct. 15	Summer Palatability Per Cents	Abundance	Relative Importance
Grasses and Grasslike Plants							
Agropyron spicatum (Pursh.) Scribn. & Smith.		70	40	20	40	rare	very low
Agrostis exarata Trin.		80	50	30	55	common	fair-high
Bromus carinatus Buckl.		85	60	75	70	common	high
Calamagrostis rubescens Buckl.		70	30	40	45	common	fair
Carex geyeri Boott.		85	55	75	65	very common	very high
Elymus glaucus Buckl.		85	60	75	70	common	high
Juncoides parviflorum (Ehrh.) Cov.		80	50	70	60	medium	fair

Indigenous Weed Species of Little Importance

Adenocaulon bicolor Hook.	Erigeron salsuginosus Gray.	Phlox caespitosa Nutt.
Arenaria congesta Nutt.	Gaultheria humifusa (Graham) Rydb.	Polygonum douglasii Greene.
Asarum caudatum Lindl.	Goodyera decipiens (Hook.) St. John	Pterospora andromedea Nutt.
Cheilanthes gracillima D. C. Eaton.	Habenaria unalaschensis (Spreng.) Wats.	Senecio serra Hook.
Circaea pacifica Ach. & Mag.	Horkila gordonii Hook.	Silene sp.
Collinsia parviflora Lindl.	Hypericum anagalloides C. & S.	Solidago sp.
Cryptogramma acrostichoides R. Bv. App.	Hypericum scouleri Hook.	Stellaria crispa C. & S.
Disporum spp.	Lupinus sp.	Synthyris missurica (Raf.) Pennell.
Epilobium paniculatum Nutt.	Lycopodium annotinum L.	Tiarella unifoliata Hook.
Erigeron macranthus Nutt.	Nuphar polysepala Engelm.	Tofieldia intermedia Rydb.

Grasses and Grasslike Plants of Little Importance

Carex festivella Mack.	Glyceria striata (Lam.) Hitchc.	Stipa columbiana Mocoun.
Carex nebraskensis Dewey.	Juncus orthophyllus Cov.	Trisetum canescens Buckl.
Cinna latifolia (Trev.) Griseb.	Melica bulbosa Geyer.	Trisetum muticum (Boland.) Scribn.
Festuca viridula Vasey.	Muhlenbergia idahoensis St. John.	

1. Fruits were not available for a few plants; therefore, only the genera were definitely classified. Since there is no published flora that deals specifically with the vegetation of Idaho, it was necessary to refer to several books on the flora of various regions of the Rocky Mountains for identification and classification purposes. In several instances the nomenclature does not agree among these books; therefore, the writers have included those scientific names that seemed most desirable for the present paper. Several such names were taken from the *Range Plant Handbook*, prepared by the Forest Service, U. S. Department of Agriculture.

2. Summer was considered from June 21 to September 21.

Among the grasses, mountain brome and blue wild-rye are considerably more important in relation to total amount of forage taken by elk. Both species were readily grazed during June and part of July but after maturity were relegated for the more desirable browse species. These two species regained favor from the middle of Spetember to the early part of October when most of the browse species had dropped their leaves and become less desirable as forage. The second growth basal leaves were especially palatable during early fall.

Calamagrostis rubescens and *Agrostis exarata* were abundant but seldom touched after July 15 except in concentrated lick areas. A particular meadow was visited every week from July 1 to October 6 but no forage was taken. These grasses were grazed lightly, however, in early June. The vegetation was composed predominantly of spike redtop. Pinegrass is very undesirable for elk forage during the summer. During the late summer and early fall numerous observations were made where mountain brome and blue wild-rye were taken extensively in proximity to pinegrass and redtop, which were virtually untouched.

Bluebunch wheatgrass *Agropyron spicatum* is found only in a few localized areas on rocky dry slopes. This species was taken sparingly in the early summer but was almost totally ignored during the summer and early fall.

Other grasses indigenous to the region and collected are: *Muhlenbergia idahoensis, Trisetum canescens, T. spicatum* and *T. Muticum, Glyceria stricta,* red fescue *Festuca rubra,* green fescue *F. viridula,* wood reed *Cinna latifolia,* subalpine needlegrass *Stipa columbiana* and oniongrass *Melica bulbosa.* Not one of these were of any importance due primarily to their scarcity. Little was obtained regarding their palatabilities, but it was apparent that their ratings would be lower than those for blue wild-rye and mountain brome.

With the exception of bear grass, elk sedge is the most abundant herbaceous species. Elk sedge constituted a very desirable forage for elk during early summer. Its palatability is equal to those of *Bromus carinatus* and *Elymus glaucus.* It was taken less extensively during mid-summer, but during late September and early October it again became important. As late as October 12 a bull elk was observed feeding for one-half hour on this plant. A careful check revealed that during that period, 80 per cent of the forage taken consisted of elk sedge. Due to its abundance and high palatability, *Carex geyeri* is the most important herbaceous species of the region as elk forage.

Other *Carex* species, including ovalhead sedge *Carex festivella,* and Nebraska sedge *C. nebraskensis,* were present in the region and were taken; but their scarcity did not permit them to be of importance.

Juncus orthophyllus and millet woodrush *Juncoides parviflorum* were above average in palatability but were not sufficiently abundant to play any important role in the elk's diet.

Browse is very prolific in many areas of the region and as a summer forage was more important in the elk's diet than the grasses and sedges.

Alnus tenuifolia formed large patches on the moist slopes and are the favored haunts of the elk during the heat of the day from the middle of July to September. The foliage of alder was of little consequence as for-

age until late August, at which time the elk showed a decided preference for alder shoot leaves. A cow elk, killed by a hunter on October 15, had been feeding extensively on alder leaves as determined by stomach analysis. As a rule, however, alder forage was only taken in very small amounts after September since the frost and blight caused most of the leaves to fall.

Acer glabrum, Amelanchier alnifolia, Ceanothus sanguineus, bitter cherry *Prunus emarginata,* and *Salix spp.* are all essentially in the same palatability class and taken during the same season. These were taken lightly in June and early July, but grazed in increasingly larger amounts with the advance of the season until late summer and early fall when the leaves begin to fall. With the exception of *Ceanothus sanguineus,* all of the above species furnish the major portion of the elk's summer forage which is due to their high palatability and wide distribution. *Ceanothus sanguineus* rarely grows above 4,000 feet elevation and is not a factor in the summer forage of elk.

Dogwood *Cornus stolonifera,* honeysuckle *Lonicera utahensis, Ribes cognatum, Ribes viscosissimum, Symphoricarpus albus* and *Rosa spp.* comprise another browse group of lower palatability than the one just mentioned but nevertheless important. They are not abundant in any given area but are generally scattered over the entire region. Dogwood is not important, due to its scarcity, but did constitute a desirable browse species because of its high palatability. All of the above were taken from mid- to late summer. *Ribes viscosissimum,* reported in the *Range Plant Handbook (6)* as poor to fair for livestock, was found to be a desirable forage for elk. The untilization per cent of 60 for sticky ribes in Plot 1 *(Table I)* is proof of its desirability.

Representing a class of intermediate palatability but of importance because of their collective abundance are such species as: *Alnus tenuifolia,* bearberry honeysuckle *Lonicera involucrata, Ceanothus velutinus, Menziesia ferruginea, Opulaster malvaceus,* thimbleberry *Rubus parviflorus, Sericotheca discolor, Spiraea lucida* and *S. menziesii* and *Vaccinium membranaceum.*

Lonicera involucrata is very sparsely distributed, hence of little or no importance as forage for elk, but the *L. utahensis* is common and quite abundant in certain areas. Snowbrush is very abundant in many areas, often forming almost impassable thickets. In early June the young tender shoots of this shrub were taken heavily by elk while in late June and early July the inflorescenses were eagerly sought. This plant was only slightly grazed after its flowering stage because other browse species were considered more palatable by elk. As a rule, snowbrush is one of the most important early summer browse species of the region. *Menziesia ferruginea,* an Ericaceous plant, has been reported as poisonous to livestock. This species is very abundant in all timbered areas and grows on many exposed slopes, as well as on sites with a heavy herbaceous cover. Fool's huckleberry, although regarded by some botanists to be unpalatable, was taken in considerable amounts by elk in July and to a lesser extent until October when it was still green in the timbered areas. Thus, Fool's huckleberry fulfilled a browse requirement during July when elk were primarily on a herbaceous diet. During this season many patches of this plant

showed a hedged appearance resulting from heavy browsing. *Menziesia ferruginea* is rarely taken where it occurs in the heavy browse area. Ninebark and oceanspray are found together on the dry south and west exposures. Elk restricted their grazing to the shoot tips and leaves and some inflorescenses of these species in middle and late summer. Thimbleberry is prevalent over the entire region and is taken in fair amounts but is important due to its prevalence.

Big whortleberry, a widely distributed browse, is important as elk forage during June when its leaves are young and tender. As early as June 5, a bull elk was observed feeding exclusively on *Vaccinium membranaceum* leaves for several minutes. This species was taken after June only where shaded and when the leaves were comparatively tender.

Chokecherry *Prunus demissa,* and trembling aspen *Populus tremuloides* var. *aurea,* are both restricted species, but many observations were made to determine their palatabilities. Aspen was taken in early June but was rarely grazed after this date.

Shrubs of negligible palatability in the Selway area are as follows: False azalea *Azaleastrum albiflorum,* dogbane *Apocynum pumilum,* kalmia *Kalmia polifolia,* mountain heather *Phyllodoce empetriformis,* cascara *Rhamnus purshiana,* western black currant *Ribes petiolare, Vaccinium scoparium,* and smooth Laborador tea *Ledum glandulosum.*

Sambucus melanocarpa and *Sorbus scopulina* are the most palatable browse in the Selway elk range. Elderberry is uniformly distributed, but is not important from the standpoint of total forage produced because it is not abundant in any given area. Mountain ash is abundant, however, in a few areas but not widely distributed. Elk strip the leaves from these species from early June until September which would give essentially 100 per cent utilization. The period of heaviest utilization of these two species by elk is during August and September. Both elderberry and mountain ash can withstand total defoliation year after year according to reports, since the leaves are usually taken in late summer after considerable food has been stored early in the season. Notwithstanding the fact that heavy grazing does not kill this species, they are not "key" species because they are not sufficiently abundant to be considered important in the carrying capacity of the range. In addition, elderberry is considered to be an "ice cream" plant by the Forest Service of Region 4, and according to the *Range Management and Wildlife Handbook* of Region 4 *(5)* an "ice cream" plant cannot be considered as a "key" species. Mountain ash, because of its similarity to elderberry, can well be placed in the same category.

The general field observations, as well as the results obtained from the acre plots, show that elk prefer grasses and sedges until the middle of July. At this time they turn to browse for forage until the middle of September, when the leaves change color and become tough and unpalatable. The elk again return to grasses and sedges for forage after the middle of September.

Evidence that elk take trees and browse twigs on the summer range was very meager, since they showed preference for the leaves and tender twig tips. *Menziesia ferruginea* and *Ceanothus velutinus* showed twig cropping when they were succulent. Isolated maple, willow, and service

berry often revealed a hedged effect. It is highly possible that elk crop twigs just prior to returning to winter range when snow covers the ground.

Estimates were made by the writers relative to the percentages of the three forage types which constitute the elk's diet for three different periods during the study.

These estimates are as follows:

Grazing season	Forage types	Per cent taken
June 1—July 15	Grasses and sedges	65
	Browse	20
	Weeds	15
		100
July 15—September 15	Grasses and sedges	25
	Browse	55
	Weeds	20
		100
September 15—October 15	Grasses and sedges	40
	Browse	40
	Weeds	20
		100

Browse is much more important as elk forage in the Selway area than in the Yellowstone where forage studies have been reported. Rush *(3)* reports in his Yellowstone studies: "Grasses, when available, make up the larger part of the elk's diet." Stomach analysis of elk killed by hunters show that grass is 95 per cent, weeds and browse 5 per cent of the total."

Browse makes up fully 50 per cent of forage taken by elk in the Selway area from June 1 to October 15. This fact cannot be accounted for by the absence of grasses and sedges for they were abundant. The Yellowstone summer elk ranges must be lacking in the abundance of desirable browse species which are so prevalent in the Selway region. The Selway elk show a decided preference for browse throughout most of the summer, and this fact is not because desirable grasses are not available.

Prior to July 15, elk concentrated on the grassy footslopes and the meadow areas or in the valley heads supporting a sparse browse vegetation. From July 15 to September 15, the elk showed a definite preference for browse over grasses and sedges. It was during this period the elk were concentrated in the heavy browse areas near patches of timber and large alder. This shift was no doubt due to a change of forage as well as a desire for shade during the midday summer heat.

Mineral Requirements

An effort was made throughout the summer to obtain some concrete information relative to the mineral requirements of elk and the period when these requirements were the greatest.

The mineral requirement data were obtained from planted block salt and the Wounded Doe Licks studies.

Salt Studies

The Forest Service distributed 600 pounds of 50-pound blocks in the area selected. Eight blocks, or 400 pounds, were placed in two deposits approximately 500 feet apart in the meadow of the Fish Lake Saddle. A

high rocky point 600 feet away afforded an excellent vantage point from which to make periodic observations. Two other deposits of four and two blocks, respectively, designated in Table IV as Low Ridge and High Ridge deposits, were made at respective distances of 1 and 1½ miles from the Fish Lake Saddle salt. The salt was placed out at 3:30 p. m., July 26. The Fish Lake Saddle salt was observed continuously from the time of placement until the morning of July 28, to determine the length of time required for elk to locate and use the salt.

Periods of 24 hours, commencing in the afternoon and ending the following day, were spent in observation of the Saddle salt every fifth day following July 26 until August 15. Following this date, the time interval was lengthened to 10 days until the completion of the study, October 4. Data obtained relative to the observations made are tabulated in Table V as animal numbers observed utilizing the salt, as well as the animal minutes spent in licking salt.

Each of the three salt deposits was visited each day following the 24-hour observation period spent at the Fish Lake Saddle salt. Utilization estimates were made to determine the period of heaviest mineral requirements. Data obtained are tabulated.

The salt at the Fish Lake Saddle, as mentioned above, was placed out at 3:30 p. m., July 26.

The first animal to visit the meadow was a mule deer doe at 7:30 p. m. She did not go to the salt but walked across the meadow between the two deposits and showed no particular interest concerning the salt. At 8:00 p. m. two bull elk came to the meadow. One bull walked directly to a bare dirt area midway between the salt deposits where salt had been placed the previous year and licked the dirt for a few minutes. The other bull frisked about the meadow for a few minutes, then cautiously approached within 100 feet of the salt deposits. He moved in a semi-circle about the salt, but was too suspicious to approach near it.

At 8:55 p. m. a cow moose crossed the Saddle. As she neared one of the salt deposits, she sensed something unusual and cautiously approached within 60 feet of the salt. She gazed distrustfully at the salt and moved in a semi-circle about it. After several minutes of investigation, she trotted away in the direction of Wounded Doe Licks, a distance of 3 miles. Such cautiousness on the part of the moose seems unusual in view of the fact that two female moose on different occasions came to a salt block placed 15 feet from the camp. The junior author was able to approach within 12 feet of a 2-year-old moose heifer while she stood licking this block of salt. A cow moose with her calf, while investigating the camp, according to her tracks, entered the cook tent and came within 5 feet of the occupant while he was asleep without any apparent alarm. This same cow and calf were licking salt the next morning and showed no apparent concern or suspicion to the human scent or the camp oddities.

Elk visited the salt deposits at the Fish Lake Saddle during the night following its placement. At 4:57 a. m., when it first became light enough for visibility, an elk heifer was seen licking a salt block while lying down. At 5:00 a. m., two cows, two calves and a heifer approached the meadow from the opposite slope. It became apparent that they had visited the salt during the night, for they took but a few casual licks at the blocks before

Table IV. Fraction utilization estimates of salt deposits.

Salt Deposit	July 31	Aug. 5	Aug. 10	Aug. 16	Aug. 26	Sept. 5	Sept. 15	Sept. 25	Oct. 5
Fish Lake Saddle 400#	Every cake licked on all sides	1/12	Much leaching by rain	More leaching		3/10	1/3		1/2
Low Ridge 200#	Every cake licked on all sides	Too little to estimate			1/8		1/5-1/6		1/5
High Ridge 100#	1/4		1/3-1/2	1/2	1/2-2/3	slight use	slight use		3/4

Table V. Animal numbers[1] and minutes observed spent at the Fish Lake Saddle salt.

Time of Day	July 25	July 26-27	July 27-28	July 31-Aug. 1	Aug. 5-6	Aug. 10-11	Aug. 15-16	Aug. 25-26	Sept. 4-5	Sept. 14-15	Sept. 24-25	Oct. 4-5
Evening	Nothing	Nothing		4 elk 57′ 2 deer 65′ 1 moose 34′	3 elk 162′	2 deer 25′	3 deer 15′ 2 moose 41′ 1 elk 25′		6 elk 92′ 1 deer 5′	8 elk 45′	2 elk 10′	3 elk 17′
Morning[2]	Nothing	4 elk 55′		5 elk 28′ 2 deer 58′ 1 moose 52′	3 elk 118′		1 deer 47′	7 elk 73′	2 moose 90′			2 elk 19′
Total Animals		4		15	6	2	7	7	9	8	2	5
Total Minutes		55′		294′	280′	25′	128′	75′	187′	45′	10′	36′

[1]The young of elk, moose, and deer are included whenever they took salt.
[2]Observation results are recorded separately for late afternoon and for the following morning.

moving on. The heifer, however, continued licking until 5:39 a. m., when she arose and hurried away. No more elk visited the salt during the daylight hours of July 27, nor up to 10:00 a. m., July 28, when the observations were discontinued for the day. A utilization check on the 28th revealed that the other two salt deposits were also visited by elk sometime after 3:30 p. m., July 26. It is interesting to note that the elk discovered all three salt deposits so soon after they had been deposited.

Utilization of the salt deposits by big game was greatest from July 26 to August 10. Leaching of salt was especially noticeable at the Fish Lake Saddle deposit where the blocks were placed on flat bare areas and the rain water did not drain freely.

Observations in the Fish Lake Saddle revealed that elk, moose, and deer visited the salt only when dusk approached, during the night, and early morning before the sun rose. There was usually considerable activity on the meadow at night, as the thudding of hoofs would indicate. The results are that the animal numbers at the salt and animal minutes observed spent at the salt are not indicative of its true utilization because most of the utilization came during periods of darkness. However, the data obtained do indicate trends and the period of greatest utilization. Further observations showed that the salt was much more highly desired by elk, deer, and moose during the fore part of the period when it was placed out. Animals feeding on salt during this period were very greedy and would lick continuously with few interruptions. In contrast, later in the season animals licked the salt spasmodically, taking time out to play or forage and walking restlessly from block to block. As proof of the acute need for salt by big game during the period when the salt was first deposited, the following observation is cited:

Three elk and a bull moose visited the Saddle salt at dusk on July 31. These same animals were licking the salt as eagerly the following morning at dawn as they had been the previous evening, however, it is highly possible they did not lick the salt during the entire night. They were licking while lying down, evidently tiring after standing for some time. However, the elk and the moose left as the sun began to rise. Elk visiting the Saddle salt following the middle of August never displayed such evidence of salt hunger, and deer and elk were noted during late September to walk past the salt without licking a single block.

Analysis of Table V corroborates the data of Table IV. The heaviest salt utilization on the basis of observed animal minutes occurred during the 24-hour period from July 31 to August 1, when 294 animal minutes were recorded. The event was likewise high on August 5 and 6 when 280 animal minutes were recorded. These utilization dates tend to correspond to the period of heaviest salt utilization as estimated in Table IV.

Wounded Doe Licks Studies

Corral and platform construction in the lick area curtailed elk numbers in the licks from late June until July 9. However, elk steadily increased for some time and the following numbers were estimated: July 14, 70; July 18, 150; July 19, 85; July 31, 80, and August 1, 75. After August 1, a steady decline was noted and no more than 30 elk were observed at any given time during September and early October.

Because of the disturbances to which the elk were subjected the lick numbers are not typical for the area, but the period of greatest concentration from July 10 to early August conforms quite closely with the period of greatest mineral requirement of elk while on summer range.

General Discussion of Mineral Requirement Studies

The salt requirement of elk on winter range begins as soon as they start to feed on the early spring vegetation. The heavy usage of the natural licks at Blum's Ranch, which is located on winter range, would indicate the salt requirement is high during this season. In addition, many old salt grounds on the winter range showed heavy licking by elk during May and June. However, the greatest elk lick numbers on summer range did not occur until July, for the elk had not yet completed their migration to summer range.

According to reports of wildlife investigators, salting of big game should fulfill the following three purposes:

1. In certain cases to draw big game earlier from the winter range to the summer range and thereby aid in the preservation of the winter range.
2. To help fulfill the mineral requirements and thereby maintain the health and vigor of big game.
3. To obtain better distribution of elk on the summer range.

To fulfill the first purpose, it becomes evident that salt should be distributed on the summer range not later than June 15. If salt is distributed at this early date with regularity from year to year, elk and deer would learn to expect it and earlier migration might result.

An excellent illustration of how salt may be a factor in the holding of elk on the winter range occurred at the Moose Creek Ranger Station. Here three elk cows visited the corral to lick salt almost nightly throughout the summer. They never left the winter range.

It is doubtful if salting on the summer range would be a factor in lengthening the fall grazing period for big game. As stated elsewhere, salt utilization by elk had practically ceased by October 5.

Salt for big game should be placed out by June 15 to insure complete utilization. Salt used in the present studies and especially the Fish Lake Saddle salt was but partially utilized. Elk and deer recover much of the leached salt by licking and eating the dirt where it is deposited. This is not desirable because the deer and elk consume so much dirt in concentration area where parasitic infestations may be present. Evidence definitely indicates that elk, like livestock, should have salt but the amount required for each season for such an animal to maintain its good health is quite uncertain. Rush *(3)* states "that analysis of the natural lick waters of Yellowstone showed only 4.45 to 10.25 parts per million of salt." He estimated that an elk, to fulfill its daily mineral requirements, must drink in excess of 1,000 gallons of water per day from the better licks and more than 2,000 gallons per day from the poorer licks.

Assuming the average mineral content of the Selway licks[9] is similar to those of the Yellowstone Park licks, it becomes evident that the elk of

[9]The mineral composition of the Selway licks are to be reported in a later paper.

the Selway must have minerals. In fact, these elk crave minerals so strongly that logs from which the elk had devoured the heartwood were found throughout the area studied. The elk would open up logs by pawing them with their front hoofs. These partially eaten logs were usually near water. Whether elk selected such logs in order to quench their thirst at intervals was not determined. Logs in advanced stages of decay were apparently not desired, since they were not disturbed.

In addition to the logs, pits were found where salt had been deposited in previous years. The deer and elk had eaten the dirt down to a depth of 2 feet in many places in their attempts to recover leached salt. The "pig-sty" appearance of natural licks of the region gave additional evidence of the extreme need of salt by the elk.

The third purpose advocated for salting is to obtain better distribution on the summer range. Salting was found to be of little consequence in obtaining more uniform distribution in the Selway. There is little need to obtain more uniform distribution, since over-concentration of elk on summer range was not observed except in localized areas such as licks. The area comprising natural licks are too limited to warrant a salting program to alleviate the usage of such areas. Deer and elk do not normally congregate at salt or water areas until the forage is depleted, as cattle naturally do. Deer and elk that travel to salt deposits or natural licks to satisfy their salt hunger usually return to the general areas from which they left. Elk often travel 4 or 5 miles to salt areas and return as was attested by observation and by the many game trails leading to and from natural licks.

Although salting of elk could not be justified on the merits of obtaining better distribution on the Selway summer range, it is strongly justified on the basis of the two purposes mentioned, namely: (1) to maintain the health of the big game animals and (2), to preserve the winter range by obtaining earlier migration to summer range.

Predators, Insects, Parasites

The importance of predation as a decimating factor of elk calves was not determined. No signs of cougar were noted during the period, and only three bears were seen. Only a small amount of bear feces was found and that contained no hair. Coyotes, on the other hand, were quite numerous, as indicated by those seen and the prevalence of feces as well as tracks.

In order to obtain some measure of the predation importance of coyotes, 25 pellets were collected during July and August to be analyzed for deer and elk hair. Random samples were collected to obtain a representative cross-section and no pellets were rejected because they had little or no hair in them.

The pellets were sent to the Biological Survey laboratory in Denver for analyses. A part of the accompanying letter and analytical results are as follows:

"The 25 samples of coyote feces mentioned in your letter of November 14 have been received and examined and a copy of our analyses is enclosed herewith.

"You will note that we have not attempted to separate or specifically identify elk and deer hair although it is possible that each of our refer-

ences to cervid may be elk. Our reference collections and the limited amount of study done on hair structure prevents us from specifically identifying cervids when the material is ground up as in the case of scat samples. Usually identifications can be made from stomach material.

"1. July 5—*Citellus columbianus* and young cervid (elk or deer)
2. July 11—Young cervid
3. July 15—*Citellus columbianus*
4. July 22—Young cervid and *Perognathus* (pocket mouse)
5. July 22—Young cervid and a quail
6. July 22—Young cervid
7. July 29—Young cervid
8. August 9—Cervid, *Perognathus* and cerambycid
9. August 10—Cervid and *Thomomys* (pocket gopher)
10. August 10—Carrion (many fly larvae present)
11. August 11—Cervid
12. August 11—Cervid
13. August 11—Young cervid
14. August 11—Mormon crickets
15. August 11—Young cervid and *Thomomys*
16. August 11—Cervid and porcupine
17. August 11—Cervid
18. August 11—Porcupine
19. August 11—Young cervid
20. August 11—Cervid
21. August 11—Porcupine
22. August 22—*Citellus columbianus*
23. August 26—Cervid, *Perognathus* and a bluejay
24. August 31—Young cervid."

It will be noticed by reference to the above table that nine of the pellets contained old cervid hair. This hair, no doubt, came from old deer or elk which might have failed to survive the hardships of the past winter or from a few animals that died of unknown causes during the summer. Of greater significance is the fact that 10 of the pellets contained elk calf or fawn hair. How many contained elk calf hair is only speculative. For the purpose of this report, it would have been very desirable to know the identity of the young cervid hair. The elk population was estimated to be ten times greater than that of deer in the area in which the pellets were collected. It is the belief of the writers that the greater part of the 10 pellets contained elk calf hair rather than fawn hair. This belief is based primarily on observations and the greater abundance of elk calves.

Two instances were observed during the summer which would indicate elk have an instinctive fear of coyotes when they become aware of their presence.

Since no definite evidence was obtained on the summer range that coyotes kill elk calves, it would seem logical to assume that these predators kill the calves on the winter areas at the time of early calving. The calves, if found by bears or coyotes during the first week after birth, could be easily killed and eaten by these predators while the mothers were absent.

Insects cause elk considerable annoyance and misery from about June 15 to August 15. Mosquitoes, Tabanids, such as "horse flies," "deer flies,"

and botflies are the main offenders. Several elk were observed during the summer snorting and gently pawing their nostrils with their hind hoofs. They were probably attempting to rid their nasal sinuses of the botfly larvae or trying to prevent the flies from depositing eggs in their nostrils. Elk were also seen busily switching their ears, swaying their heads, kicking, stamping, and even wiggling their stubby tails in an attempt to obtain relief from insect pests. With the exception of mosquitoes, insects were as prevalent at the higher elevations as at the lower elevations.

Evidence of ticks on elk was not noticed until late September. At this time the ticks were so engorged with blood that the raised hair spots on the elk could be distinguished at some distance.

Summary and Conclusions

The Selway Game Preserve, located in a large wilderness area of north central Idaho, is a big game haven because of its partial inaccessibility to hunters and the luxuriant growth of forage. The dense vegetation composed of browse, weeds, grasses, and grass-like plants have come in since the severe forest fire of 1910 as a successional development. It was in such an environment that a study was made concerning elk in relation to their characters, development, breeding habits, forage, and mineral requirements, as well as the general effect of the predators during a given season.

An interesting character observed was the bounding gait of elk calves in play. This gait is similar to the bounding gait of the mule deer.

The calving period in the Selway is between May 15 and June 10.

The calf crop as determined by the number of cows and calves observed was 74 per cent. For reasons explained elsewhere, 80 per cent calf crop is believed to be the approximate value.

A calf was observed taking forage as early as July 5 as compared with July 19, the first date reported for calf foraging in Yellowstone.

Practically all the calves seen nursing during August, September, and October did so on their knees because of their large size. Weaning among calves seemed to be effected in most cases during September.

No large harems were observed in the Selway Game Preserve. The average harem consisted of two or three cows as compared with the average harem of six cows reported by Rush *(3)* in Yellowstone.

Wallowing as observed was definitely correlated with the male sex. Wallowing began with the velvet shedding of the bulls and lasted until the close of the breeding season in early October. Observations clearly indicated the breeding season extended from September 10 to October 5.

The plant utilization studies show that elk take different forage types during different periods of a given season. The results of this investigation show that grasses and sedges constituted the main diet of elk from June 1 to about July 15. From July 15 to September 15, elk showed a definite preference for browse. After September 15 the elk gradually return to a grass and sedge diet which is no doubt maintained until the critical winter period.

The palatability studies definitely point out that the "key species" for elk on the Selway summer range are *Salix spp., Acer glabrum, Bromus*

carinatus, Elymus glaucus, and *Carex geyeri.* Elk sedge *Carex geyeri* is the most important herbaceous forage species because of its great abundance and high palatability. Although *Amelanchier alnifolia, Sorbus scopulina* and *Prunus emarginata* are not "key species" in the Selway, nevertheless they were a very important part of the elk's diet during the period of investigation.

The plant utilization studies show that not only do the plant species vary greatly from one another in palatability, but a given species is highly variable in palatability within a summer season. For example, *Vaccinium membranaceum* and *Pteridium aquilinum* are palatable in early June only, while *Senecio triangularis* is palatable during September and early October. *Boykinia major* is highly palatable from late June to early August.

Penstemon pinetorum was the most important weed species studied from the standpoint of total forage taken by elk.

Such plants as *Heracleum lanatum* and *Angelica lyallii* that are readily grazed by livestock were only slightly taken by elk, while *Menziesia ferruginea* and *Ribes viscosissimum,* considered quite unpalatable for livestock, were utilized rather commonly by elk.

The mineral requirements of elk on the summer range reached the greatest demand from early July to early August. It was during this period that elk concentrated heavily in Wounded Doe Licks and at the planted salt areas.

The results of the present investigation indicate that artificial salting of deer and elk on the Selway Game Preserve would be beneficial to big game.

Coyotes are the greatest predator menace of fawns and elk calves in the Selway Game Preserve.

The most important general result of this investigation is the demonstration that both the character and range habits of elk can be quite accurately determined when quantitative methods are employed on natural ranges. To obtain such results, one is obliged to devote many hours in the field each day, watching elk under different environments in order to determine their habits and character peculiarities.

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