Range Survey in Teton County, Wyoming

Part 2. Utilization and Condition Classes

A. A. Beetle

Agricultural Experiment Station
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Contents

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Part 2. Utilization and Condition Classes

By Alan A. Beetle

Professor of Range Management

THIS IS THE SECOND of companion bulletins. The first (Bulletin 376) described the climate, soils, and vegetation which have shaped the potential of Teton County, Wyoming, as a range resource. The present bulletin deals with the history of use of this resource and defines the range-condition classes of the major plant communities.

The research reported here, which covered a period from 1956 through 1960, was sponsored by the Wyoming Natural Resource Board, the Wyoming State Game and Fish Department, the Teton National Forest Permittees Association, and the Wyoming Agricultural Experiment Station. The administration of the Teton National Forest agreed to the study but did not sponsor it financially. Related studies were sponsored financially by both the National Park Service and the Rocky Mountain Forest and Range Experiment Station of the United States Forest Service. Field facilities were made available throughout the study by the University of Wyoming Biological Research Station at Moran. While engaged in graduate work Dixie Smith, Joel Verner, Jerry Waitman, and William Laycock made notable contributions toward completion of this bulletin. In addition, the active help of Nels Dahlquist, Teton County Agricultural Agent, and of the staff of the National Elk Refuge is gratefully acknowledged.

Range-Condition-Class Survey

Range-condition-class survey is a technical science based on the growth requirements of plants. Its basic premise is the ecological fact that, historically, plant communities have developed and have been controlled by the interaction of soil and climate. Its other cornerstone is the fact that animal grazing, often accompanied by trampling pressure, may change the environment sufficiently to result in a change in the vegetation. Range conditions are merely measured steps between the primary ecological climax and the grazing disclimax.

Where possible, natural conditions are determined first. Then, for the same sites, descriptions and measurements are made of changes, especially when the cause is well documented. Fenceline contrasts are found to be particularly useful.

History of Use

Like many other areas in Wyoming, historically, Teton County was occupied by Amerindians only during the summer months. They came to hunt big game. Their influence was predominant until the advent of the first white settlers in 1884. Within 12 years thereafter their influence ended completely with the passage of the first non-resident hunting-license law, which halted their summer trips from Idaho.

From John Colter's visit in 1807 until the Hayden Expedition in 1872, hunters, traders, trappers, and travellers entered and left the county, bringing back fragmentary reports of the vegetation and wildlife. At best, this is a very unsatisfactory and incomplete picture. Aside from a few museum specimens and the fossil record, basic data in regard to the flora and fauna of Jackson Hole date from the photographs of W. H. Jackson (1872) taken on the Hayden Expedition. From that time on, photographs have been an important part of the record.

From the advent of the first homesteaders in 1884 until 1920, private ownership and settlement were the major influences in the county. From 1920 until the present, the decrease in private holdings and the increase in control by recreation and wildlife have overshadowed private industry. Since the late 1800's and continuing to the present time, there has been conflict of interest between the livestock industry and wildlife.

History of the Study

The Jackson Hole Biological Research Station, administered by the University of Wyoming under agreement with the New York Zoological Society and the Teton National Park, encourages field studies in basic ecology, taxonomy, behavior, and other areas in which the Jackson Hole region furnishes opportunity for substantial and significant research. The works of Reed, Laycock, Verner, and others who used this station as their base were referred to in Part I.

The several Wyoming Agricultural Experiment Station projects centered in Teton County may be summarized as follows:

(a) Study of competition between game and livestock to determine the degree of utilization of major grasses and shrubs by them; to delimit the areas of and intensity of competition (*cf.* Smith and Wilbert, 1959);

(b) Development of vegetation-condition classes for Wyoming range types, to study the ecological succes-

sion and the vegetation climax (Part I of this publication); to determine the range-condition classes on a grazing-allotment basis of lands grazed by domestic livestock (results reported here); to determine the best management practices (*cf.* Lang, 1960);

(c) Methods of establishment of browse species on rangeland (*cf.* Waitman, 1961);

(d) Determination and description of naturalness on elk summer range (unpublished reports to the National Park Service).

All of these studies contributed significantly to this publication.

Animal Numbers and Distribution

LIVESTOCK NUMBERS AND DISTRIBUTION

According to publications concerning the Teton National Forest (U. S. D. A., 1953), "Some 15,000 cattle from nearby high mountain valleys graze through the summer months on the less rugged and more accessible parts of the forest. Cattle raising is the main agricultural pursuit in the valleys. A small number of sheep are grazed for short periods on the southern part of the forest." Since 1948, permits for over 1,000 horses have been issued yearly (Table 1).

Except for cattle on Pacific Creek, there are now no cattle or sheep allotments north of the Moran-to-Togwotee Pass highway. South of this highway, the cattle allotments stretch along the Gros Ventre River valley to the headwaters of Fish Creek and similarly occupy the tributaries and lower reaches of the Hoback River. In interpreting land availability or grazing rights of animals, it must be remembered that variations affecting grazing capacity involve (1) numbers of animals, (2) size of areas occupied, and (3) time of occupation (Table 2).

NUMBERS AND DISTRIBUTION OF WILD ANIMALS

Anderson (1959) gives a detailed record of the Jackson Hole Elk Herd. Both aerial observations and ground counts have been intensified in recent years (*cf.* Anderson, 1953, 1954, and 1959). Elk tagging, according to Anderson, offers the surest means of collecting data on migration habits of elk and has already proved that (a) there is intermingling on the summer range of herds that may be widely separated on the winter range, and (b) that hunting, severe winters, and other factors are constantly changing the migratory habits of elk. While the exact number of elk may be in dispute, the fact that over $100,000 a year is spent feeding this herd suggests that there are too many animals for the winter range to support. Beetle

TABLE 1—Comparisons of Livestock and Animal Populations in Teton County

Kind	Start	Peak year	Peak numbers	1960 Status	Opt. no. for county	Average weight of mature male	Relative units in figuring carrying capacity
Cattle	1884	1919	17,000	Below peak	?	1000-1100 lbs.	1
Sheep		Not included in this study				130 lbs.	5
Horses	1807	1958	1,300	Peak	?	1000 lbs.	1 +
Elk	Native	1935	22,000	15,000	?	650 lbs.	1 —
Mt. Sheep	Native	1900	?	Rare	?	200 lbs.	2 - 3
Mule Deer	Native	No reliable data	?	Numerous	?	150 lbs.	3 - 5
Moose	Native	1960 (?)	?	Peak	?	1000 lbs.	1
Pocket Gopher	Native	?	?	?	?	3 oz.	?

TABLE 2—History of Land Ownership in Teton County, Wyoming, Until 1958

Teton County has a land surface of 1,801,600 acres, and a water surface of 37,120 acres, making a total of 1,838,720 acres. Of this total, the Federal Government controls 1,696,181 acres.

	Start	Year peak was reached	Maximum size in acres	1958 Status in acres	Percent of 1958 land controlled*
Private ranches	1884	1927	120,000	85,519	4.0
State and local government, and Town of Jackson	1890			7,000	0.4
U. S. Forest Service	1897	1932	1,802,128	1,341,067	
National Park Service	1929	1958	301,291	301,291	
Bureau of Reclamation	1903	Surface acres of Jackson Lake plus 1,000 acres		26,648	95.6
Bureau of Land Management (and earlier equivalents)	1806	1806	1,801,600	3,484	
National Elk Refuge	1912	1958	23,691	23,691	

* The % here is taken from Hamston *et al.* (1959).

(1952) and Croft and Ellison (1960) have pointed out that range conditions on the summer range indicate that there are too many animals for that range to support also.

Population size of all other big-game animals may be held in check by the size of the elk herd. This is true of mule deer, bighorn sheep (*cf.* Honess and Frost, 1942; Buechner, 1960), and moose (Harry, 1957). (Table 1.)

Rabbits are not now, and apparently never have been, abundant in Teton County. On the other hand, the pocket gopher is now so numerous that it calls for special attention and will be discussed later in this bulletin.

Browse

In Jackson Hole there is the richest concentration of shrubs to be found in the State of Wyoming. That this is not consistently evident is due to the excessive use by game. Shrubs like other plants may be divided into preference classes. In Jackson Hole, on the basis of browse utilization (shown by Smith and Wilbert (1959) to be 95% due to game use, 5% to cattle), the following groupings for trees and shrubs are suggested. (When utilization of a species is associated with only one class of animal, this is indicated by the name in parentheses).

PREFERRED BROWSE:

Abies lasiocarpa (Moose)
Acer glabrum
Amelanchier alnifolia
Betula glandulosa
Chrysothamnus nauseosus
Juniperus scopulorum (Deer)
Pachystima myrsinitis
Pinus flexilis (Moose)
Populus tremuloides
Prunus melanocarpa
Pseudotsuga menziesii (Moose)
Rosa arkansana
Salix scouleriana
(and other willows) (Moose)
Sorbus scopulina
Vaccinium membranaceum (Moose)

INTERMEDIATE TYPES:

Alnus tenuifolia
Artemisia arbuscula
Artemisia cana subsp. *viscidula*
Artemisia longiloba
Artemisia tridentata
Ceanothus velutinus
Chrysothamnus viscidiflorus
Populus angustifolia
Purshia tridentata
Ribes spp.
Rhus trilobata
Salix wolfii
Tetradymia inermis
Vaccineum scoparium (Elk)

BROWSE USUALLY NOT UTILIZED:

Artemisia tripartita
Gutierrezia sarothrae
Juniperus communis
Picea engelmannii (Moose)
Picea pungens
Pinus contorta (Moose)
Potentilla fruticosa
Sambucus racemosus
Shepherdia canadensis
Symphoricarpos tetonensis

For the range manager, browse lines are a facile method of determining game concentrations. The work of Smith and Wilbert (1959) has helped to demonstrate its reliability. To a certain extent, browse lines are characteristic and reveal the type of animal responsible. For example, elk can

reach from one to two feet higher than any of the other browsers and, consequently, cause a higher line (from 9 to 12 ft.). Deer are fond of juniper, while other animals are not. Where the snow is relatively deep, moose may be the only animal eating willow.

On the other hand, many species of shrubs and trees are equally palatable to a large number of wintering animals, and the competition for the limited amount of browse may be severe. Browsing is so severe on some species that reproduction is inhibited. Thinning of browse by eliminating shade may lead either to new kinds or to an increased density of forage plants on the ground. Not infrequently the browse may be severely hedged, but the herbaceous vegetation remains unchanged. Where the browsing is caused by game, and associated changes occur in the vegetation, there may be an abnormal increase in bluebunch wheatgrass if the range is in good to fair condition, or in bulbous melic and Sandberg bluegrass if the range is in poorer condition.

Anderson (1958) comments that "artificial feeding has kept the (elk) herd above the limits of winter-spring ranges, and of portions of the summer ranges, resulting in the destruction of the browse," and Wilbert (1958) similarly states that "nearly all the browse in the Gros Ventre shows signs of severe use."

Some of these shrubs *(e.g., Prunus melanocarpa, Populus tremuloides,* and *Symphoricarpos tetonensis)* persistently tiller and reproduce from the base, and at times, the depth of the snow is evident from the mowed top of the old branches, only the current year's growth appearing above. The snow pattern, through mechanical protection, has done much to preserve the native flora, particularly the shrubs, of Jackson Hole. In addition to this purely mechanical function, (protection), the winter snow pattern (regardless of depth) often controls the distribution of plant communities through persistence. The presence of snow late in the spring has a strong controlling influence on big sagebrush and may account for a broad ecotone (in contrast to the narrow one as described by Reed, 1952) between aspen and big sagebrush *(cf.* the Two Ocean Lake Area). For a further discussion of aspen, see page 21.

Honess and Frost (1942) report *Populus tremuloides* as part of the browse diet of Bighorn sheep in March and April. Throughout the Jackson Hole region, high lines would long since have eliminated aspen as a major part of the diet of Bighorn sheep, as well as many other browse species. Deer, affected in the same way, turn to juniper.

No exclosures were found which included juniper. To a certain extent the south-facing slopes of Cache Creek act as a protected area for comparison. Here, because of the depth of the snow, the juniper is unhedged. Elsewhere, around the floor of Jackson Hole, the juniper marks the snow-free areas of concentration of game. Here, unlike the aspen, which is so uniform in appearance throughout the county, juniper takes on a variety of appear-

ances. These are illustrated in Figure 1.

Forms are the result of (1) differences in palatability between the individuals, (2) outgrowing the reach of deer or (3) mechanical protection of snow in winter given to basal branches. If released from grazing pressure, it is probable that junipers would be more plentiful. Old photographs on file in the office of the National Elk Refuge show that junipers have not changed appreciably, at least since 1920.

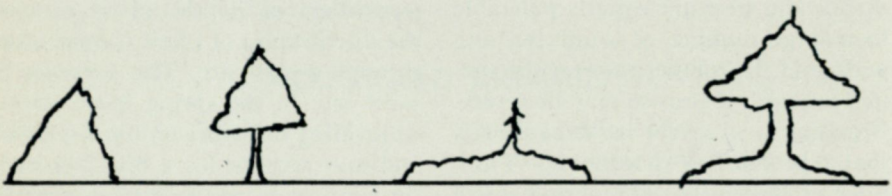


FIG.1—Normal Form Umbrella Form Cushion Form Dumbbell Form

Grazing Utilization of Plant-Community Complexes

The plant-community complexes analyzed here are presented in the same arrangement as given in the preceding bulletin (Wyoming Agricultural Experiment Station Bul. 376) of this pair. Table 3 diagrams the four complexes. Because the communities within any one of the complexes tend to be adjacent, the pattern of use of the community complexes is related. In Teton County, however, not only are the different related communities often mixed, but there may frequently be complicated mixing of different complexes.

In each of the tables presenting range-condition classes, the figures are generalized—sometimes as an average of its many occurrences under the given situation and sometimes as an adjustment based on experience. Each species has a wide range of abundance, changing with climate and soil as well as with condition class. When special situations arise, the figures given here need to be interpreted on the basis of information given in the first bulletin. In most cases, a single species is a poor indicator; on the other hand, when combinations of species all point to the same conclusion, this may be considered an excellent indication of range condition.

MEADOW COMPLEX

The intervale and the mountain meadow are the key associations in the meadow complex from the point of view of range-condition studies be-

TABLE 3—Diagrams of Four Community Complexes

(1) Meadow	(Meadow	(Grass meadow	(Mountain meadow	
	(	(	(Alpine meadow	
	(	(Wet meadow	(Intervale	(Tuffed hairgrass
	(		(Sedge mdw.	(Shrubby cinquefoil
	(Streamside forest		(Shrub swamp	(Silver sagebrush
(2) Shrub	(Curlleaf mountain-mahogany			
	(	(Threetip sagebrush		
	(Shrub	(Big sagebrush	(Big s.	
	(	(Low sagebrush	(Big s./Bitterbrush	
	(	(Alkali sagebrush	(Big s./Bluebunch wheatgrass	
	(			
	(Mesic		(Big s./Idaho fescue	
	(Grassland	(Arrowleaf balsamroot		
		(Thickspike wheatgrass		
		(Rockymountain juniper		
		(Idaho fescue	(Lowland	
(3) Coniferous Forest			(Subalpine	
	(Engelmann spruce			
	(Lodgepole pine			
	(Limber pine			
	(Whitebark pine			
	(Douglas fir			
	(Alpine fir			
(4) Deciduous Forest	(Aspen	(Wet aspen		
	(	(dry aspen		
	(Aspen margin shrubs	(Saskatoon serviceberry		
	(	(Snowberry		
	(	(Black chokeberry		
	(	(Woods rose		
	(Forb	(Mixed forb		
		(Mulesears wyethia		

cause they are most extensive, they are heavily utilized, and because changes in plant composition are easily detected.

MOUNTAIN MEADOW

Mountain meadows, those open areas characterized by alpine timothy, slender wheatgrass, timber danthonia, sedges, and rushes as well as a rich variety of forbs, are extensively utilized both by big game throughout the northern half of the county and by big game and livestock in the southern half. Those areas on Big Game Ridge and adjacent southern Yellowstone National Park are an erosional hazard to the whole Snake River watershed, as pointed out recently by the U. S. Forest Service (Croft and Elli-

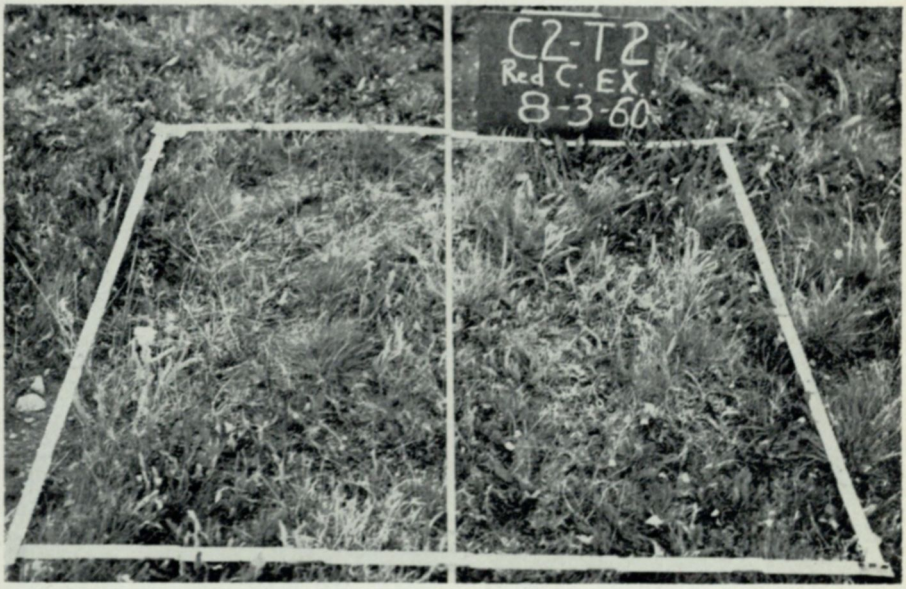
TABLE 4—Guide to Range-Condition Classes in the Mountain Meadow Based on Grasses and Sedges

	Natural	Decreaser	Increaser	Invader
Agrostis thurberiana	5	0	0	0
Agrostis exarata	5	10	5	0
Agropyron trachycaulum var. majus	10	10	10	10
Carex spp.	10	10	10	10
Danthonia intermedia	5	10	5	0
Festuca brachyphylla	5	10	5	0
Koeleria cristata	5	5	5	5
Muhlenbergia filiformis	5	5	5	5
Phleum alpinum	10	5	3	1
Poa alpina	5	3	2	1
Poa canbyi	5	10	5	0
Poa fendleriana	5	....	....	0
Poa interior	5	10	10	0
Poa rupicola	5	0	0	0
Poa secunda	5	10	10	10
Stipa columbiana	5	3	0	0
Stipa lettermanni	0	5	10	5
Trisetum spicatum	10	5	5	0
Trisetum wolfii	5	0	0	0
Juncus spp.	5	3	3	0
Helictotrichon hookeri	2	1	0	0
Total Forb Component:	35	50	50	95

Note: Natural in this and the following tables indicates range which is 75 to 100 percent similar to a relic area; the decreaser class is 50 to 75 percent similar to a relic area; the increaser class is 25 to 50 percent similar to a relic area; the invader class is 0 to 25 percent similar to a relic area.

son, 1960). Overgrazing in these areas has been studied by the Wyoming Game and Fish Department (Wilbert, 1957 through 1959).

The findings of Wilbert are confirmed by the present study. Overgrazing in extensive areas of the elk summer range is marked by reduction of perennial grasses where formerly they comprised from 25 to 50 percent of the plant cover; now, in the most severely utilized areas, they may represent less than 5 percent. (See Table 4 for a description of range-condition classes for mountain meadow). Under overgrazing one may expect reduction in total cover, reduction of perennial grasses, and increase in certain forbs. As a result of overgrazing, changes in the mountain meadow are more marked, from the standpoint of vegetation change and habitat appearance as well as in microclimate and soils, than in any of the other plant communities studied.



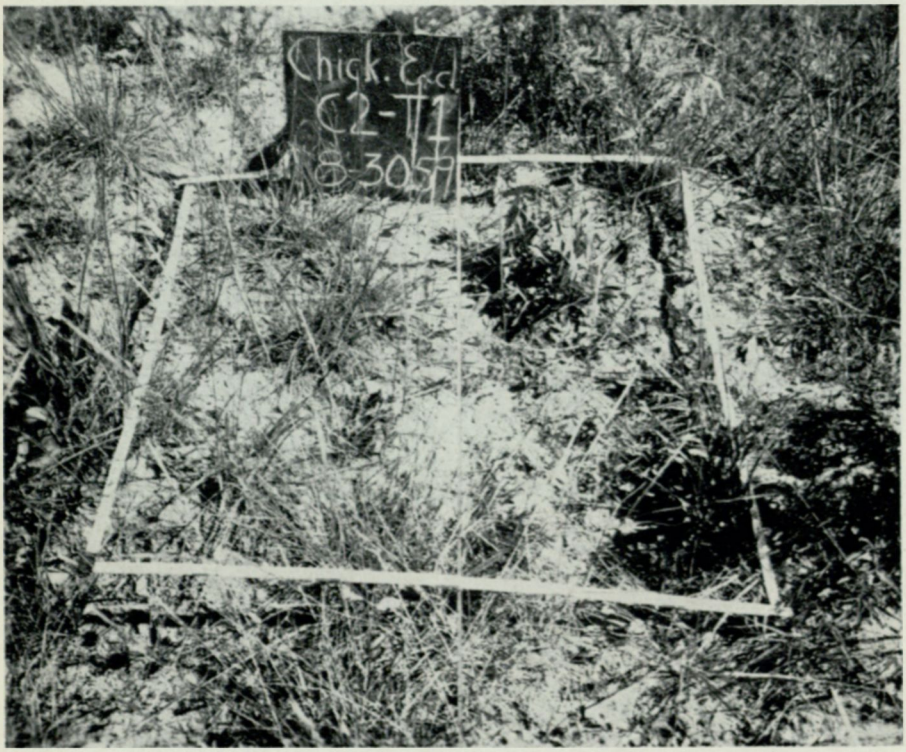
Sample area at the Red Creek exclosure in southern Yellowstone National Park showing herbaceous cover of the subalpine Idaho fescue community.

ALPINE MEADOW

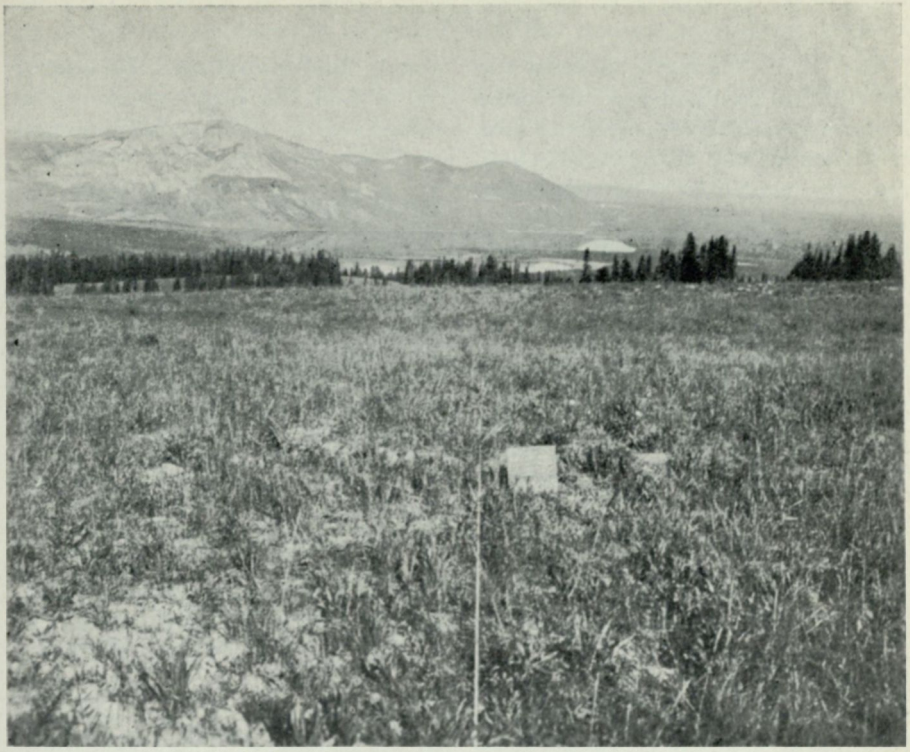
Alpine meadows are poorly developed in Teton County. Strangely where they are poorest developed, they are receiving the heaviest use. For example, the Teton Range and some of the more remote and rocky areas of the Gros Ventre Mountains support concentrations of mountain

sheep, while the gentler and more extensive slopes, as for example around Breccia Peak in the vicinity of Togwotee Pass, show no current evidences of utilization by either game or livestock.

Nowhere in the county can these areas be considered critical from a management point of view. Shaw (1958) gives one of the few comments to be found on this zone: "The alpine area with its prevailing low temperatures and exceedingly short growing season is located between 10,000 feet and 13,500 feet. Low annuals and perennials related to arctic species are represented in this barren tundra. The rocky talus slopes and windswept ridges are habitats for clumps of *Silene acaulis, Geum rossii, Polemonium viscosum, Chaenactis alpina,* and *Epilobium latifolium.* Near the summits of the higher peaks are found scattered colonies of *Smelowskia calycina, Eritrichium elongatum* and *Saxifraga oppositifolia.* Alpine lakes and streams are surrounded by a great variety of plants. *Primula parryi, Salix*



Close-up of the mountain-meadow community on Chicken Ridge in southern Yellowstone National Park. The predominant grass is Stipa columbianum.



General view of the mountain-meadow community on Chicken Ridge in southern Yellowstone National Park. Heart Lake lies in background.

arctica, Anemone globosa, and *Phyllodoce empetriformis* are species of these moist situations." Dr. Charles Laing has made an intensive study (unpublished report to the National Park Service) of the area surrounding Lake Solitude. Here horses are the most common grazing animal.

While elk are common in summer in the mountain meadow, they have not been observed on the alpine meadow. Mountain sheep, which might normally be expected in this area, are so reduced in number through competition for forage on the winter range that their impact is not felt.

INTERVALE

One may frequently observe the intervale (areas dominated by tufted hairgrass) severely overutilized, even to the extent of a change of composition to dandelions and fivefinger, while the sedge swamp on one side and the fescue grassland on the other remain in undisturbed condition. This is usually an indication of a concentration of horses.

An abundance of dandelions is one of the most reliable indicators of overutilization in the intervale. Crushed dandelions are the best bait for trapping ground squirrels and are a favorite food of the pocket gophers. For changes in the intervale when grazed, see Table 5.

SEDGE MEADOW AND SHRUB SWAMP

The sedge meadow and the shrub swamp are nearly always adjacent in their occurrence, especially at lower elevations. Even at the highest elevations, dwarf willows mark the boundary between the sedge meadow and the intervale. The sedge meadow is not easily overgrazed. It is not an area

TABLE 5—Range Condition Classes for the Intervale

	(Numbers represent average percentage of the composition) STAGES OF GRAZING DISCLIMAX			
	Natural	Decreaser	Increaser	Invader
Grasses and Sedges:				Combined
Deschampsia caespitosa	20	15	10	native
Carex spp.	10	10	10	grasses and
Muhlenbergia richardsonis	10	15	20	sedges
Koeleria cristata	5	5	0	5
Agropyron trachycaulum var. unilaterale	5	5	10	
Poa canbyi	5	5	10	
Poa pratensis	0	5	15	25
Forbs:				
Achillea millefolia	0	3	5	5
Native Annuals	0	3	5	10
Agoseris elata	5	5	5	0
Aster integrifolius	5	3	1	0
Collomia linearis	0	1	3	5
Frasera speciosa	0	5	5	0
Potentilla arguta	0	5	10	20
Valeriana spp.	0	5	5	0
Taraxacum officinale	0	5	15	20
Geranium richardsonii	0	1	3	5
Gilia aggregata	0	1	3	5

generally preferred for summer grazing, either by livestock or by game. In the fall, elks leave the mountain slopes to congregate and feed on the sedge meadows. Here they resume feeding on an area which has been left essentially untouched since late spring. They follow the sedge meadow back to the winter feeding grounds, and on the National Elk Refuge this is their favorite type as long as the feed there lasts.

Cattle have sufficient feed, which they prefer, in the intervale and seldom are found, on summer ranges, utilizing the sedge meadow to any extent. Before cattle left the Colter Bay and Donahue Point allotment for confinement on the Elk Ranch, they made as heavy summer utilization of the sedge meadow as anywhere in Teton County. Within two years after they left, the vegetation was so nearly natural that no obvious evidences of their former presence remained. Since that time a new pattern of trailing and utilization involving horses used at Colter Bay for recreational purposes has appeared.

Frequently one may see severely browsed willows bordering a sedge swamp which seems otherwise to be entirely undisturbed. This is usually an indication of concentration of moose in winter. Only where utilization in summer is so severe that accelerated erosion changes the drainage pattern, may extensive changes be caused in the plant composition of the sedge meadow or shrub swamp. Such cases are very rare in Teton County, and none was found on the Teton National Forest.

STREAMSIDE FOREST

The streamside forest, from the point of view of grazing, is quite in contrast to aspen, even though both are dominated by species from the same genus. All of the tree types are relatively unpalatable to game *(Populus angustifolia, P. balsamifera,* and *Picea pungens).* Likewise the associated shrubs, although browsed, are not the woody types most sought after by any of the big-game animals *(Alnus tenuifolia, Eleagnus commutata, Shepherdia canadensis,* and *Rosa woodsii).* Both *Rosa woodsii* and *Eleagnus commutata* have a tendency to increase under grazing.

While the streamside forest has not been changed significantly by game use, in many areas it has been extensively altered by the grazing of domestic stock. Here, again, the woody species remain relatively unaffected, but there are extensive changes in the herbaceous vegetation. Of the forbs and grasses characteristic of undisturbed areas, only goldenrod and aster remain, and the rest of the cover consists of a sod of some of the commonest agricultural grasses — Kentucky bluegrass *(Poa pratensis),* Red top *(Agrostis alba),* smooth brome *(Bromus inermis),* and timothy *(Phleum pratensis)* interspersed with such invading weeds as American licorice, thistle, dandelion, and black medic.

While fluctuations in stream level are characteristic of these areas, irrigation demands sometimes cause de-

structive flooding by shifting the dry, cobbly sands of stream beds in summer.

SHRUB COMPLEX

Just as the intervale and the mountain meadow are the key to range condition in the Meadow Complex, the various big-sagebrush communities are the key to range condition in the shrub complex for the same reasons—extent, use, and change.

CURLLEAF MOUNTAINMAHOGANY

Although curlleaf mountainmahogany is a preferred food for deer, the area involved is too small to be of any importance in estimating grazing capacities or to be significant in range survey. However, this and less striking examples of edaphic control are especially common at lower elevations in Teton County.

In Teton County one finds coincidentally a great variety in the number of dominant species which apparently are associated only with the edaphic factor. Here, also, edaphic changes in dominance are often similar to a grazing disclimax.

ROCKY MOUNTAIN JUNIPER

Rocky Mountain juniper occupies a very narrow belt around the base of the mountains and usually marks the border between communities dominated by *Agropyron dasystachyum* on drier sites and those where *Agropyron spicatum* occurs in more mesic situations. The condition classes developed for these two wheatgrass areas will serve for juniper also.

In Teton County, *Juniperus scopulorum* reaches its northern limit on a precipitous south-facing slope rising sharply above the Togwotee Pass highway and Buffalo Fork on the north side of Turpin Meadow. This is the northern limit also for many associated plants such as *Tetradymia inermis, Chrysothamnus nauseosus, Comandra pallida,* and *Agropyron dasystachyum*. Here all the trees exhibit a well-defined browse line of 5 to 7 feet, indicating deer activity. However, elk and moose sign can be seen on the slope. No domestic stock or horse sign is evident. The bases of old juniper trees are now two to three feet above the ground, and nearly all the roots are exposed. In some cases the trees have died. The age of the junipers indicates no recent burn. Scattered over the steep bank are plants of bitterbrush, snowberry, chokecherry, spineless horsebush, rabbitbrush, and, on rocky outcrops, currants. The associated herbaceous vegetation consists of *Agropyron spicatum* (20%), *Leptodactylon pungens* (20%), *Artemisia frigida* (5%), *Aster* (5%), *Gutierrezia* (5%), and *Agropyron dasystachyum* (5%). Very sharp, new gullies are forming on this slope. (Tables 6 and 7).

TABLE 6—Range-Condition Classes for Mesic Grassland

	(Numbers represented average percentage of the composition) STAGES OF GRAZING DISCLIMAX			
	Natural	Decreaser	Increaser	Invader
Grasses and Sedges:				
Agropyron dasystachyum				
Agropyron spicatum	50	25	10	1
Agropyron trachycaulum	5	5	0	0
Bromus tectorum	0	0	1	50
Carex spp.	5	5	5	3
Festuca idahoensis	5	5	0	0
Koeleria cristata	10	10	10	5
Poa secunda	10	5	5	5
Stipa comata	10	5	3	0
Stipa lettermanni	5	10	10	5
Forbs:				
Antennaria arida	5	5	10	5
Artemisia frigida	5	10	10	10
Castilleja	5	10	10	5
Chrysothamnus lanceolatus	5	5	0	0
Comandra pallida	0	0	5	5
Crepis acuminata	5	3	0	0
Gutierrezia sarothrae	3	5	10	10
Haplopappus acaulis	1	3	5	5
Phlox glabrata	5	10	20	10

There seems to be some evidence that the destruction of this community by grazing leads to invasion of species from the *Agropyron dasystachyum* community. According to Smith (1960), a bluebunch wheatgrass/needleandthread association is a topoedaphic climax found on eastern exposures of mountains of sedimentary origin. On these same soils a junegrass/bluebunch wheatgrass faciation is a topoedaphic climax on western exposures.

TABLE 7—Range-Condition Classes for the Thickspike Wheatgrass Community

	(Numbers represent average percentage of the composition) STAGES OF GRAZING DISCLIMAX			
	Natural	Decreaser	Increaser	Invader
Grasses and Sedges:				Among the
Agropyron dasystachyum	10	10	5	invaders
Carex spp.	5	3	1	found were:
Koeleria cristata	5	3	1	Bromus
Oryzopsis hymenoides	1	3	5	tectorum
Poa fendleriana	5	3	1	Chenopodium
Poa secunda	5	10	15	album
Stipa comata	5	10	20	Kochia scoparia
Forbs:				Lactuca scariola
Antennaria arida & A.				Lappula
dimorpha	5	10	20	occidentalis
Astragalus tegetarius				Matricaria
Castilleja flava	10	5	0	sauveolens
Crepis acuminata	5	10	10	Polygonum
Erigeron compositus	1	3	5	aviculare
Eurotia lanata	10	10	5	Rumex crispus
Gutierrezia sarothrae	0	5	15	Salsola kali
Stenotus acaulis	5	15	50	Sophia pinnata
Community also characterized				Thlaspi arvense
by species of Eriogonum				

Coniferous Forest Complex

According to Harmston *et al.* (1959), there are 814,000 acres of timber lands within Teton National Forest of which 217,200 acres are considered operable commercial forest, with the timber consisting of Engelmann spruce, lodgepole pine, douglas fir, and whitebark pine (listed in order of importance.)

LODGEPOLE

In contrast to limber pine, which is browse-lined throughout the winter range, lodgepole pine is not generally touched. The few cases where browsing has been reported on lodgepole pine (including stomach samples) apparently are misidentification of limber pine. Browse lines on limber pine are common, but not even in the most heavily utilized areas of the National Elk Refuge are there any signs of utilization of lodgepole by either elk or deer. Harry (1957) reports that lodgepole is less than half of one per-

cent of the winter diet of moose. The report by Anderson (1959, pg. 73) of browseline on lodgepole pine is almost certainly based on the misidentification of limber pine.

The herbaceous vegetation on the floor of relatively mature timber stands of lodgepole pine is composed largely of very characteristic species such as *Carex geyeri, Vaccinium scoparium, Calamagrostis rubescens,* and *Arnica cordifolia,* and species of *Danthonia (cf.* studies by Albert Dobrenz, 1959). Of the species listed, only the danthonias are preferred species for both game animals and domestic stock. However, particularly the leaves of *Vaccinium scoparium,* but also the heads of *Arnica cordifolia,* as well as leaves of Oregon grape, currant, huckleberry, mountain ash, and other minor species are a very large part of the elk diet, sometimes in the summer, but probably universally in the fall.

While there is great variation in the plants on the floor of lodgepole forests in Jackson Hole, these are all related to either age and density of stand or to variations in site. No evidence was found of altered vegetation patterns in lodgepole pine forests due to grazing of either livestock or game.

While no exclosures were found within the Lodgepole pine, the islands of Jackson Lake and Yellowstone Lake are reliable relic areas. Croft and Ellison (1960, pg. 24) noted the spread of lodgepole pine reported in Wyo. Agr. Exp. Sta. Bulletin 376 and have related this spread around the meadows in Fox Park to accelerated erosion caused by elk.

SPRUCE, FIR, AND OTHER CONIFERS

At the base of Cascade Canyon a horse corral built in the shade of douglas fir has resulted, through trampling by horses on shallowly buried or surface roots, in death of mature trees in the immediate vicinity. Croft and Ellison (1960) report the spread of limber pine on Big Game Ridge and state that "since these trees are invading former herbland, the process constitutes strong evidence of disturbance of the herbland soil." In this case, the disturbance is caused by elk.

Deciduous-Forest Complex

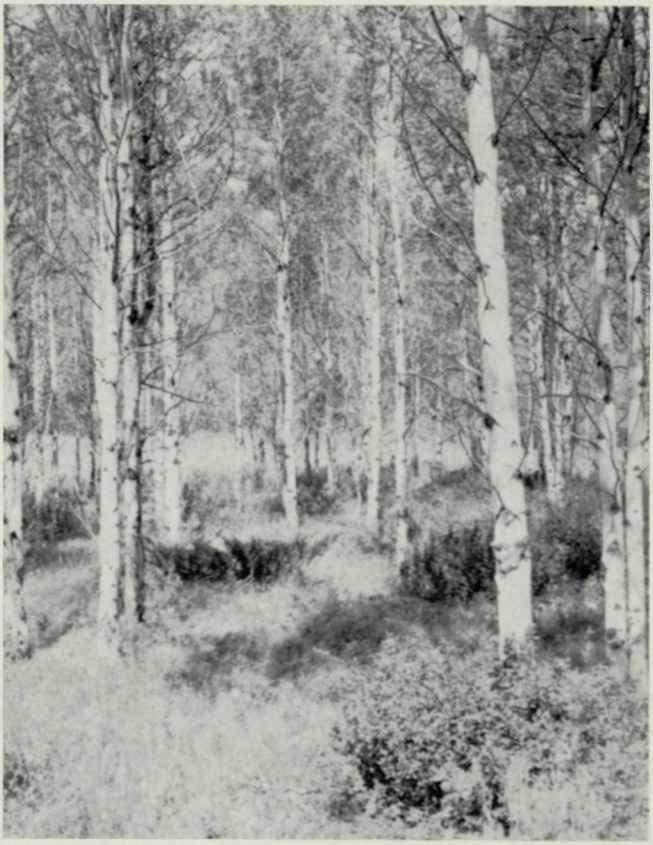
ASPEN

Aspen is not common today on the route followed by Nelson and his exploratory party in 1898. Although collected by them, it received no special mention (Gooding, 1944). However, aspen is intimately woven into the migration paths of the elk and into all but their summer forage requirements. Relic stands of aspen (Red Mountain, Mt. Hancock) even suggest that aspen (along with other shrubs which appear to survive as relics) may formerly have played a part in the summer nutritional requirements also.

Evidence of elk populations outrunning their subsistence first appears as a browse line on aspen. These browse lines soon turn to high lines. Since the early 1900's, browse lines and high lines have been characteristic of the Jackson Hole Region as evidenced by their appearance in photographs, paintings,* and the remarks of range managers.

Preble in 1911 noted that "Many herds remain on the open hillsides and among the aspen. They browse on the twigs and bark of aspen poplar and to a less extent on the spruces. Any brush left by wood choppers is eaten at night." Grange (1937) stated, "The most natural feed for big game in winter is browse. Where it is practical to provide a sufficient quantity

* For example, "The Prospector", by F. Remington (1861-1909), and "Buck Deer" by C. M. Russell (1864-1926) in the Whitney Museum of Western Art, Cody, Wyoming.



Aspen community. Understory stands are Shepherdia canadensis, Juniperus communis, and Symphoricarpos tetonensis.

of good browse by felling such trees as white cedar, birch, aspen, maple, cherry, or hemlock, the browse will be relished by the animals." (This seems to be a tacit admission of high browse lines and implies that trees should be sacrificed to obtain healthy animals!)

Murie (1944) states, "Aspen groves are on the way out, and have been so heavily browsed that except for fallen leaves, they no longer furnish much feed." Kittams (1950) echoes, "Quaking aspens have been on the downgrade in Yellowstone for decades." These are perhaps exaggerated statements, although it is true that game use, in part through barking damage and polishing of elk antlers, but more through eating of bark, has eliminated some aspen stands. Another classic misinterpretation is made when some observer happens upon an old, highlined aspen stand and discovers the profuse attempts at vegetative reproduction. Each year the new sprouts are mechanically protected to various levels by the snow pattern. These observers often state that aspen is "on the way back," but repeated observations indicate that, for fifty years, aspen in Jackson Hole has consisted of both old trees highlined and a layer of young reproduction mowed short every year by game use.

Pressure of shrubs in these communities may be strongly influenced by light; *e.g.*, sagebrush does not occur in dense shade, while *Shepherdia* seldom is found away from dense shade (*c.f.* Verner, 1958). The opening up of the canopy of aspen has had much to do with the reduction in abundance of shrub species which were unpalatable to both game and livestock but were nevertheless not light tolerant.

Based on canopy alone, four types of aspen stands may be recognized in Teton County: (1) relic stands with a closed canopy; (2) highlined stands with a conspicuous shrub layer; (3) highlined stands with the shrub layer gone; and (4) aspen areas where the whole canopy is gone. Changes in the herbaceous flora of the aspen stands which are associated with the above types are very complex; they vary according to the mesic or xeric character of the stand. Mesic stands, when grazed, tend to be characterized by *Taraxacum officinale, Poa pratensis,* and *Elymus glaucus. Agropyron trachycaulum* var. *unilaterale* may be conspicuous around the edges. Xeric stands tend to become characterized at their center by the same plants which would normally mark the edge of the stand. Around the edges, species which are characteristic of the big-sagebrush communities encroach as far as the shade patterns permit (Table 8).

FORBS

The forb community is nearly always heavily disturbed by the pocket gopher. Disturbance of this community seems to result in increases in *Rudbeckia occidentalis, Agastache urticifolia,* and *Hackelia floribunda.* All of these have been associated by Houston (1954) with aspen stands of the inter-

mountain region. Perhaps a study should be made to determine whether these plants mark the former occurrence of aspen, now only a rare remnant in the areas where the forb community occurs.

TABLE 8—Range Condition Classes for Aspen Communities

	(Numbers represent average percentage of the composition) STAGES OF GRAZING DISCLIMAX			
	Natural	Decreaser	Increaser	Invader
Grasses and Sedges:				
Agropyron subsecundum	5	10	10	5
Agropyron trachycaulum	5	10	10	5
Bromus marginatus	0	5	5	0
Carex hoodii and C. raynoldsii	5	10	10	5
Elymus glaucus	10	20	15	5
Poa palustris	0	5	5	5
Poa pratensis	0	5	10	25
Stipa lettermanni	0	0	5	5
Forbs:				
Achillea lanulosa	3	5	10	10
Agoseris glauca	5	5	10	10
Collomia linearis	1	1	10	10
Geranium richardsoni	10	15	20	5
Nemophila breviflora	0	0	5	5
Symphoricarpos tetonensis	Often becomes the dominant understory			
Taraxacum officinalis	0	5	10	15
Valeriana obovata	5	5	10	5

Since the variations in natural stands were described in Bul. 376 (pg. 32), only those species which are the best indicators of condition class are listed here. Elk, by severely limiting shrub development in aspen stands through winter browsing, open these communities to greatly increased herbaceous production and, consequently, to increased utilization by cattle during the summer.

Disturbance

BURNING

Burned areas occur throughout Teton County. While the evidence of burns in timber persist on the surface in the form of old logs, standing trunks, and changed patterns in the vegetation, the extent and age of burning in sagebrush and grassland communities is not obvious.

Many areas with sagebrush trunks at least 100 years old have been found, indicating escape from fire for at least that period. On the other hand, many stands are dominated by much younger plants. In sagebrush communities, *Agropyron spicatum* is hardly damaged by fire, so that the destruction

and regeneration of big sagebrush may be the only s.gnificant change.

Lodgepole pine burns are the commonest. Where the burned stand has failed to regenerate, the cover has been carelessly interpreted as evidence of grazing abuse, since, in the patchy nature of the resultant plant composition, they may resemble areas disturbed either by grazing or by severe rodent activity. Sometimes the amount of fallen timber makes grazing use of burned areas very difficult. However, even when old logs are not a hindrance, these areas may be avoided by both stock and game.

Burning is never used as a management practice in Teton County, even in the big-sagebrush type, and accidental burns have, in recent years, been rare.

ROADS

In mid-August, 17 randomly chosen roadside localities, at 5-mile intervals from southern Yellowstone to northern Lincoln County, through the middle of Teton County, involving constructions of various ages and crossing a variety of plant communities, showed approximately 50 plants, half of which were natives, the other half, introduced weeds. Those commonest are listed here in order of descending frequency: *Aster* spp., *Taraxacum officinale, Phleum pratense, Poa pratensis, Agropyron trachycaulum, Lactuca scariola, Agropyron cristatum, Melilotus alba, Chenopodium album,* and *Polygonum aviculare.*

CHEMICAL SPRAYING

There is ample opportunity to study the effects of spraying with 2,4-D on the headwaters of the Hoback. Here willows have been killed in a few bottoms and big sagebrush and silver sagebrush on lower slopes and hillsides. Spraying has sometimes controlled the forbs as well. Areas such as this, normally rich in a great variety of forbs (see the botanical description of the big-sagebrush community), become a dense (over 50% ground cover) grass/sedge cover *(Poa fendleriana, Festuca idahoensis, Stipa columbiana, Carex phaeocephala,* and others). This change in plant composition is an accentuation of the changes that excessive game use tends to make in the same communities. To the extent that game are dependent upon a forb diet, this shift from forbs to grass is detrimental to their use, but the change is beneficial to cattle which may be observed to concentrate on the sprayed areas.

In some areas of sagebrush control, no effect has been observed on rabbitbrush, which, so far, seems to remain confined to the few isolated spots occupied before spraying. However, care should be taken that control of sagebrush does not lead to infestations of rabbitbrush or larkspur, which would spoil the range for both game and livestock.

ACCELERATED EROSION

Once again, reference must be made to Croft and Ellison (1960), who have confirmed that the most severely overgrazed areas of Teton National Forest are in the Wilderness area, and conform precisely with the boundaries of the summer range of the elk. Nowhere else in the Teton National Forest, or in Teton County, have similar conditions been encountered.

As explained in Part I (Wyo. Agr. Exp. Sta. Bul. 376, pg. 11), the steep, exposed slopes of the Gros Ventre River drainage are Paleozoic formations quite different from those of surrounding areas and are naturally comparatively barren.

TRAILING AND TRAMPLING

Trails crisscross Teton County in many directions. Those which are most evident are caused by elk migration. Because of cryopedogenic action each year, the evidences of trampling are soon obliterated.

Winter Feeding

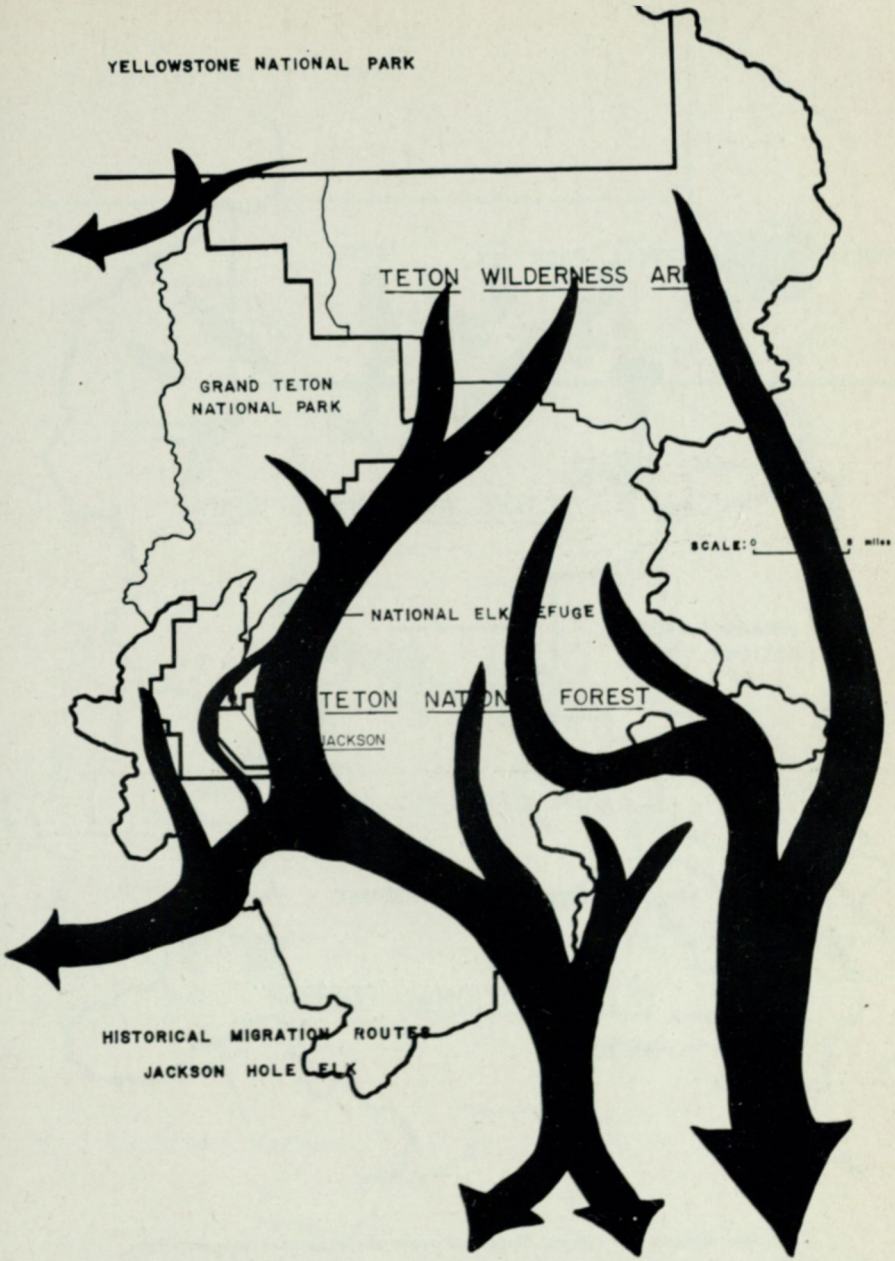
As early as 1897, the report of the Superintendent of Yellowstone National Park remarked that "The park furnishes ideal summer range for 40,000 elk, but there is not enough winter range for one-fourth that number." At that time there were an estimated 25,000 elk, but the peak number was not reached until 1915, when 37,000 head were reported.

Until 1895, hunting and control of elk were loose; numbers in the herds surrounding Jackson Hole were held down by (1) predators, (2) hunters, and (3) winter starvation.

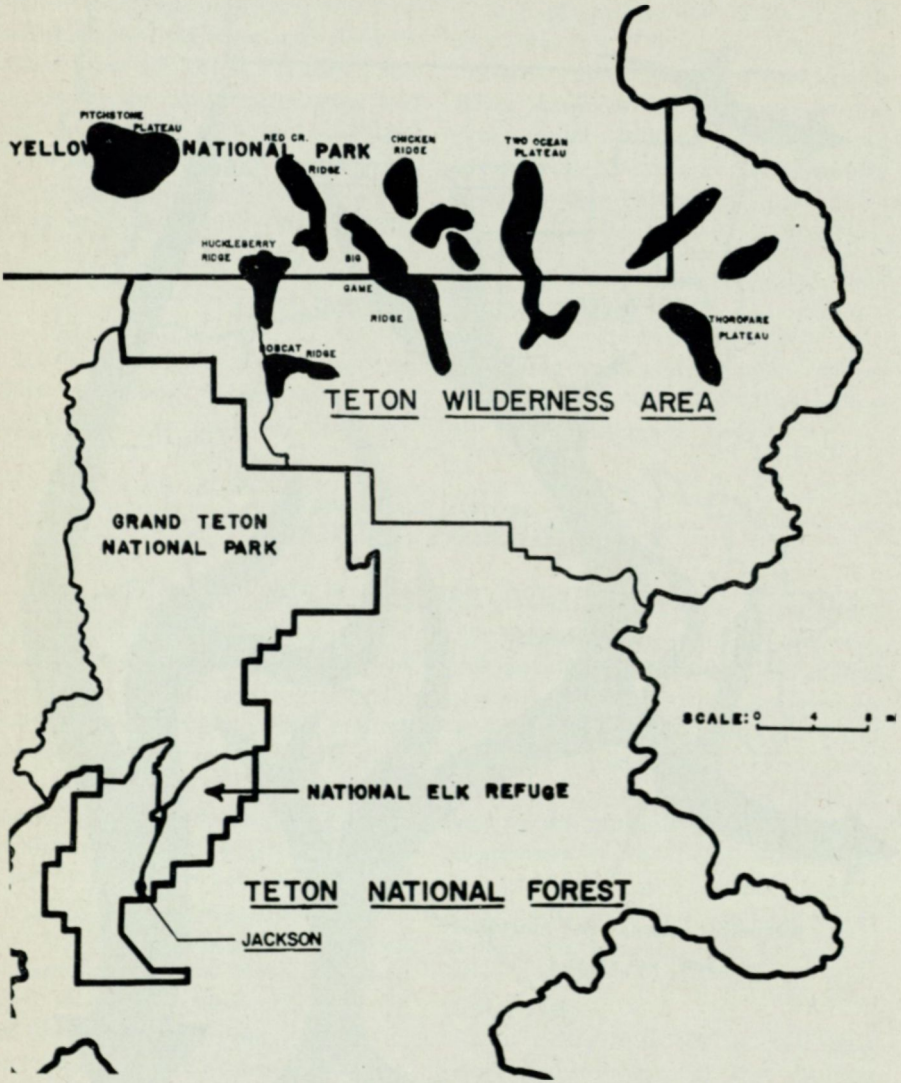
From 1895 to 1905, control of harvest and mild winters resulted in a large increase in the herds and started the destruction of the winter range which has continued ever since.

Since 1905, creation of the Wyoming Game and Fish Department (1907), further control of harvest, elimination of predators, and a regular winter feeding program have all served to increase elk numbers. Land aquisition (since 1913), transplanting (since 1910), and the setting aside of land for elk use only (since 1905, date of creation of the Teton Game Preserve), creation of a second national park, and hunter harvest have failed to keep elk numbers low enough to allow for any improvement in their winter range.

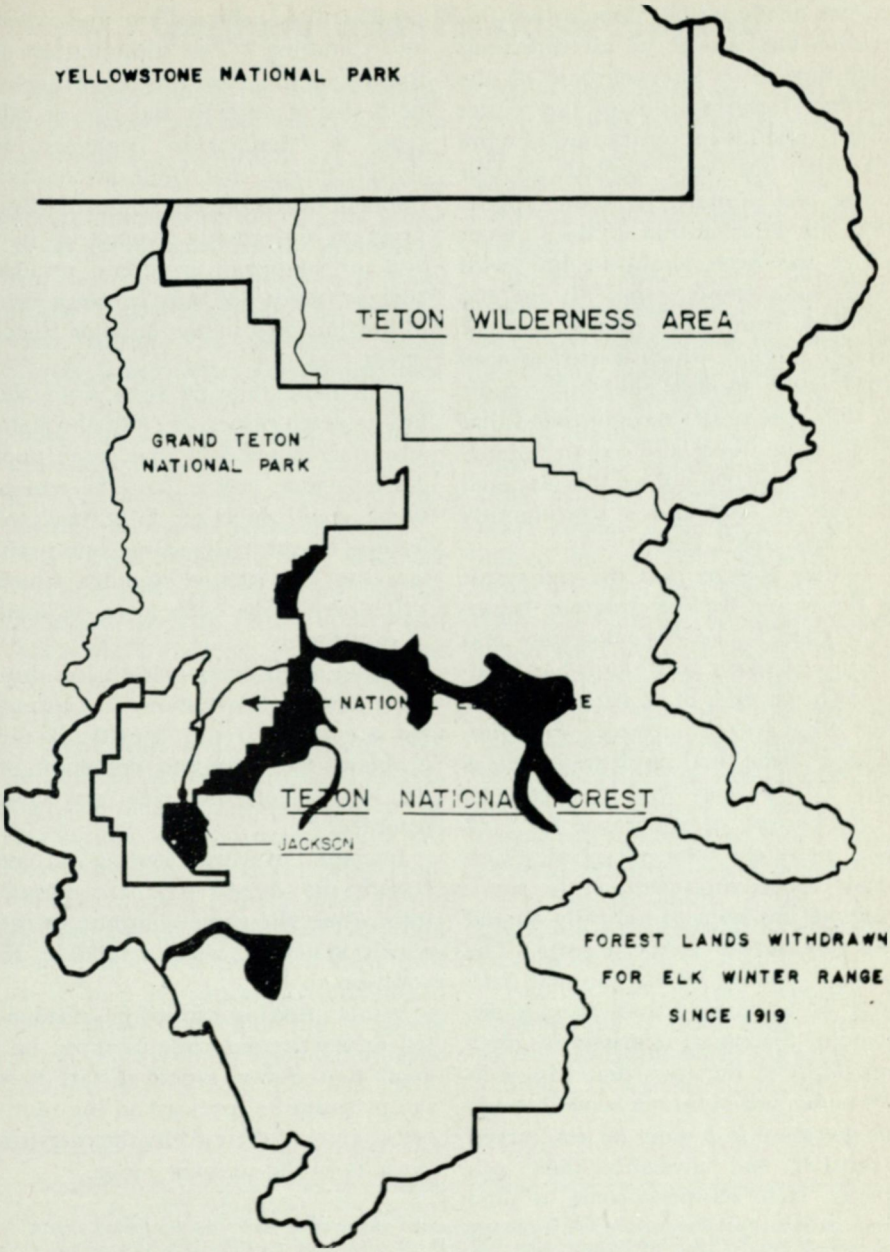
It is difficult to say at just what point deterioration of the summer range occurred, but, as Anderson *(cf.* "The Jackson Hole Elk Herd") points out, this deterioration was apparently caused by two factors: (1) control of predators in the area, which led to



Historical migration routes of Jackson Hole elk.



Principal summer elk ranges. Blackened areas show summer concentrations.



Forest Lands withdrawn for elk winter range since 1919.

release of the gopher population (this release has spread in all directions and now is as characteristic of the summer range as it is of the winter range), and (2) concentrations of more elk than the very limited summer range can support. It would appear that the deterioration of the summer range has been about in line with Anderson's graph 7 (pg. 77) and has resulted from the enlargement of winter feeding, which started around 1935 (even though Sheldon's report of 1927 specifically recommended that this not be done) and led to populations over 10,000 elk on the National Refuge in 1943 and a continuously high level until 1956.

It now appears that the end result of the winter feeding program, begun as a good-Samaritan emergency and continued like a bad habit, has finally sown the seeds of destruction of the very elk it seeks to preserve. First prediction of the final result was made as early as 1946 by W. B. Sheppard, "Life History of American Elk," 12 pgs., privately mimeographed, "Certainly the environment of the surviving elk has been so radically altered that the future is not roseate. The relative paucity of the annual calf-crop is a portent and an augury. Some of the causal relations are obvious. Most of the cows that winter in Wyoming and Montana come through the gestation in a more or less starved condition and probably their offspring lack stamina—some of the present day yearlings are undersized and spindling." The continuation of this trend *(i.e.,* continued decline in both size of animals and size of calf crop) is described by Anderson. It would appear that both severe curtailment of the present winter feeding program and greatly stepped up harvest are necessary to reverse present adverse trends not only in range condition but also in the animals themselves.

It is more than 50 years since the heavy death losses in 1909 brought attention to the fact that game populations were larger than the winter range could support. Fifty years of feeding has partially solved one problem but has created another which will prove to be even more difficult of solution.

While severe winter death loss during unusually heavy snows first attracted atteniton to the severity of the problem, the attendant depletion of the shrubs of the area was also recorded.

Initiation of winter feeding did not restore the shrubs to their normal form, since the game continue to eat woody materials, where available, in addition to hay.

Winter feeding cannot be eliminated in the present circumstances, but good management would dictate that the program be confined to the number of animals dictated by the carrying capacity of the summer range.

Gophers and Predator Control

In Teton County the history of predator control, and the reason, are well documented. According to Preble (1911), "One of the most destructive natural enemies of the elk, the puma or mountain lion, is now eliminated from consideration, since it is practically exterminated in the Jackson Hole region. On the other hand, wolves, which were formerly unknown there, are common and increasing. They first appeared about 10 or 12 years ago, coming in from the Green and Wind River region, probably following the introduction of stock . . . The coyote, unlike the wolf, is almost certainly native to the region, but has increased greatly with settlement. Adult elk are seldom or never killed by them, but a few young calves fall victims."*

Eight years later, Graves and Nelson (1919) again reported: "The predatory animal is a large factor in the annual loss of elk, particularly of the year's increase of calves. Such substantial progress is being made in the destruction of wolves and mountain lions that it is hoped in a short time these may be practically eliminated as a serious source of injury to elk herds. Headway is also being made against coyotes, but they are still a serious factor in elk loss. They follow the migrating herds in numbers, pulling down the calves, especially those weakened from any cause. Still more vigorous measures against them are needed."

Sheldon (1927) states: "No doubt before the settlement of the country and even discounting the influence of Indian hunting, there was an annual attrition which kept the herds within limits. They had to contend with natural causes and the competition of other species. But these natural checks have been largely removed and artificial obstacles substituted. . . . Just how much of a factor predatory animals are has not been determined with any degree of accuracy. In Jackson Hole, the coyote is considered a valuable fur-bearing animal and is extensively hunted as such by local residents and professional trappers. In view of the fact that the coyote is a source of no mean income to local residents, there ought to be an exhaustive study of the coyote's place in the administration of wildlife in Jackson Hole."

Among the factors reported by Grange (1937), which largely account for the development of big-game food shortage, is "excessive removal of such

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* Cahalane (1947) indicates that the majority of food in a wolf's stomach consists of mice, ground squirrels, rabbits or pocket gophers.
Murie (1940) reports that 5,000 coyote droppings had 9,000 individual items. During spring, summer, and fall rodents constitute by far the most important part of the coyote diet, the majority of these being field mice and pocket gophers.

natural enemies as the cougar, timber wolf, and lynx, without substitution of compensatory methods for the removal of aged and surplus big-game animals." Most reports indicate that predators take only calves. Hatch in 1938 again states, "Since rodents represent the chief food source of most predators during the spring and summer, provision must be made in all intensive predator-control programs to eradicate rodents as well."

Craighead (1950) studied both coyote and raptor predation in Jackson Hole and discovered that coyotes were an important factor in rodent control but were not in elk-population control. He found not only that raptors, unlike coyotes, were unimportant in gopher control, but also that coyotes and raptors had essentially different diets. In other words, if coyotes are controlled, their work cannot be left to raptors. Robinson and Cummings (1951) determined that, between Yellowstone National Park and Montana, "much of the coyote drift precedes and is not dependent upon the movements of big game."

Even as wildlife managers have not yet reached general agreement upon carrying capacity of big-game range, they have not defined natural, small mammal populations. However, just as a balance with nature is essential on properly managed game ranges, a similar balance would seem to be essential in determining normal rodent populations. Thus, when summer mounds and winter cores of pocket gophers occupy more than half the available area (in some places in Teton County, where there are no stock and no great concentrations of game, they occupy 100 percent of the available space), the population is out of balance.

To put it another way, if the gophers find that they must rework their recent (two to three years old) feeding areas, before these have had a chance to return to a natural cover (one which completely masks the evidences of their work), then the population is out of balance. Observations of areas which are considered normal as far as gopher populations are concerned indicate that recent and one-year-old mound and core areas are obvious, two-year-old areas are slightly obscure but readily detected, and, under the conditions in Teton County, if the population is normal and nothing else is interfering, evidences of the work of the pocket gopher are obliterated in the third and fourth years. When this is true, the pocket gopher fulfills its natural function as a soil builder. When the populations are out of hand, the pocket gopher destroys both the range vegetation and the soil.

Management Suggestions

Cattle trails (summer to water) may often be observed running at right angles to elk trails (migration routes), and elk utilization of steep slopes and ridges may be observed adjacent to cattle concentrations without apparent overlapping *(e.g.,* the Pot Holes area south of Signal Mountain, from which the cattle have now been removed, or east edge of Jackson Hole near the Triangle X Ranch). This points up the fact that two management problems exist in Teton County, the one involving cattle, the other, elk. In general, these are separate problems.

The U. S. Forest Service issues a statement on "vegetative readiness" to the permittees which reads, in part, "The important grasses from 6 to 10 inches in height. Sandberg bluegrass and mutton bluegrass *(Poa fendleriana)* should be in blossom. Cheatgrass *(Bromus tectorum)* should be starting to head . . ." Cheatgrass brome, according to the transects taken over a five-year period, is rare to absent on the cattle ranges on the Teton National Forest, although at low elevations it is occasional along road disturbance. Such great changes in elevation occur within the county that range readiness needs to be developed for several different communities and for several different ranges in elevation if it is found to be a useful tool. However, it must be pointed out that the animal most in need of improved range, the elk, disregards all laws of range readiness throughout spring and early summer.

R. L. Lang (Lang and Beetle, 1959) has had notable success in planting various grasses and legumes, on a variety of sites and with various treatments. These will be treated in detail in other publications of the Wyoming Agricultural Experiment Station, but they point up the fact that there are a number of ways to improve the range aside from relying on its natural ability to recuperate under deferment.

On the National Elk Refuge excellent stands of crested wheatgrass *(Agropyron cristatum)* and desert wheatgrass *(Agropyron desertorum)* have been obtained in 1952 and various other years. Some of these stands remain in excellent condition after eight years. Elk ignore them in winter but clean up the area in the spring before they leave. Although ample seed heads are formed every year, the crested wheatgrass has neither become excessively sod bound, nor has it spread into the adjoining native vegetation. Neither has the native vegetation been able to establish itself within the stand of crested wheatgrass, either where grazed or within either of the two exclosures which were erected over parts of two seedlings at the time they were established.

Alfalfa has been used as feed on the elk refuge. To maintain production it has been necessary to spray for alfalfa weevil. Salt-cured, second-cutting alfalfa has proved the best lure for trapping elk.

The creation of a Jackson Hole Elk Advisory Committee was suggested by Sheldon (1927), again in *Wyoming Wildlife* (1949, pg. 32); it finally became a reality in 1958. This group, consisting of both a technical committee and an advisory council, includes representatives of the U. S. Forest Service, National Park Service, University of Wyoming, National Elk Refuge, and the Wyoming Game and Fish Department. The most pressing problem confronting this group appears to be reduction of the elk herd within the carrying capacity of the summer range. This will involve (1) recognition of the limited nature of the summer range, (2) an estimate of the carrying capacity of that range, and (3) a reliable mechanism in the winter to accomplish herd reduction.

Both public and private groups responsible for land ownership should estimate the amount of land they have in each vegetation type. To the extent that their ownership is limiting to any particular type of game animal or traditional use by domestic stock, these parties should accept the responsibility of maintaining their range in the proper range condition and should object when management of adjacent lands interferes.

Conclusions

This paper has discussed the significance in terms of grazing pressures by game and livestock of the following phenomena observable in Teton County: (1) changes in plant composition; (2) incidence of sagebrush seedlings; (3) browse lines on woody species; (4) high lines on aspen; (5) trailing; (6) presence of certain individual species such as the common dandelion and cheatgrass brome; and (7) disturbance patterns.

The large number of dominants involving shrubs, forbs, and grasses of all types on varied areas has, at present, ruled dominants out as good general indicators of range-condition class. Likewise, the general absence of invaders (except on the floor of the Hole and the Elk Refuge) rules them out as general indicators, except where loss of percentage composition of decreasers can be demonstrated. This leaves only the general class of increasers as a possible key to range condition. Here there is, perhaps, some hope of developing a clearer picture of vegetational change. One of the most promising indicators is Sandberg bluegrass, which cuts across soil types as well as vegetation types, over a broad zone of elevation, and invariably increases in abundance as the habitat becomes disturbed. This disturbance may be by cattle, sheep, big game, or gophers; the grass does not distinguish the cause. In the same manner, two forb genera (both mainly composed of increaser species) seem to have significance over about the same area as Sandberg bluegrass, and these are pussytoes and sandworts.

The most evident changes in vegetation patterns in Teton County are related to the geologic youthfulness of the area. Game animals have severely altered the vegetation. In contrast, the pattern of change caused by livestock is less easy to detect and less obviously associated with their distribution.

Winter feeding by eliminating the winter range as a factor in elk-herd size releases the population for additional growth in numbers until a new limiting factor asserts itself. This new factor has proved, for the elk, to be the summer range. The present survey points conclusively to the elk as a major cause of disturbance of vegetation in Teton County and warns of further damage to the Snake River watershed and the elk herd itself.

Where the shrub layer has been severely browsed on south slopes and *Agropyron spicatum* remains the dominant grass, all range damage, trailing, erosion, and shrub pruning can be attributed to game alone.

Under ideal circumstances it is possible to graze more than one kind of animal without competition. In some circumstances, as in the early stages of aspen-stand deterioration in Jackson Hole, the grazing by one kind of animal may be complementary to that by another, the two together doing better than either would do alone. However, *in all cases, and regardless of the name of the animal, overused ranges lead to competition for the few remaining plants.*

The problems of range management in Jackson Hole are apparently not primarily concerned with the competition between domestic stock and big game, although there are points of conflict. The primary concern is that big game compete among themselves for food.

Overgrazing patterns in Teton County can be attributed largely to elk. On the winter range the damage is confined largely to high ridges and browse and is accentuated by competition from deer. On the summer ranges the damage is on high, open parks where there is no grazing by domestic livestock.

The most pressing problem appears to be reduction of the elk herd within the carrying capacity of the summer range. This involves (1) recognition of the limited nature of the summer range, (2) an estimate of the carrying capacity of that range, and (3) a mechanism in the winter to accomplish herd reduction. None of these is likely to be accomplished in the near future.

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COVER PHOTO—Open stand of Lodgepole pine and Douglas fir on the floor of Jackson Hole.

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University of Wyoming
Agricultural Experiment Station
N. W. Hilston, Director
Laramie