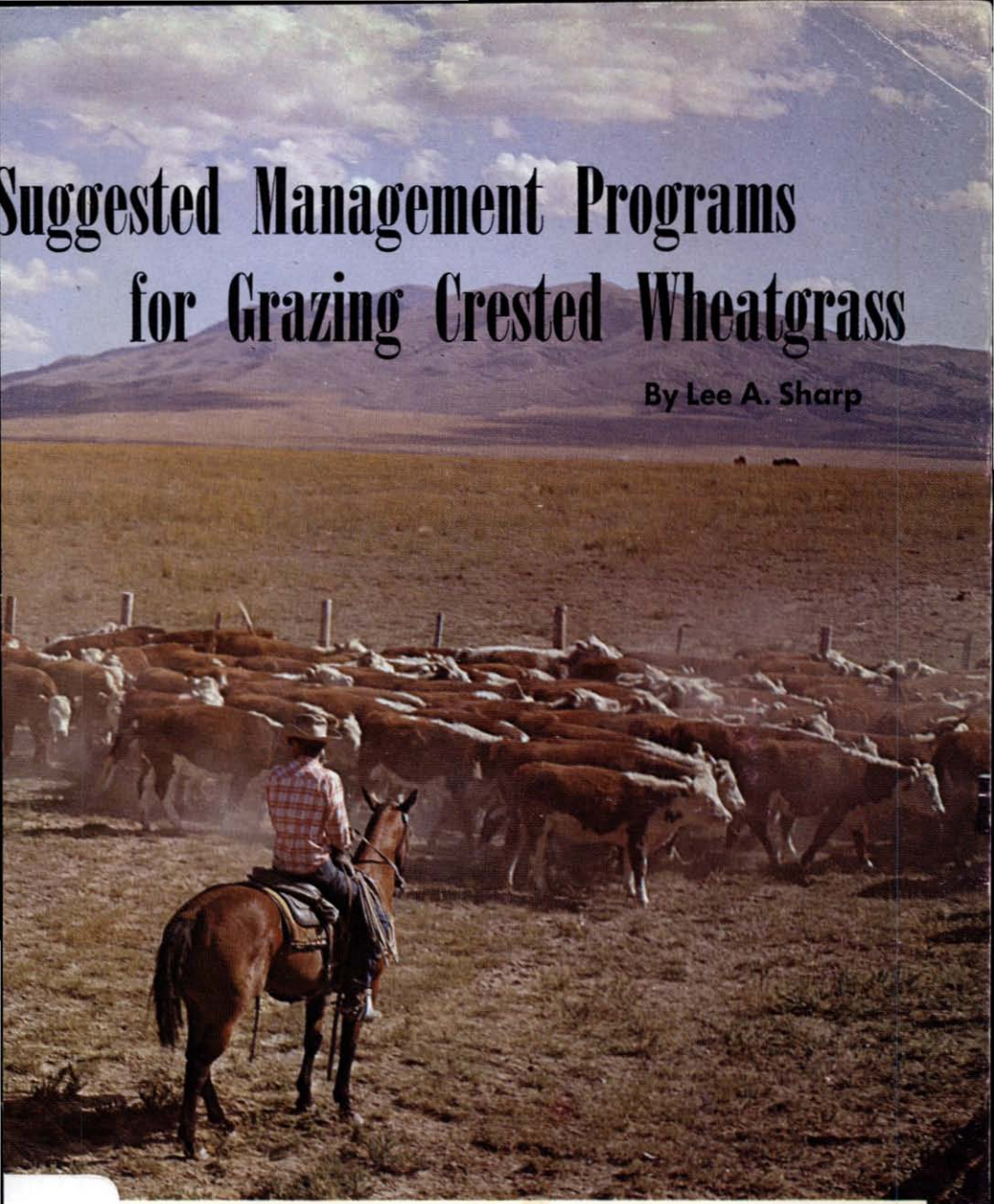
Suggested Management Programs for Grazing Crested Wheatgrass

By Lee A. Sharp



llife and Range Experiment Station

Bulletin No. 4

UNIVERSITY OF IDAHO
COLLEGE OF FORESTRY-WILDLIFE
AND RANGE SCIENCES

loscow, Idaho

March, 1970

Acknowledgments

The research providing the basis for much of the material presented in this paper has been a cooperative effort of the University of Idaho Forest, Wildlife and Range and Agricultural Experiment Stations, the Bureau of Land Management and the Point Springs Grazing Association.

The Bureau of Land Management provided the experimental area, technical assistance and financial support through the period of study. The Burley District and the Idaho State Office of the BLM extended their support of the study much beyond the requirements of the cooperative agreement. Livestock ranchers of the Point Springs Grazing Association provided the animals, assisted in weighing and handling the animals, and enthusiastically supported the project in every way possible.

Suggested Management Programs for Grazing Crested Wheatgrass[1]

Lee A. Sharp, *Professor*
Range Management
University of Idaho

Forest, Wildlife and Range Experiment Station
University of Idaho
Ernest Wohletz, *Director*
E. W. Tisdale, *Associate Director*

BULLETIN NO. 4

Issued under partial support of the Bureau of Land Management

Introduction

Fifteen years of grazing trials at the Point Springs experimental area in southern Idaho provides the basis for the suggested management of crested wheatgrass rangeland presented in this paper.

Successful management of crested wheatgrass range, as well as other types of forage areas, requires an artful application of scientific principles. General guides such as 50 or 65 percent utilization levels or rigid patterns of rotation among pastures are inadequate for the intensive management that will be needed as rangeland area decreases and other land uses impose restrictions on the amount of forage harvested by grazing animals.

Essential to the formulation of a management program for the effective use of rangeland is a knowledge of: (1) the goals and objectives to be achieved, (2) general plant growth characteristics, (3) limitations imposed on forage production by habitat conditions, (4) the relationship of forage production to alternative grazing practices and (5) the requirements of grazing animals and the livestock operation. Other information is often required such as the use of the rangeland area for purposes other than grazing, but such considerations are outside the scope of this paper.

Goals and Objectives for Management

It is assumed, for the purpose of the material to be presented, that optimum sustained livestock production is the primary goal in managing crested wheatgrass. This goal can best be achieved by maintaining the stand of grass in a productive state and protecting the soil resource from deterioration. Pursuing this goal generally does not detract from other resource values such as maintaining favorable wildlife habitat, watershed values and scenic attractiveness.

Description of the Experimental Area

The Point Springs Experimental area, located in the Raft River Valley of Cassia County, Idaho at an elevation of approximately 4800 feet, has similar physiographic features as large parts of Nevada, Utah and eastern Oregon. Broad valleys bordered by parallel mountain ranges characterize these areas. Annual precipitation averages about twelve inches at the experimental site, but has varied from 6 to 18 inches during the twelve years from 1957-1968. Table 1. About 35 to 40 percent of the annual precipitation falls during the months of April, May and June, the period most important for plant growth. The gray desert soils of the area have limited development. The depth to a restrictive layer varies from six inches to 19 or 20 inches and averages about 12-13 inches. Irregularly shaped areas with soils high in salt concentrations (Solidized-Solonetz) occur. These areas are unfavorable for plant growth in years with less than average precipitation.

[1]Crested wheatgrass as used in this paper includes *Agropyron desertorum* (Fisch.) Schult. and *A. cristatum* (L) Gaertn.

Table 1. Average precipitation at the Point Springs Experimental Area, 1957-1968.

Period	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Average
November through April	3.52	6.20	5.40	3.93	5.84	4.04	6.93	6.80	7.42	4.60	5.55	3.82	5.34
May	4.78	0.51	2.50	0.54	0.48	2.07	4.64	2.91	2.07	1.18	1.22	1.86	2.06
June	1.14	1.13	0.24	0.31	0.85	0.48	1.51	3.57	2.35	0.62	3.50	1.32	1.42
July	0.48	0.31	T	0.35	T	0.46	1.01	0.02	1.39	0.33	2.21	0.49	.59
August	2.22	0.49	1.15	0.46	2.07	0.66	2.19	0.02	4.15	0.56	0.37	3.69	1.50
September	0.14	0.98	1.56	0.92	1.86	0.77	1.46	0.21	0.36	0.42	0.49	0.33	.79
October	1.07	1.47	0.24	0.24	1.37	0.40	0.71	1.25	0.21	0.00	1.16	0.94	.75
Total	13.35	11.09	11.09	6.75	12.47	8.88	18.45	14.78	17.95	7.71	14.50	12.45	12.46

Because of the limited soil development and varying salt concentrations in the soil profile, the experimental area is less productive than much of the rangeland that has been planted to crested wheatgrass in the Intermountain country. In the viewpoint of the writer, crested wheatgrass is adapted to the Point Springs area largely as a result of the high proportion of the annual precipitation that falls during the growing season.

The vegetation on the study area probably consisted of an *Artemisia tridentata-Agropyron spicatum* association. Big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass (*Agropyron Spicatum*) dominated but Sandberg's bluegrass (*Poa securda*) occurred frequently. Greasewood (*Sarcobatus vermiculatus*) and rabbitbrush (*Chrysothamnus viscidiflorus*) appeared less frequently. A few annual forbs comprised the spring flora and perennial forb ssuch as death camas (*Zigadenus paniculatus*) and loco weed (*Astragalus beckwithii*) occurred scattered in the area.

Interspersed in the sagebrush-bluebunch wheatgrass association on the salty soils mentioned previously were small islands containing saltsage communities. The principal species, saltsage (*Atriplex nuttrallii*), may have been associated with Indian ricegrass (*Oryzopsis hymenoides*) and squirreltail grass (*Sitanion hystrix*).

Heavy livestock grazing in the days of settlement and prior to regulated use of the public domain drastically altered the original vegetation. Herbaceous species declined and the woody species, especially big sagebrush, increased in amount. Livestock grazing capacity was rated at 27 acres per animal unit month by the Bureau of Land Management in the early 1950's compared to an estimated 3-5 acres when livestock were introduced.

Immediately prior to seeding, the study area had a thick cover of big sagebrush and some rabbitbrush. Herbaceous species occurred infrequently and these consisted primarily of Sandberg's bluegrass, halogeton *(Halogeton glomeratus),* Russian thistle *(Salsola Kali),* tansy mustard *(Descurainia richardsonii)* and peppergrass *(Lepidium perfoliatum).* The shrubs and other plants were removed with a wheatland disc plow on approximately 7,000 acres in the summer of 1952. Planting of crested wheatgrass and yellow sweetclover (*Melilotus officinalis*) took place in the fall of the same year at the rate of 5.5 pounds and 1.1 pounds per acre, respectively. A flexible harrow drag covered the seed broadcasted with an E-Z flow fertilizer spreader.

A number of annual plants grew in the extremely favorable spring of 1953. Tansy mustard, peppergrass, and Russian thistle attained considerable size during this period and obscured the crested wheatgrass plants. The extremely dry growing season of 1954 caused poor growth of the annual plants. The material produced by Russian thistle in 1953, however, remained on the ground as dry material in 1954 and provided protection from drying winds for the young crested wheatgrass plants. The stand of crested wheatgrass was well established by the fall of that year despite the drought in 1954. Experimental grazing trials commenced in the spring of 1955 and have continued through 1969.

The experimental trials consisted of grazing yearling cattle at three intensities, 50, 65, and 80 percent (light, moderate, and heavy) utilization of the forage supply in each of two seasons, spring and fall. Spring grazing commenced about May 1 and fall grazing started in early September. The grazing period varied between 45 and 56 days in each season. The animals grazed 160-acre fenced areas between 1955 and 1960. Division of the 160-acre pastures in 1960 provided for the addition of spring-fall grazing combinations on 80-acre pasture areas, Figure 1. Abandonment of the light and moderate fall grazing treatments after the 1965 trials provided area for an alternating early and late spring grazing treatment.

General Growth Characteristics of Crested Wheatgrass

In the Raft River Valley, growth of crested wheatgrass generally starts in mid-March to early April. New growth on the first of April averages about 70-85 pounds per acre. Crested wheatgrass stands at lower elevations and on areas with warmer temperatures could be expected to have two or three times this amount of production on the first of April.

Crested wheatgrass herbage accumulates generally at a rate between four and seven pounds per acre per day during April and averages between 200 and 300 pounds per acre the first of May. With adequate moisture and warm temperatures, growth rate may exceed this value and a production as high as 400 pounds of new growth on May 1 has been recorded at Point Springs. With the advent of warmer temperatures in May, the growth rate increases and may be as high as 20 or 25 pounds but averages about 10-15 pounds per acre per day.

With growth generally complete by mid-July, the grass rapidly loses or has lost green color. Growth terminates earlier in a dry year, or, with summer precipitation, continues on into the fall. New green growth develops in the fall of some years when moisture and temperature conditions are suitable. The 150 to 200 pounds of fall growth on crested wheatgrass in 1968, following a moist August, contrasts sharply with the less than 50 to 100 pounds produced in some other years of the study.

The stem apex of crested wheatgrass, near the surface of the ground until early May, elongates rapidly until late May or early June. Heads emerge from the boot in late May or early June and flowering occurs from mid-to late June. With the stem apex intact the stem will continue to grow. Once the stem apex has been removed, that stem ceases to grow and all regrowth must come from buds at the base of the grazed stem. The new stem may or may not produce a seed head. The new growth, often more leafy than the original stem first grazed, has significance in the nutritive value of the forage for fall grazing.

Impact of Climatic Conditions on Growth Characteristics

Climatic conditions during any one year have a decided influence on the growth characteristics of crested wheatgrass. The amount and distribution of April, May and June precipitation largely determines the annual forage production at Point Springs. Air and soil temperatures also influence plant growth during this period of suitable soil moisture.

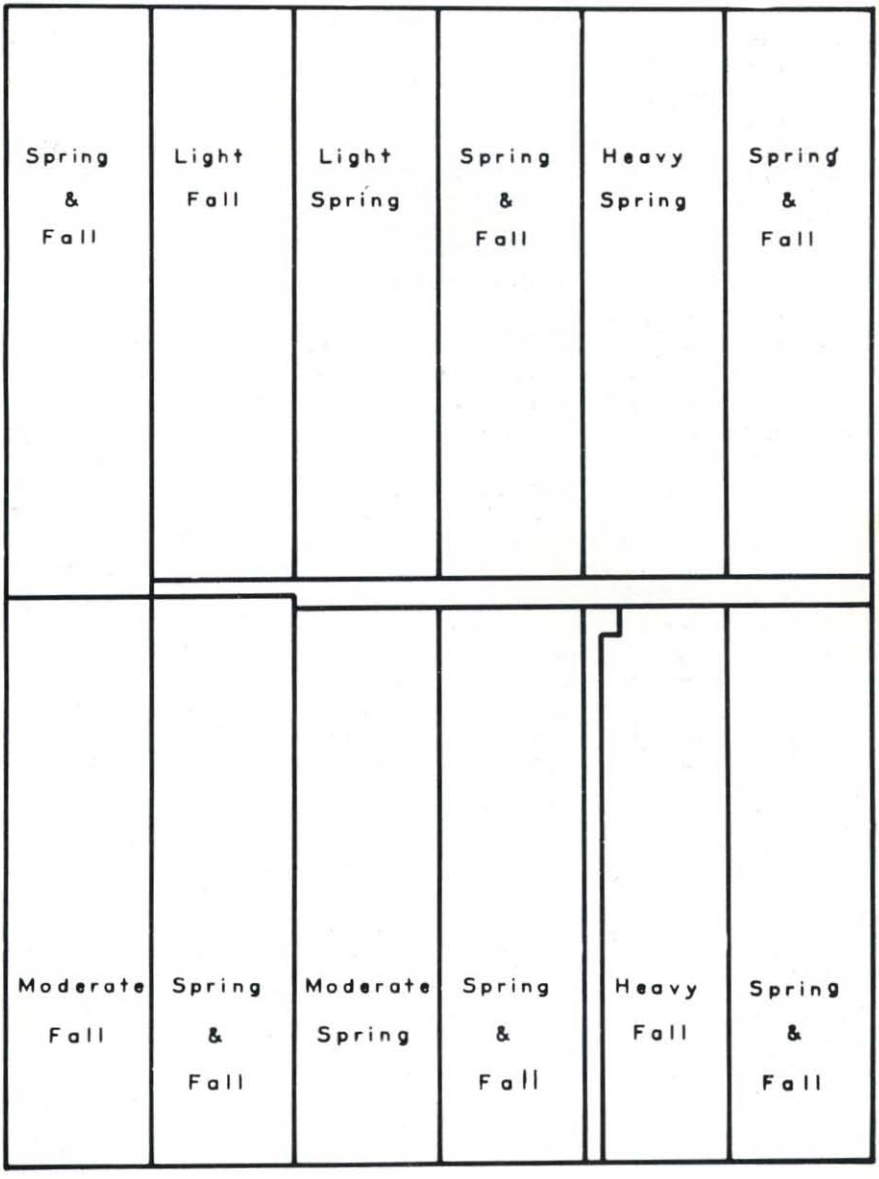


Figure 1. Arrangement and grazing treatment of the 80-acre experimental pastures at Point Springs, Idaho.

Annual production at the Point Springs experimental area averages between 450 and 500 pounds of air dry herbage per acre but has varied from about 880 pounds to 170 pounds per acre over the time of study, Figure 2. Between 70 and 80 percent of this variability in production can be attributed to the amount of precipitation that falls on the area in April, May and June. With accumulated winter moisture generally sufficient during April for plant growth, temperatures largely influence growth rate in this month. The increase in air dry production during April varies from about four to seven pounds per day, Table 2. The generally warmer temperatures in May provide the stimulus for rapid growth if moisture conditions are suitable. The growth rate in 1967 varied between 19 and 25 pounds per day after mid-May. Less than two pounds per day of growth occurred during this period in 1969, Table 2. Lack of moisture rather than unsuitable temperatures limited growth rate in late May of 1969.

Table 2. Growth rate of crested wheatgrass per day at the Point Springs experimental area, 1967-1969.[1]

	1967	1968	1969
	(Pounds per Acre)		
Late March - Mid April	3.6	5.8	--
Mid April - Late April	6.8	0.8	7.3
Late April - Mid May	7.1	4.2	3.4
Mid May - Late May or early June	19.4	9.6	1.4
Late May - Mid June	25.5	--	--

[1]Air dry weight

Impact of Soil Condition on Plant Growth

The relatively shallow soils at the Point Springs experimental area have limited development. Soil areas with high concentrations of exchangeable sodium occur within the less salty areas of soil and range in size from less than one acre to about 15 acres. During years with less than average growing season precipitation, these saline areas have a more stunted herbage growth than the less saline areas. The number and size of the crested wheatgrass plants on the salty areas often decline during or following the dry years. Little or no difference has been observed between the two kinds of soil areas in years with above average growing season precipitation, Figure 3.

Impact of Grazing on Plant Growth

Grazing practices have an influence on stand density, herbage production and nutritive value of the forage produced. The nature and extent of the grazing influence on plant growth vary with weather conditions, soil type, intensity and time of grazing and other factors.

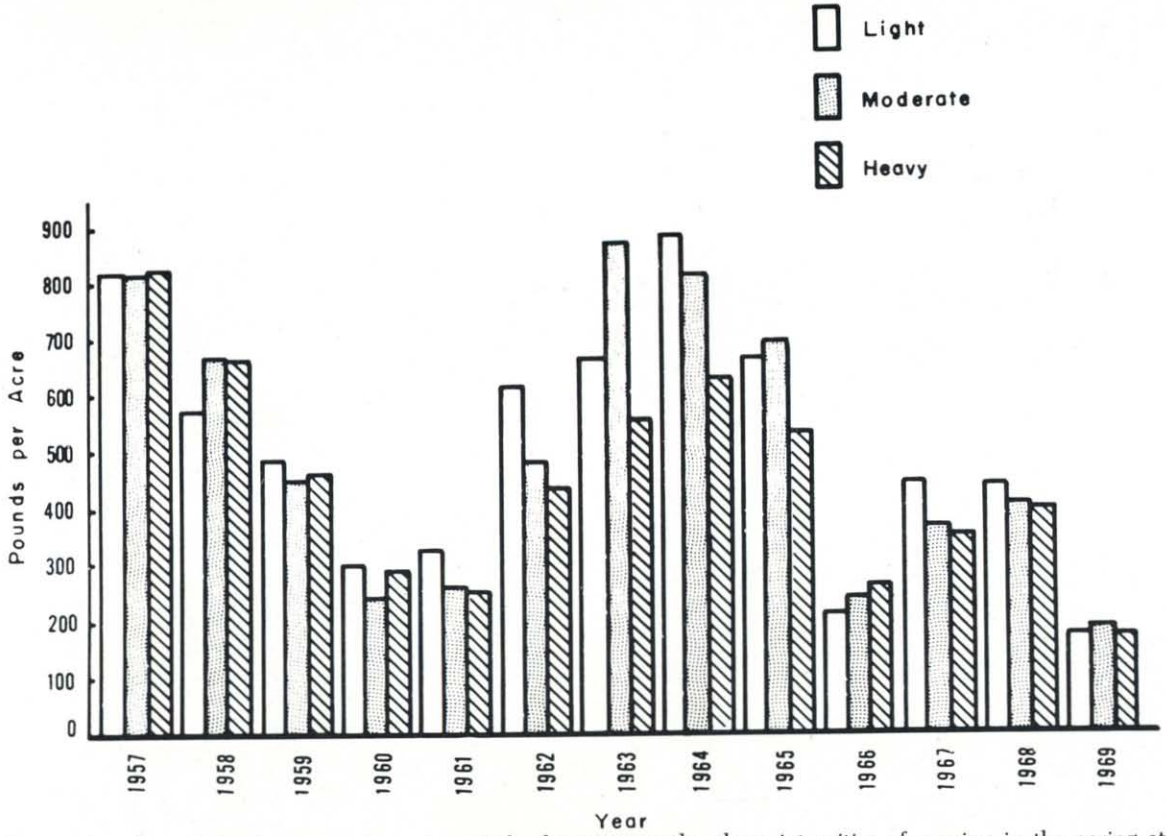


Figure 2. Annual air dry production of crested wheatgrass under three intensities of grazing in the spring at the Point Springs Experimental Area, 1957-1969.

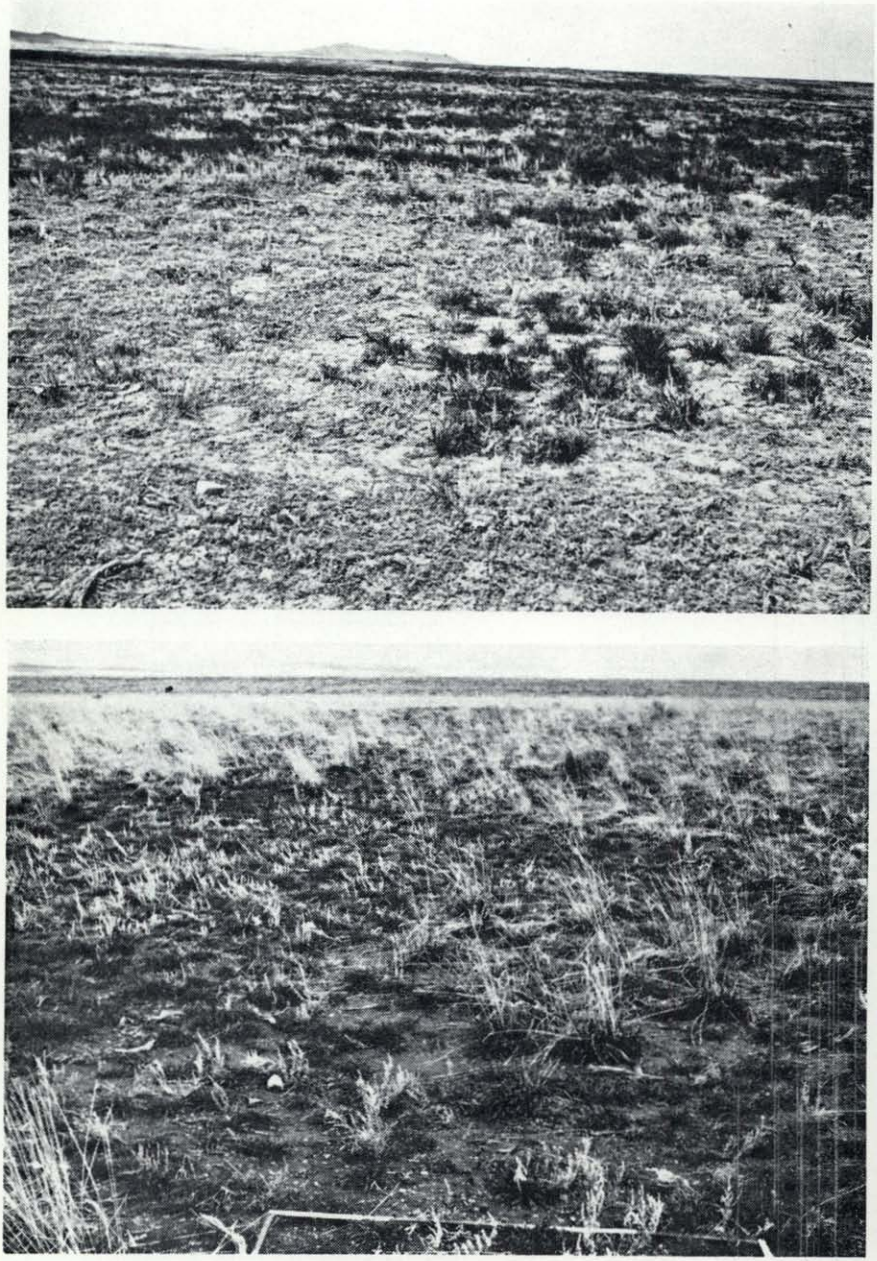


Figure 3. Upper photo illustrates the loss of crested wheatgrass plants on soil areas high in salt concentrations following two years of much below average spring precipitation. Lower photo illustrates the re-establishment of crested wheatgrass plants on the same area following two years with above average precipitation. Upper photo taken May 1, 1962 and the lower photo on May 2, 1964.

Stand Density and Frequency of Occurrence. In general, close cropping of crested wheatgrass for a number of years during the growing season causes a reduction in plant size, a decrease in the number of plants and a less uniform distribution of plants over the area, Table 3.

Table 3. Number of crested wheatgrass plants per square-foot of surface under three intensities of grazing in the spring at Point Springs.

Intensity of use	Year											
	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1968	1969
Light	1.62	1.67	2.02	1.71	1.36	1.27	1.50	1.84	1.84	2.18	1.77	2.34
Moderate	1.35	1.58	2.25	1.82	1.58	1.23	1.29	1.88	2.02	2.34	2.80	2.45
Heavy	1.60	1.66	2.48	1.83	1.40	1.16	1.26	1.75	2.14	2.34	1.98	1.93

Heavy intensity grazing causes the plants to fragment and an apparent larger number of plants per unit area occurs after a few years. As close cropping continues the stand becomes less dense and less uniform in distribution, Table 4.

Table 4. Frequency of occurrence of crested wheatgrass plants in one square-foot sample plots under three intensities of spring grazing at Point Springs, 1955-1969.

Intensity of Use	Year							
	1955	1956	1957	1959	1963	1967	1968	1969
Light	63.5	71.7	73.5	91.5	85.0	87.5	89.0	86.9
Moderate	57.4	67.5	62.6	95.0	79.4	89.4	90.3	92.5
Heavy	58.2	73.2	74.1	92.8	82.8	76.9	80.2	82.2

Fragmentation of plants followed by a decline in the number of plants occurs most rapidly in a series of years with below average precipitation. Plant numbers and frequency declined under all intensities of use during and following the 1960 and 1961 drought. Declines were greater, however, under heavy grazing than light or moderate grazing.

During years of favorable precipitation plant numbers increase and dead plant centers often disappear during these periods.

Impact of Grazing on Nutritive Value. The limited chemical analyses of forage material from the Point Springs experimental area indicate that moderate or heavy grazing in only one season improves the quality of forage available to livestock the following year compared

to light grazing in only one season. This results because of the lower amount of residue carried over to the following year at the heavier intensities of grazing. In 1967, at the conclusion of the spring grazing trials, the crude protein content of the herbage remaining was 11.4 percent in the light use pasture, 11.9 percent in the moderate use pasture and 16.7 percent in the heavy use pasture.

Pastures grazed in the spring and again the fall had a crude protein content of about seven to eight percent in August of 1967 compared to about five percent crude protein for the pasture ungrazed in the spring previous to the fall grazing trials. Spring grazing at light to moderate levels stimulates new tiller development on at least part of the plants in the pasture and this new leafy growth has a higher nutritive value than the ungrazed plants or tillers.

Impact of Grazing on Forage Production. Although climatic conditions appear to have the greatest impact on crested wheatgrass growth characteristics and forage production, previous and current grazing treatments also have an influence.

The three pastures grazed at the three intensities in the spring had similar forage production in 1957. During periods of above average precipitation (1962, 1963, 1964 and 1965), the calculated forage production in the heavy use pasture was below that of the pastures used at lesser intensities. No great difference in forage production occurred among treatments in drier than average years (1960, 1961, 1966 and 1969). When moisture is deficient in May, as in the years indicated, little plant growth occurs during May and consequently, grazing after May 1 has little influence on the annual forage production. Annual production in the heavy grazing intensity pasture averaged about 12 percent less than production in the light and moderate grazing treatments over the thirteen-year period 1957-1969. The reduction in annual production, however, was 36 percent in the favorable growing year of 1963.

Response of Crested Wheatgrass Stands Following a Change in Management Practices

The grazing trials at the Point Springs experimental area show that a stand of crested wheatgrass may persist for more than 15 years under continuous heavy grazing in the spring of the year. This characteristic of crested wheatgrass rangeland provides for flexibility in meeting management objectives.

A portion of the pasture grazed at the heavy intensity in the spring received no grazing use in 1968 or 1969. Prior to the start of the grazing treatments in 1968, similar initial production occurred on the portion of the pasture to be rested and the portion that would continue to receive heavy spring grazing. After one year of rest, the initial production doubled on the rested portion compared to that on the portion grazed heavily the previous spring, Table 5. Almost twice the total production developed in 1969 on the rested area compared to the non-rested area.

Table 5. **Forage production on May 1st and total forage production on an area rested from grazing in 1968 and 1969 after 13 years of heavy grazing compared with an adjacent area continuously grazed heavily for 15 years.**

	Initial Forage Production May 1,		Total Forage Production	
	1968	1969	1968	1969
	(Pounds per Acre)			
Rested in 1968 and 1969	148	166	554	419
Grazed continuously in the spring 1955-1969	141	87	488	219

Data from the Bliss Point Seeding north of Bliss, Idaho show comparative production rates in 1969 of 352 pounds per acre after two years of rest, 400 pounds after four years and 506 pounds per acre after five years of rest from grazing. The extremely poor growing conditions in 1969 may have had an influence on the relative magnitude of the differences that occurred in this year.

The data at Point Springs suggest that similar results can be obtained by alternating the timing of grazing in the spring from early to late season in succeeding years. Although this grazing treatment has been tested for only a short time, a positive response has developed. The pasture used in early spring has sufficient time, in most years, for regrowth following removal of the animals. The regrowth has a relatively high nutrient content for fall grazing and enhances animal production in this period. It is recommended that the pasture grazed in the late part of the spring season not be grazed in the fall in most years. Since animal numbers are allocated on the basis of anticipated forage production in the pasture grazed first, the late grazed pasture has considerable residue remaining at the conclusion of the spring grazing period. In the event that plant growth the following year is slow or limited in development because of weather conditions, animals have a forage supply with which to start the grazing season because of the residue carry-over. In 1969 the pasture grazed first in 1968 and again in the fall had 106 pounds of new growth and 48 pounds of forage residue on May 1. The pasture grazed late in the spring of 1968 had 167 pounds of new growth and 328 pounds of residue carry-over on May 1, 1969.

Stocking Rates for Crested Wheatgrass Pastures

The light intensity of use treatment in the spring has been stocked at an average of 1.5 acres per yearling animal month compared to 1.4 and 1.2 acres per yearling animal month for the moderate and heavy use pastures respectively, Table 6. Translating this to AUM's by assuming that one yearling is 0.6 of an animal unit provides an average stocking rate of 2.5 acres per AUM for light grazing and 2.1 acres per AUM for heavy grazing in the spring period.

Table 6. Stocking rate in acres per yearling animal month and acres per animal unit month for three intensities of use in the spring season 1957-1969.

	Light	Moderate	Heavy
Average			
Acres/Yearling Animal Month	1.5	1.4	1.2
Acres/Animal Unit Month	2.5	2.4	2.1
Range			
Acres/Yearling Animal Month	2.5-0.8	2.3-0.7	1.6-0.7
Acres/Animal Unit Month	4.2-1.4	3.9-1.2	2.8-1.2

Stocking rates have varied from 4.2 acres per AUM under light grazing to 1.2 acres per AUM under moderate and heavy grazing over the years of study.

In the latter years of study, however, the moderate and sometimes the light grazing treatments required fewer acres per AUM than the heavy grazing treatment. This resulted from a relative decline in forage production in the heavy intensity pasture and a larger forage residue carryover in the light and moderately grazed pastures.

It is relatively easy under experimental conditions to vary the number of animals in any year to fit the forage supply or anticipated forage supply of the specific year. It is much more difficult to vary animal numbers if the livestock operation depends on a yearly sustained supply of AUM's of grazing. Some possible alternatives for meeting this problem will be presented later in the paper.

Range Readiness

Animal welfare generally has more importance than other considerations in determining the time to begin grazing on rangeland seeded with crested wheatgrass. This plant species does not suffer to the extent that blue-bunch wheatgrass does by early grazing. The growing point of the stem remains at or below the plant crown level until early May and consequently heavy demands on the organic reserves for the initiation of new tiller growth are not made until this growing point has been removed by grazing.

Most important to the time that grazing starts is the forage supply available. This will vary with elevation, spring and winter weather conditions, previous grazing practices and other local factors. At Point Springs forage production averaged 70-85 pounds per acre about the first of April and growth during the month added four to six pounds per day. If an animal requires about 25 pounds of dry matter per day, each animal unit would have to harvest all the forage from an acre within 3 to 4 days to satisfy the animal's daily dry matter requirement. Assuming that a grazing animal's mouth is five to six inches wide, this "mower" blade would have to travel a distance of about four to five

miles to harvest 25 pounds of dry matter when forage production is 70 to 85 pounds per acre. It is not likely that the animal will be able to satisfy dietary requirements under these conditions.

Animal requirements are more easily met at Point Springs in late April and early May when production is 200-300 pounds per acre and rate of growth is much greater. Substantial amounts of plant residue remaining from the previous year permit an earlier grazing start than if little or no residue is present on the area.

Animal Response to Grazing Treatments

Animal gains and gains per acre at the Point Springs experimental pastures are shown in Figure 4. The values presented are for a six-year period, 1960-1965. Data are available for a longer period of time on most treatments but some change in pasture design in 1960 and a change in some grazing treatments in 1965 limit comparability of all treatments beyond 1965. Data over the longer period, 1957-1969, on the unchanged treatments, however, show that the 1960-1965 data are comparable to the longer term data.

As would be expected, animal gains decline and gains per acre increase with increasing grazing intensity. Animal gains in the spring range between 111 pounds per animal under heavy grazing to 122 pounds with light grazing. Gains per acre in the spring average 48 pounds with light grazing compared to 53 pounds with heavy grazing.

Fall gains per animal varied from 25 pounds with heavy fall grazing only to 34 pounds on pastures grazed the previous spring and again in the fall. Fall gain per acre varied from nine pounds under light grazing to 14 pounds with heavy grazing. Fall gain per acre was least (eight pounds) in the pastures grazed the previous spring.

Of significance in the management of crested wheatgrass rangeland is the higher animal gain in the spring and also in the fall on those pastures grazed both spring and fall. Total gain per acre in pastures grazed spring and fall is comparable to the moderately grazed spring pasture. The less intense spring grazing on the spring-fall pastures maintained stand density and forage production and the combined spring-fall grazing improved the nutritive quality of the forage in both seasons. The combined spring and fall grazing also largely eliminated the problem of "wolf" plants in the pasture area, consequently all plants contribute to the forage supply.

The alternating spring grazing treatment has been tested for such a short time that it is not possible to indicate animal response patterns at the present time.

Some data are available that compare animal gains during various seasons of the year, Table 7. These data have been obtained in a variety of ways and serve only to illustrate comparative gains by each class of animal in the three seasons. For example, in some years, the same yearlings used in the spring grazing trials on the experimental pastures were returned for the fall trials after grazing on privately owned crested wheatgrass range during the summer. One owner has a permit on the large Point Springs seeding for spring, summer and fall use; these animals provide the data on cow and calf gains.

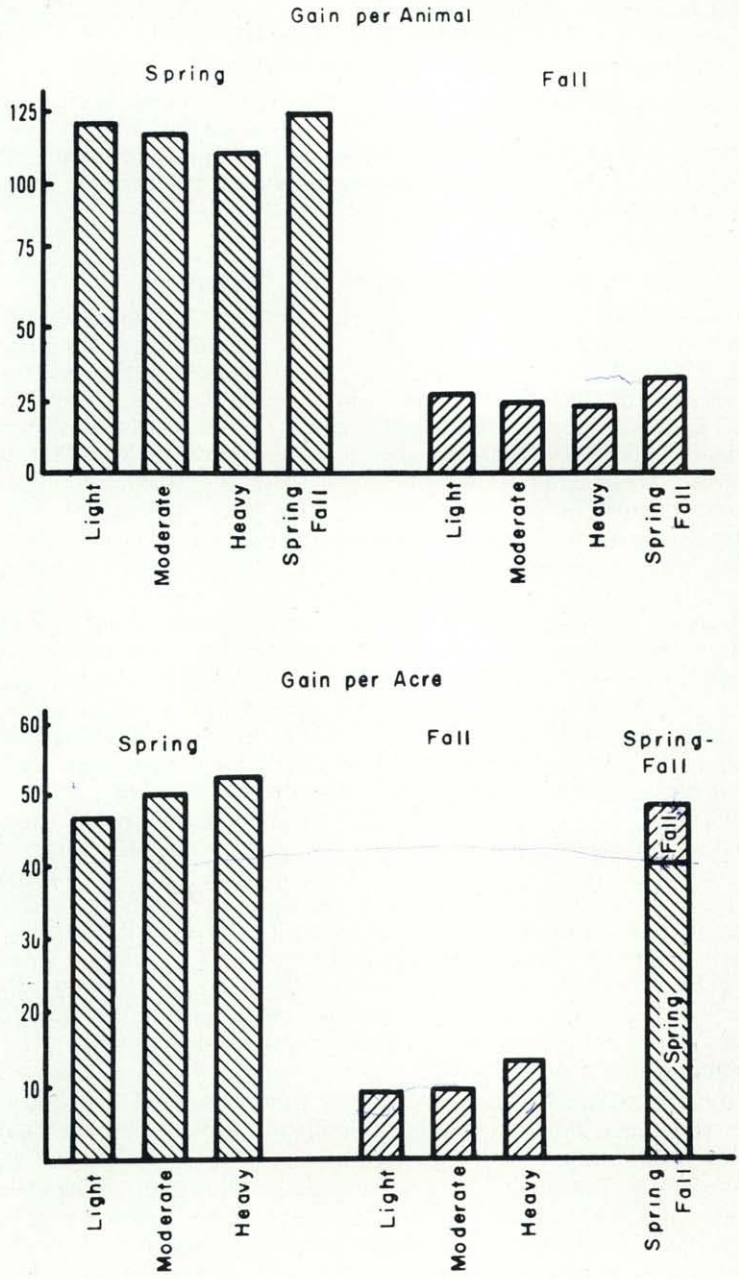


Figure 4. Average animal gain and gain per acre in the spring and fall grazing periods. Data are shown for pastures grazed only in the spring at the three separate intensities and for pastures grazed only in the fall at the three separate intensities. These data are compared with pastures grazed both spring and fall.

Table 7. Average daily gain of cows, calves and yearlings grazing crested wheatgrass at different seasons of the year.[1]

Year	Class of Animal	Gain per Animal per Day		
		Spring	Summer	Fall
1962	Yearlings	2.2	0.7	1.3
1963	Yearlings	2.3	0.7	1.1
1964	Yearlings	2.0	1.1	–0.5
1965	Cows	--	0.2	--
	Calves	--	1.8	--
	Yearlings	2.1	0.9	0.4
1966	Cows	1.4	--	--
	Calves	1.5	--	--
	Yearlings	2.2	1.1	–0.1
1967	Cows	2.4	1.8	–0.1
	Calves	1.7	2.2	1.0
	Yearlings	2.0	1.1	0.6
1968	Cows	0.8	0.2	0.8
	Calves	2.0	1.9	1.5
	Yearlings	2.1	0.8	1.0
1969	Cows	1.9	0.4	–0.4
	Calves	1.6	1.9	1.5
	Yearlings	1.5	1.2	0.7

[1]The spring season is approximately late-April to late-June; summer season is late-June to mid-September; and fall is mid-September to early-November.

Cows have gained between one and two pounds per day in the spring and 0.2 to 1.8 pounds in the summer. Fall gains ranged from a loss of 0.4 pounds to a gain of 0.8 pounds per day. Calf gains ranged from 1.5 to 2.0 pounds per day in the spring and were about two pounds a day in the summer period. Calves ranged in weight from 135 to 200 pounds near the end of April and weighed in excess of 400 pounds about the first of November.

Yearling animals generally gained in the neighborhood of two pounds or more per day in the spring and about a pound per day in the summer. Variations in forage supply, amount of green growth and other factors caused considerable variation in fall gains.

Sufficient green growth of crested wheatgrass occurs in some years to augment the nutritive value of the dry grass and animals respond accordingly. For example, sufficient green growth developed in the fall of 1968 to produce 1.8 pounds per day of gain on yearling animals during the first 28 days of trial. Because of the quantity of green material available in the fall of this year, the yearling animals consumed much greater quantities of forage than normally in the fall. As a consequence, all pastures were overstocked and gains diminished to 0.5 pounds per day during the last 28 days of the trial period. Quantity and not quality of forage became limiting in this case. Green material at the beginning of the fall trials in 1965 was sufficient to produce high animal gains. Cold temperatures–16°F–early in the trial period diminished the nutritive value during the remainder of the trial period. The

lower nutrient content and unfavorable climatic conditions reduced animal gain compared to 1968.

The forage produced in a year of deficient spring moisture is generally of good quality and satisfactory gains are made in the fall providing stocking rates insure the animals an adequate quantity of forage.

Animal response reflects not only forage characteristics, climatic conditions and stocking rate, but also the quality and previous management of the animals. A comparison of yearling cattle of three ownerships show a maximum difference of 72 pounds on April 28, but a difference of 111 pounds per animal on October 31, Table 8. Animals of owner number two were smaller than the animals of owner three, but gained at about the same rate through the period of grazing. All animals grazed crested wheatgrass in the spring and fall. Owner two grazed his animals on crested wheatgrass in the summer, owner one and owner three had their animals on forage other than crested wheatgrass during the summer.

Table 8. Daily gains of yearling cattle of different ownerships at the Point Springs experimental area in 1969.

Owner	Number of Animals	Average weight on April 28	Average Daily Gain			Average weight on October 31
			April 28 to June 23	June 23 to September 4	September 4 to October 31	
			(pounds)			
1	15	556	1.1	0.9	0.5	713
2	14	505	1.7	1.5	0.7	750
3	10	577	1.7	1.3	1.0	824
All	39	543	1.5	1.2	0.7	755

Summary of Information For Use in Developing Management Programs on Crested Wheatgrass Rangeland

1. Crested wheatgrass begins growth early in the spring. New growth at Point Springs averages 70-85 pounds per acre in early April and 200 to 300 pounds per acre in early May.
2. Precipitation in April, May and June strongly influences yearly forage production. Forage production may be four or five times as great in a favorable year for plant growth as in a poor year. New growth may occur in the fall with August and September precipitation. Fall growth generally does not add substantially to the total forage production under conditions existing at Point Springs but nutritive value of the forage is enhanced.
3. Close continuous grazing throughout the growing season causes stand density, uniformity of plant distribution and forage production to decline compared to less intensive spring grazing levels.

4. Early spring grazing followed by removal of the animals prior to the time that moisture becomes limiting on plant growth causes new tillers to develop in some years. These new tillers are more leafy and nutritious for summer or fall grazing. At Point Springs, grazing until about May 20th followed by removal of the animals provides the greatest opportunity for such regrowth to develop.
5. Light spring grazing only of crested wheatgrass causes many of the forage plants to become coarse and unattractive to grazing animals. Nutritive value of the forage is less than under more intensive levels of use.
6. Close grazing in the fall of the year causes growth to start at a later date the following spring and fewer tillers develop on each plant. With some stubble remaining after grazing in the fall, less severe temperature extremes occur in the plant crown during the winter. Favorable spring temperatures for plant growth occur earlier when some stubble remains from the previous year. Moisture relationships for plant growth may be enhanced because of winter snow accumulation in the ungrazed stubble.
7. Light fall grazing diminishes animal production and adds to the "wolf plant" problem in crested wheatgrass stands.
8. Combining some level of summer or fall grazing with light or moderate spring grazing maintains stand density, forage production and increases nutritive value of the forage during all seasons compared to grazing at light or moderate intensities in only one season. Coarseness of the forage plant material and the number of "wolf plants" is diminished with this treatment.
9. Crested wheatgrass stands provide highly nutritious forage in the spring of the year. Yearling cattle gains generally exceed two pounds a day from late April to late June. The reproductive rate of cows and uniformity in size of the calves at weaning time has improved at Point Springs during the years of study.
10. Early grazing of crested wheatgrass is more detrimental to animal production than to plant production and vigor at the Point Spring's area. Soil compaction considerations do not generally limit early grazing.
11. Fifteen years of heavy spring grazing have not destroyed the stand of grass in this treatment area at Point Springs. Forage production has been reduced and stand density has declined, however.
12. Forage production and plant vigor have been restored to heavily used crested wheatgrass stands by resting a year or two, by deferring grazing during the growing season and/or alternating the timing of grazing during the growing season.
13. Because of the growth characteristics, tolerance of heavy grazing and rate at which crested wheatgrass improves vigor and production, a number of alternative grazing programs can be devised. Because of the flexibility that is possible on this forage type, management programs for other kinds of rangeland in the operation are enhanced. Crested wheatgrass vegetation improves the potential for stabilizing livestock numbers and increases the flexibility in manipulating animals to achieve desired objectives.

14. Efficient management programs for crested wheatgrass vegetation requires yearly on-the-ground decisions because of varying climatic conditions, animal needs and program objectives.

Management Programs for Crested Wheatgrass Rangeland

The followilng suggestions for the management of crested wheatgrass rangeland are based on the experience gained at the Point Springs experimental area in southern Idaho. Such programs should be modified to meet changing conditions and resource management objectives.

One Unit Grazing Management

If the type of grazing program requires that the same area be grazed about the same time of year every year, stocking rate should be at some moderate level. On the Point Springs seeding this would be about 2 to 3 acres per animal unit month when grazed from approximately May 1st until the desired level of use is achieved. A higher stocking rate may be possible when the grazing capactiy is obtained by grazing fewer animals for a longer period of time. This approach provides the plants a greater leaf surface area to function in plant growth during the growing season. A higher concentration of animals for a shorter period of time will lower forage production approximately 20-30 percent and thus require more acreage to achieve the desired animal production.

When the area is to be used both spring and fall as a source of forage for livestock, stocking at a rate of 3 to 4 acres per animal unit month in the spring will normally leave adequate forage for fall grazing. The quality of fall forage is enhanced nutritively by regrowth that occurs during the spring period. In most years at Point Springs, animal gain and gain per acre in the fall is much improved in those pastures grazed as indicated above in contrast to pastures grazed only in the fall. Stand vigor and plant density have been maintained under this program of management. Fall stocking rate can be adjusted, in numbers or time, to remove the desired amount of forage. With fall grazing, the development of "wolf plants" is minimized or eliminated.

This program of grazing management provides stability for the livestock operation primarily through a stocking rate that can be accommodated in the driest years experienced at Point Springs. In years with below average growing conditions, the amount of fall grazing may be reduced by selling early or providing additional feed or forage areas. Fall grazing may be increased by staying longer and/or holding calves longer in years of above average production.

Two Unit Grazing Management

A two unit crested wheatgrass range area provides more flexibility in manipulating animals to attain optimum forage production and consequently optimum animal output. With a two unit area, one unit is grazed

early one year and late the second year. The sequence of grazing, i.e. early and late, is alternated on the two units in a two year pattern. The unit grazed early one year will be grazed late the next year and vice versa.

Under this program, grazing should stop on the field grazed late when about one-half of the forage is used. The unused forage will provide material that can be utilized the next year when this unit is grazed early in the spring. Initial growth will be greater and more rapid on this unit than on the field grazed early the previous year and again in the fall. The unit grazed first in 1968 and again in the fall of that year had produced 106 pounds of new herbage on April 26 in 1969 contrasted to 167 pounds of new forage in the field grazed late in the spring of 1968. A field deferred from grazing in 1968 after 13 years of heavy spring grazing had an initial production of 165 pounds of new herbage compared to 82 pounds on the unrested adjacent area.

The field grazed early may be used again later, or in the fall, if regrowth has occurred. This provides good quality fall forage and animals respond well to this treatment.

Stocking rates can generally be somewhat higher than under continuous grazing. In years of below average precipitation, the production in the unit grazed second is known at the time grazing starts and the livestock operator has time to make required adjustments. With the two unit system and recognizing the fact that crested wheatgrass will tolerate at least a year or two of severe grazing, drastic adjustments in animal numbers should not be necessary. Adjustments in timing of use can be made to restore vigor to the units in those years of average or above average growing conditions. Such adjustments must be based on field examination and requires application of the art of range management.

Three or Four Unit Grazing Management

More intensive management and greater flexibility in the alternatives of management programs are provided with three or four units that are fenced separately. Under a grazing program of this type, one unit each year is deferred from grazing through the growing season. The unit deferred is alternated among the three (or four) units each year so that once in three (or four) years each unit is deferred during the growing season. The other units are alternated between early and late grazing during the growing season so that no unit is grazed at the same time of the season in successive years.

Stocking rates on the Point Springs seeding have been about 2 acres per AUM during the four years that a four unit program has been tested. Stocking rate on these pastures used in the spring is between 3 and 4 acres per AUM depending on forage production and 1½ to 3½ acres per AUM in the fall. Almost any degree of grazing is permitted in the fall except on the deferred unit. About one-half of the forage is left as carryover until the next spring when this unit will be grazed first.

Adjustments can easily be made in this program as required by climatic conditions, animal requirements and changing management objectives.