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REST-ROTATION GRAZING AT HARVEY VALLEY--range health, cattle gains, economics.

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## INTRODUCTION

One objective of Forest Service range management is to provide economic stability to livestock operations and rural communities that depend upon rangelands for support. Mountain rangelands of northeastern California produce forage for livestock during a four to five month season--the season when forage, at home, on foothill ranges of the Sacramento Valley is dry and of lower grazing value. These mountain rangelands also support deer and antelope and are important as producers of timber, water, and recreation. Therefore, these ranges should be managed on an ecologically sound basis.

The history of early grazing (1870 - 1906) suggests that range management was not ecologically sound. Rather, rangelands of northeastern California were badly mismanaged. Overstocking led to overgrazing of the range which, with improper seasonal use, resulted in severe deterioration of the range resource (Hormay[1/] and 74th Congress, 1936).

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1/ Hormay, A. L. Management and study plan--Harvey Valley Experimental Range. 1954 (Rev. 1956). (Unpublished report on file at Pacific S. W. Forest and Range Exp. Sta., U. S. Forest Service, Fresno, Calif.)

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An improved livestock grazing management system was needed to arrest and then reverse the down-trend in range condition, increase range livestock production, and enhance other range values. Many range allotments were badly in need of such help, and the Harvey Valley allotment was no exception.

Traditionally, these mountain rangelands were (and most still are) grazed by the free choice system (hereafter referred to as the season-long system). Cattle were brought to the summer range as soon as snow conditions permitted. They were left to graze the range at will (free choice) during the summer and then gathered for the drive home just before the fall storms.

Little attention was paid to the factors by which livestock grazing is managed: (a) stocking rates; (b) season of use; (c) livestock distribution and (d) frequency of use. A range will improve or deteriorate and livestock production will be efficient or inefficient depending on how these four factors are manipulated. All other factors that affect grazing management are generally beyond the control of the range manager or ranch operator.

After establishment of the National Forests in northeastern California major efforts were made toward obtaining moderate use of the ranges. The stocking rates were gradually reduced, the seasons of use were shortened, and techniques of improving livestock distribution were employed. However, the ranges continued to be grazed by the season-long system. These efforts gave some improvement in range condition in those areas not preferred by livestock. But the preferred grazing areas did not improve. [To increase range livestock production and enhance other range values, ranchers and managers needed an improved livestock grazing management system.]

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## THE HARVEY VALLEY AREA

Harvey Valley and nearby allotments are in the southern Cascades on the Lassen National Forest, California. The region has broad valleys with fairly level lowlands and terraces between volcanic peaks (Figure 1). Elevations vary from 5,600 feet to around 7,500 feet.

Climate.--Rather dry summers and cold wet winters with considerable snowfall characterize the climate. Summer precipitation accounts for less than three percent of the yearly mean of 18.4 inches (Ratliff and Keppert, 1965). Twenty percent of the annual precipitation comes in fall and a similar amount in spring. Winter provides 57 percent of the annual precipitation. Shortages in seasonal and yearlong precipitation occur often. Drought conditions were present in the area in one-third of the years from 1935 through 1963. During this same period of years, spring drought occurred 54 percent of the time.

Average monthly air temperatures are usually below freezing during November through February, at or near freezing in March, and above freezing in all other months. Hormay and Talbot (1961) reported a low of -27 deg. F in January 1937 and a high of 98 deg. F in July of 1946.

Figure 1.--Broad, level lowlands and volcanic peaks are typical of the Harvey Valley area. View across Harvey Valley, 6-15-67.

Soils.--Soils of the area are quite diverse. They range in thickness from a few inches to 5 feet and more. Surface textures vary from loamy sand in the higher areas to clay in the lower areas. Calcareous hardpans developed in some soils a few inches to two feet or more below the surface. Soils on the slopes of the mountains are primarily residual. These residual soils have formed from two ages of parent rock: Pleistocene and recent basalt. Soils on the lowlands formed over ancient lake and more recent alluvial deposits.

and Vegetation[2/] --Meadows have formed in the drainage bottoms. These meadows are watered by winter snows and spring runoff. Some are fairly well drained, while ephemeral lakes form on others in spring. Most meadows are on moderately deep to deep soils; however, hardpans are present in some soils of the ephemeral lake sites.

The silver sagebrush (Artemisia cana) type grows slightly above the meadows. Often the areas are covered with water early in spring. Here the most important grasses are Nevada bluegrass (Poa nevadensis) and bottlebrush squirreltail (Sitanion hystrix). Soils of the silver sagebrush type are generally dark in color and moderately deep. They may occasionally have a hardpan at moderate depth.

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2/ Scientific names of plants referred to follow, A California Flora, by P. A. Munz and D. D. Keck, 1959. Univ. of Calif. Press, Berkeley, and Los Angeles.

The black sagebrush type (Artemisia arbuscula) usually occupies an intermediate position between the silver and big sagebrush types (Artemisia tridentata). Soils under black sagebrush are usually very shallow and often have a calcareous hardpan. This type of soil is generally the least productive of forage and has the least potential for improvement. The most abundant grasses on these areas are Sandberg bluegrass (Poa sandbergii) and bottlebrush squirreltail. However, we do find some Idaho fescue (Festuca idahoensis), western needlegrass (Stipa occidentalis), and Junegrass (Koeleria cristata).

Big sagebrush occupies fairly deep, well-drained soils. Idaho fescue, bottlebrush squirreltail, Sandberg bluegrass, and various needlegrasses are the principal grasses in this type. Ross sedge (Carex rossii), an important grasslike plant, occurs here and is well liked by cattle.

The open grassland type, sometimes called the shorthair sedge (Carex exserta) bunchgrass type, occupies a physiographic position very close to that of big sagebrush. The two types often blend together and the soils are similar. Shorthair sedge often dominates this vegetation type. However, bunchgrasses may dominate some areas even to the exclusion of shorthair sedge.

On the lower slopes of the mountains there is ponderosa pine (Pinus ponderosa), big sagebrush transition type. Idaho fescue, various needlegrasses, and bottlebrush squirreltail are the major components of the forage in most of this ecotone. Soils are usually moderately shallow to a fractured bedrock. They produce a good growth of forage where tree canopy and needle layers are not too heavy.

In the pine type proper the slopes are steeper than on the ecotone. However, the soils are very similar in depth, texture, and color. Where the canopy is open, good forage is produced. Perennial bromes (Bromus) grow in some abundance on the higher elevations of this type.

In the fir (Abies) type, important forage plants include brome, bottlebrush squirreltail, and needlegrasses. Openings are often occupied by big sagebrush, and greenleaf manzanita (Arctostaphylos patula) may form dense stands on burnt areas.

Additional information on soils and vegetation of the area was presented by Hormay and Talbot, 1961.

History.--Records of livestock use on the Harvey Valley allotment start in 1870. From then until 1906, when the Lassen National Forest was established, around 7,200 "animal" months (one animal month equals one 1,000 pound cow grazing for one month) of grazing were obtained from the allotment each season. Except for a temporary increase during World War I, after 1906 stocking rate and season of use were gradually reduced. However, health of the range continued to decline. By 1951 only one-third of the "animal" months of grazing obtained in the late 1800's were being obtained from Harvey Valley (figure 2). Nearby allotments have a similar history of early use and reduced grazing capacity.

Rest-rotation grazing was started in 1954 on the Harvey Valley allotment. Preparations for using the system and control of grazing were begun in 1951. 1950 Harvey Valley was the first allotment to be placed under a rest-rotation system of grazing. Nearby allotments have continued to be grazed under a season-long system.

Figure 2.--Grazing use on Harvey Valley Allotment, 1906-1965.

## REST-ROTATION GRAZING PRESCRIPTION

Research by Hormay and Talbot (1961) at the Burgess Spring Experimental Range led to development of the rest-rotation system of grazing management. This system controls all four factors by which grazing is managed and is intended to provide for both ecological and cultural range improvement.

The basic principles of rest-rotation grazing ~~are~~ were covered in detail by Hormay (1970). They may be stated as follows:

(1) A major cause of range deterioration is selective close grazing of plants and range areas in similar yearly patterns of use;

(2) the only effective way to control this selective grazing by livestock and counter its harmful effects is to rest these areas from grazing at appropriate intervals.

(3) To encourage maximum rate and degree of improvement in range condition, the exact prescription of rest and grazing must be correlated with the growth and reproduction requirements of the key species of a specific range or allotment.

The Harvey Valley allotment (consisting of 34,775 acres) was cross-fenced into five range units of about equal capacity. The prescription of rest and grazing--keyed to the requirements of Idaho fescue--called for each range unit to be rested two full grazing seasons out of five. In addition, two half seasons of rest and a full season of use were planned for each range unit.

Following a full season of use, a given range unit was rested a full season to permit recovery of plant vigor. The third season the unit was rested until midseason to permit plants to ripen seed and then fully grazed in order to trample seed into the soil and maximize forage utilization and livestock production. During the fourth year of the rotation, the range unit was rested to permit seedlings to become established. The range unit was grazed moderately to midseason and rested the second half of the fifth season as a further aid to seedling establishment. In the sixth year the unit was again grazed season-long to maximize forage utilization and livestock production.

The prescription provided for emergency use of those range units scheduled for rest. Their use was permitted in years of low forage production, thus assuring ample feed for the cattle for the full grazing season.

From 1954 through 1962 the season of use on Harvey Valley was June first to September 30. Since 1963 the closing date has been October 31. However, during the period of study there was no increase in the animal unit months of grazing obtained from the allotment.

## EXPECTED RESPONSES AT HARVEY VALLEY

Rest-rotation grazing management and the improvement program for Harvey Valley were expected to double the grazing capacity in 20 years, or by 1974 3/. This increase was to come from three sources: (a) the management system (43.4 percent), (b) cultural practices (42 percent), and (c) logging (14.65 percent).

Specific changes in plant, soil, and stand characteristics were expected to produce an improved condition and greater grazing capacity.

Plant characteristics:

1. Greater vigor of established plants as indicated by size of plant parts.
2. Greater seed production.
3. Better plant nutrient status.

Soil characteristics:

1. Increased litter cover and decreased exposed bare soil.
2. Faster water absorption and lower soil compaction.

Stand characteristics:

1. Increased cover percentages for desirable species.
2. Improved species composition, indicating a higher successional stage.
3. More seedlings of desirable species.

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3/ Hormay, A. L. 1954 (Rev. 1956). (Unpublished report on file at Pacific Southwest Forest and Range Exp. Sta., U. S. Forest Service, Fresno, Calif.)

In addition, it was expected that the rotation of grazing would permit accomplishment of spraying and seeding without requiring periods of non-use on Harvey Valley. Seedings were expected to be maintained without special fencing to separate them from areas of native range.

## NEED FOR ADDITIONAL STUDY

From 1954 through 1962 efforts by the Forest Service to evaluate the effectiveness of rest-rotation grazing were largely confined to Harvey Valley. Collection of comparable data from other allotments--although originally planned intended--was not accomplished due to lack of adequate funding. ?

Only by making comparisons with other ranges would it be possible to learn whether rest-rotation grazing was doing the job for which it was designed; specifically, to improve range health while at least maintaining an acceptable level of livestock production. Therefore, from 1963 to 1966 ~~considerable~~ Special effort was made to evaluate the effects and value of rest-rotation grazing as used at Harvey Valley.

This paper reports an evaluation of (a) comparative range health and apparent condition trends between Harvey Valley and nearby allotments; (b) cattle weight gains; and (c) economics of rest-rotation grazing on the Harvey Valley allotment.

## COMPARATIVE RANGE HEALTH AND APPARENT CONDITION TRENDS

Rest-rotation was in full operation at Harvey Valley near the end of a period of abundant precipitation. The status of range condition in Harvey Valley and the apparent condition trends, relative to neighboring allotments, were determined after the most severe period of drought since 1936 (Fig. 3). Prolonged, severe drought is not conducive to range condition improvement. This drought is a prime reason why the range resource may have made slow response to rest-rotation at Harvey Valley.

## METHODOLOGY AND LOGIC

Following the system described by Ratliff and Reppert (1966), twenty-six pairs of plots--1/4 or 1/2 acre in area--were located on sites on Harvey Valley and nearby allotments.

Plots were located in several "natural" vegetation types within Harvey Valley and four other allotments. They were grouped by two positions--boundary and interior. The boundary pairs were usually within 100 yards of each other and placed to avoid unusual cattle concentration areas or pathways along fence lines. The interior pairs were one to several miles apart.

Figure 3.--Chance of drought (precipitation less than 85% of the longterm average) in any 5-year period, Hogard Area, Lassen National Forest, 1935-36 through 1965-66.

Two assumptions were made. First, given the same management, the site capability of either member of a pair of comparable plots was the same for producing a general community of plants. Second, both members of a pair of study plots were presently producing a quantity of herbage and a quality of plant community at some unknown degree below their natural capabilities. Given these assumptions, differences between the members of a pair of comparable plots in factors reflecting the goals of rest-rotation grazing provided an assessment of conditions on the plot under rest-rotation relative to conditions on the plot grazed season-long.

Determining relative range condition for each pair of plots was done by asking a series of questions, which were restatements of expected goals of rest-rotation grazing management.

Differences in relative condition on comparable plots were used as an estimate of apparent trend--what the trend appeared to be--on those plots under rest-rotation. But to do so it was necessary to make two additional assumptions. First, the grazing program and range condition were essentially the same on a pair of plots at the time rest-rotation grazing was started in 1954 on the Harvey Valley allotment. Second, the trend in range condition had been near static after 1954 on nearby allotments under season-long use. Statements implying actual responses of plants and other factors are also based upon these assumptions.

## RELATIVE RANGE CONDITION

A relative condition score was developed for each plot pair test. Using a 100-point maximum rating, nine major condition characteristics were rated as follows: basal cover 25 points; plant vigor 20 points; nearest plant composition 15 points; litter cover and yield 10 points each; and bare soil, water absorption, soil compaction, and perennial grass seedlings 5 points each. The points were apportioned on the basis of ecological, management and sampling intensity considerations. The individual plot scores (Table 1) were arrived at by assigning a number of points for each characteristic to each member of a plot pair and then summing the points for all nine characteristics.

The points given for a particular characteristic depended upon the percentage of counts of significant differences in the characteristic favorable to each plot. For example, plant vigor was assessed using five factors. Let us say that four of the differences between a pair of plots favored Harvey Valley and one the nearby allotment. Then, 16 points were given to the Harvey Valley plot and four to the other plot.

This type of relative score, presented for each plot, does not indicate absolute or true range condition. Instead it amplifies the important and significant differences between plot pairs--differences that show whether a given plot is in better or worse condition than the plot it is compared to.

Table 1.--Relative range condition scores of 26 pairs of comparable plots and average scores by major vegetation types--based on a 100 point, 9 characteristic rating system.

(Harvey Valley Evaluation, 1954, 55, 56) 64, 65, 66)

| Major Vegetation Types | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pine-bunchgrass | | | Open grassland | | | Open shrub-grass | | | Meadow | | | |
| Plot Pair | Harvey V. Plot | Other Plot | Plot Pair | Harvey V. Plot | Other Plot | Plot Pair | Harvey V. Plot | Other Plot | Plot Pair | Harvey V. Plot | Other Plot | |
| 4 | 9.5 | 30.5 | 16 | 71.2 | 13.8 | 2 | 57.1 | 27.9 | 49 | 77.7 | 12.3 | |
| 12 | 38.8 | 36.2 | 25 | 82.9 | 17.1 | 3 | 26.9 | 48.1 | 70 | 56.9 | 38.1 | |
| 13 | 83.7 | 6.3 | 41 | 55.1 | 14.9 | 17 | 64.6 | 10.4 | 78 | 38.4 | 51.6 | |
| 14 | 43.3 | 41.7 | 47 | 63.7 | 21.3 | 18 | 33.6 | 41.4 | 82 | 52.9 | 37.1 | |
| 15 | 51.7 | 33.3 | 64 | 78.0 | 22.0 | 71 | 43.9 | 36.1 | Av. | 56.5 | 34.8 | |
| 19 | 71.7 | 8.3 | 79 | 64.3 | 20.7 | 72 | 28.3 | 61.7 | | | | |
| 20 | 67.6 | 12.4 | 80 | 57.3 | 22.7 | Av. | 42.4 | 37.6 | | | | |
| 21 | 53.5 | 21.5 | Av. | 67.5 | 18.9 | | | | | | | |
| 81 | 56.0 | 24.0 | | | | | | | | | | |
| Av. | 52.9 | 23.8 | | | | | | | | | | |

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At is instructive to note the scores of plot pairs 17 and 72. Plot pair 17 is on a silver sagebrush site which is heavily grazed under both systems of grazing. Plot pair 72 is on a less productive, more lightly grazed big sagebrush site. Hence, while the 2% open shrub-grass type hasn't done as well, the more productive sites within the general type apparently are improving under rest-rotation grazing.

Relative range condition scores (Table 1) were higher for the plot under rest-rotation in 21 or 81 percent of the 26 comparisons. Scores were higher under rest-rotation for all seven grassland plot pairs, and the average score of the season-long plots was only 28 percent of the average score of the rest-rotation plots. Only plot pair four in the pine-bunchgrass type scored higher for the season-long member. Eight others were higher under rest-rotation, and the average score of the rest-rotation plots was twice as large as for season-long grazing. Plot pair 78 (undrained basin site) scored lower for the Harvey Valley member. The other three meadow pairs scored higher for the plot under rest-rotation, and the average score for the season-long plots was 62 percent of that for meadows on Harvey Valley. Half of the scores for the open shrub-grass type were higher for the season-long members of the plot pairs. The average score of the season-long plots was 89 percent of the score for the plots under rest-rotation. Thus, the open grasslands have apparently made greatest gains in relative range condition under rest-rotation, followed by the pine-bunchgrass and meadow types. [While the open shrub-grass type apparently hasn't done as well, it is instructive to note the higher score under rest-rotation for plot pair 17. This pair is on a silver sagebrush site which is heavily grazed under both systems of grazing.]

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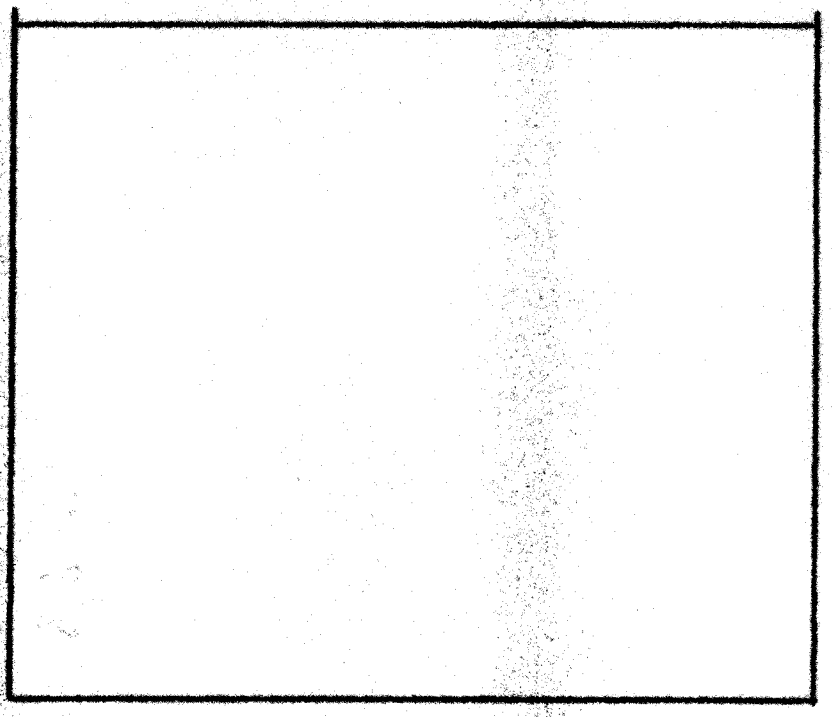
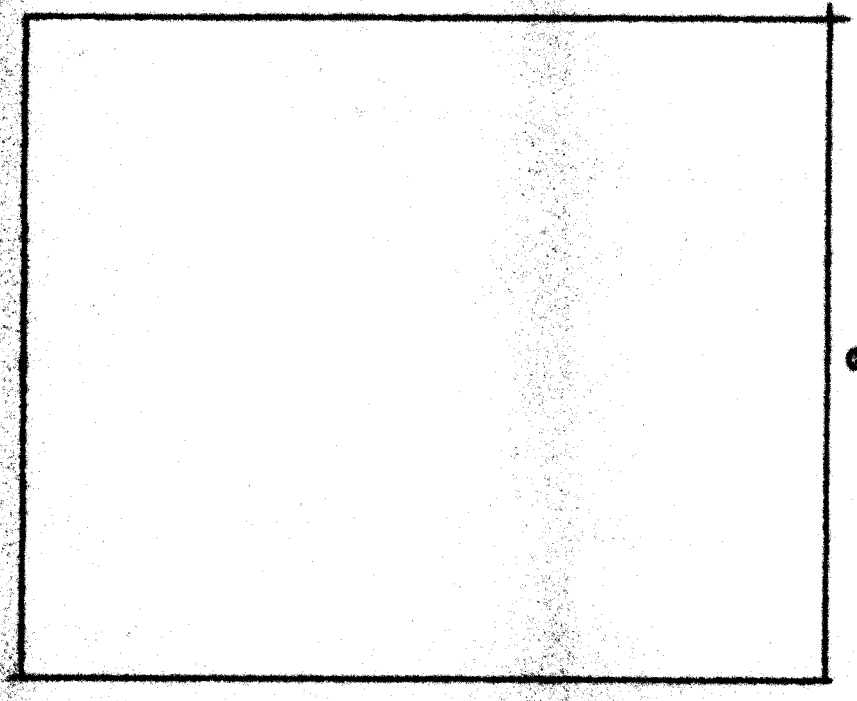
Higher basal cover values (particularly for Idaho fescue) and lower bare soil values are very apparent on the Harvey Valley member of plot pair 79 (Fig. 4).



Harvey Valley
Plot 79



Grays Valley
Plot 79

Figure 4.--Comparable plot pair 79, open grassland type--September 9, 1965.

## APPARENT TREND IN RANGE CONDITION

The plots under rest-rotation along the boundary with the Champs Flat allotment--where fence was put in at the start of rest-rotation--were generally in better condition than their pairs, indicating an improving range condition on the Harvey Valley allotment. There are seven plot pairs along this boundary, and for six of them the relative condition scores (Table 1) were higher for the plot under rest-rotation. The average score (Table 2) of the plots grazed season-long was about one-third as large as the average score of the plots under rest-rotation. Only on plot pair 18 was the relative condition score higher for the plot grazed season-long, and the score for the Harvey Valley plot was 81 percent as large.

Different patterns and duration of season-long use may have resulted in different conditions along the other boundaries and in the interiors of the allotments by the time rest-rotation was started. Still, apparent trend in condition on most of the plots under rest-rotation is upward. Only two of the other eight boundary plot pairs had higher relative condition scores on the season-long plot. Average relative condition scores along the Lower Pine Creek and Gray's Valley boundaries (Table 2) for season-long plots were 50 and 70 percent, respectively, as large as the scores for plots under rest-rotation.

Only two interior plot pairs had higher relative condition scores on their season-long members. For all 11 interior plot pairs the average score (Table 2) of plots under season-long grazing was 53 percent as large as the score of plots under rest-rotation.

Table 2.--Average relative range condition scores of comparable plot pairs[1] by location

| Location | Grazing Treatment | | Number of plot pairs |
|---|---|---|---|
| | Rest-rotation | Season-long | |
| Champs Flat | 59.5 | 20.6 | 7 |
| Lower Pine Creek boundary | 55.3 | 28.1 | 3 |
| Grays Valley boundary | 43.0 | 30.0 | 5 |
| Interior of allotments | 57.4 | 30.3 | 11 |

1/ Individual scores are given by plot pair in Table 1.

Thus, except for five of the 26 pairs of plots, evidence indicates an upward apparent trend in range condition on the Harvey Valley allotment. This is not to say that condition trend is down on neighboring allotments; it may in fact be up. If so, not as much as on Harvey Valley.

Condition trend was apparently down on Harvey Valley between 1956-57 and 1962-63 as indicated by results from condition and trend transects[4/]. This appears to contradict results from the comparable plots. However, if condition trend was down between 1956-57 and 1962-63 on Harvey Valley, and now relative to neighboring allotments Harvey Valley is in better condition, this is important. It indicates that the Harvey Valley allotment was not hurt as much by the drought of 1959-60-61, and/or was able to recover and respond more rapidly with good years, or was in better condition by the start of the drought than the neighboring allotments. With either or a combination, progress in improving range condition is being made at Harvey Valley.

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4/ Unpublished data on file at Pacific Southwest Forest and Range Exp. Sta., Fresno, California.

## Results of Supporting Studies

Plant vigor was found by taking five measurements--vegetative shoot length and weight, seed stalk length, and seedhead length and weight--made on important species.

Idaho fescue vegetative shoot weight and length were 16 and 26 percent greater on the Harvey Valley plots (Table 3). Length of both seed stalks and seedheads were significantly greater under rest-rotation. However, there was no difference in the weights of the seedheads. Results of regrowth studies using plant cores showed that some Idaho fescue plants have a better supply of root reserves on Harvey Valley than on season-long allotments. Thus, rest-rotation grazing has resulted in improved vigor of the key forage species.

The vegetative shoots of Western needlegrass were 15 percent longer and 26 percent heavier (Table 3) under rest-rotation. While there were no differences among the other factors, the results indicate a favorable response to the management system.

Table 3.--Differences in plant vigor indicators for Idaho fescue and Western needlegrass under rest-rotation (RR) and season-long (SL) grazing.

| | Plant Vigor Indicator | | | | |
|---|---|---|---|---|---|
| | Vegetative shoot wt. (mg.) | Vegetative shoot length (ft.) | Seed head length (ft.) | Seed stalk length (ft.) | Seed head wt. (mg.) |
| | Idaho Fescue | | | | |
| Average size of indicator (RR) | 100.07 | .52 | .36 | 1.80 | 222.92 |
| Average size of indicator (SL) | 79.03 | .45 | .34 | 1.74 | 220.16 |
| Average difference[1/] (RR-SL) | 21.04*** | .07*** | .02*** | .06** | 2.76 |
| | Western Needlegrass | | | | |
| Average size of indicator (RR) | 195.00 | .54 | .91 | 1.40 | 480.22 |
| Average size of indicator (SL) | 143.96 | .46 | .87 | 1.38 | 492.06 |
| Average difference (RR-SL) | 51.04* | .08*** | .04 | .02 | -11.84 |

[1/] * = Average diff. significant at the 80% level of probability by paired t test.
** = Average diff. significant at the 90% level of probability by paired t test.
*** = Average diff. significant at the 95% level of probability by paired t test.

Perennial grass seedlings were more plentiful under rest-rotation grazing in 1965--a bumper seedling year both in and around Harvey Valley. Of 19 upland plot pairs examined in 1965, 11 had significantly higher seedling frequencies for the plot under rest-rotation. Only two had higher frequencies for the plot under season-long grazing, and for six there was no difference in seedling frequency. The average difference in seedling frequency between upland plot pairs (2.05 more seedlings under rest-rotation per 100 nearest plant observations) was significant by chi-square test at the 95 percent probability level. Thus, the data indicate that--given a good seedling year--more perennial grass seedlings are likely in upland areas under rest-rotation, increasing the chance for new plants to become established.

Herbage yield results, from ten of the comparable plot pairs, indicate yield of herbage increased under rest-rotation grazing (Table 4). In eight of the plot pair tests, herbage yield averaged 288 pounds per acre (25 percent) greater on the Harvey Valley plots. On open grassland and open shrub-grass plot pairs, yield under rest-rotation was one-third more than the yield under season-long grazing. For meadows yield was about one-fifth more under rest-rotation. All ten plot pairs considered (Table 4), yield under rest-rotation was 18 percent greater than under season-long grazing.

Table 4.--Differences in herbage yield, litter, bare soil, water absorption, and soil compaction under rest-rotation (RR) and season-long (SL) grazing.

| Item | Herbage yield (lbs/ac) | Litter cover (Percent) | Bare soil (Percent) | Water absorption (min/inch) | Soil Compaction | |
|---|---|---|---|---|---|---|
| | | | | | Spring (psi) | Fall (psi) |
| RR | 1,238.2 | 53.8 | 21.8 | 6.1 | 283.6 | 432.9 |
| SL | 1,050.9 | 46.4 | 28.9 | 7.0 | 297.5 | 484.1 |
| Diff. (RR - SL)[1/] | 187.3** | 7.4*** | -7.1*** | -0.9*** | -13.9 | -51.2* |

1/ * = Significant at 80% level of probability by paired t test.

** = Significant at 90% level of probability by paired t test.

*** = Significant at 95% level of probability by paired t test.

Assuming equal range condition at the start of rest-rotation, the yield data provides an estimate of the present grazing capacity of the Harvey Valley Allotment. In 1951, the estimated grazing capacities for the open grassland, open shrub-grass and meadow types were 118.8, 636.8, and 599.2 animal unit months (AUM's), respectively. All plot pairs considered, the respective increases in yield indicated are 33.7, 35.6, and 12.3 percent. These increases times the original capacity estimates gives an estimated increase of 340 animal unit months. This is around 15 percent of the total 1951 allotment capacity of 2060 AUM's (pine-bunchgrass type included).

Litter cover increased under rest-rotation. Sixty-one (Sixteen) percent of the 26 plot pair comparisons showed more litter cover under rest-rotation. Eleven (Three) percent showed the reverse. ~~While~~ litter cover average around 50 percent under both grazing systems (Table 4), but seven percent more of the area was covered with litter under rest-rotation grazing.

Bare soil, gravel, rock, and wood were expected to be better covered by litter and plants under rest-rotation. There was more bare soil exposed under season-long grazing in 61 (on 16) percent of the 26 plot pair comparisons. Nineteen (Five) percent showed the reverse. Since the increase in litter cover is about equal to the decrease in bare soil (Table 4), it appears that the area of exposed soil is becoming less under rest-rotation with a corresponding increase in litter cover.

While individual plot pair differences occurred for gravel, rock, and wood; there were no differences between grazing systems for these characteristics.

Water absorption is faster under rest-rotation. Half of 24 tests of water absorption rates showed significant differences. Where the differences were significant it took 1.8 minutes less for one-inch of water to be absorbed on the plots under rest-rotation. All tests considered, absorption time was one minute less (Table 4).

Soil compaction, while it is an important factor on many rangelands, appears to be less important in the Harvey Valley area. Soils were less compacted in the fall (Table 4) on plots under rest-rotation. However, no difference was found in soil compaction in the spring. Apparently, frost action tends to break up compacted layers on many sites. Also, on fifteen upland plot pairs we found no difference due to grazing system in the average within plot increase in compaction.

Plant cover of desirable species should increase as a result of better plant vigor, greater seedling numbers, and better soil surface conditions under rest-rotation grazing.

The meadows show the most favorable responses in plant cover to rest-rotation grazing (Table 5). The open grasslands have also responded well, but only minor gains have been made in the pine-bunchgrass and open shrub-grass vegetation types.

Table 5.--Average differences in percent basal cover for primary, secondary, low value, and all plants for each major vegetation type and all types combined.

(Harvey Valley plot value - other plot value)

| Vegetation type | Plant grouping | | | |
|---|---|---|---|---|
| | Primary | Secondary | Low value | All plants |
| Ponderosa pine-bunchgrass | .05 | .18 1/ | -1.76 | -1.53* |
| Open grasslands | 1.32*** | .58* | -1.62* | .29 |
| Open shrub-grass | .44* | .13 | 1.28 | 1.86* |
| Meadows | 3.23*** | -.05 | -.31 | 2.88* |
| All types | .97*** | .25** | -.80 | .42 |

1/ * = Average diff. significant at the 80% level of probability by paired t test.

** = Average diff. significant at the 90% level of probability by paired t test.

*** = Average diff. significant at the 95% level of probability by paired t test.

All vegetation types considered, there have been gains on the plots under rest-rotation in cover of primary and secondary species (Table 5). Since there was no significant difference in cover of low value species and no significant difference in total plant cover, either primary or secondary species have replaced some low value ones or have advanced into previously unoccupied soil on the plots under rest-rotation. Either way it is a step toward improvement in the resource.

Thus far, bottlebrush squirreltail has been the grass most responsive to rest-rotation grazing. Under rest-rotation, bottlebrush squirreltail made up three times more of the cover than under season-long grazing (Table 6). Basal cover of Idaho fescue has not shown nearly as much response. However, there was significantly more cover of Idaho fescue under rest-rotation--22 percent more.

Junegrass was encountered in basal cover studies on six pairs of plots (Table 6). In five cases there was significantly more cover of Junegrass under rest-rotation than under season-long grazing. Considering the small number of tests and the large difference in average cover values, Junegrass appears to be responding well to rest-rotation.

All plot pair tests considered, Western needlegrass, Sandberg bluegrass, Ross sedge, and shorthair sedge have shown no response in basal cover to rest-rotation (Table 6). However, important difference between members of plot pairs did occur.

Table 6.--Differences in basal cover of some important plant species and species groups on upland plot pairs.

| Species or Group | Number of plot pairs | Percent of basal cover RR[1] | SL | Av. diff. in percent basal cover (RR-SL)[2] |
|---|---|---|---|---|
| Bottlebrush squirreltail | 19 | .35 | .11 | .24** |
| Idaho fescue | 17 | 1.25 | 1.02 | .23* |
| Junegrass | 6 | .39 | .06 | .33** |
| Western needlegrass | 18 | .53 | .56 | -.03 |
| Sandberg bluegrass | 10 | .60 | .51 | .09 |
| Ross sedge | 17 | 1.03 | .95 | .08 |
| Shorthair sedge | 8 | 3.52 | 3.03 | .49 |
| Grasses | 22 | 2.30 | 1.67 | .63** |
| Grasslikes | 22 | 2.13 | 1.86 | .27* |
| Forbs[3] | 21 | .43 | .85 | -.42 |
| Shrubs | 22 | 7.07 | 7.60 | -.53 |

1/ RR = Rest-rotation, SL = Season-long.

2/ * = Average diff. significant at the 80% level of probability by paired t test.

** = Average diff. significant at the 95% level of probability by paired t test.

3/ No forbs were encountered in basal cover on one upland plot pair.

It is likely that the response of bottlebrush squirreltail to rest-rotation can be associated with its seed dispersal (wind) mechanism, and high seedling vigor. Slower responses of other important species may be related to their relative sensitivities to grazing, competitive abilities, and requirements for seedling establishment.

All upland plot pairs considered (Table 6), basal cover of grasses and grasslikes was greater under rest-rotation grazing. No over-all differences were found in forb or shrub cover.

The differences--0.24 and 0.23 percent (Table 6)--in basal cover of bottlebrush squirreltail and Idaho fescue are seemingly small. However, even such small differences are important. In 1957--a drought year--Idaho fescue produced 1.75 and bottlebrush squirreltail 3.81 grams of herbage per square inch of live basal area. With such yields, the differences in cover mean an additional 56 pounds of Idaho fescue and 126 pounds of bottlebrush squirreltail per acre on the plots under rest-rotation.

On the four pairs of meadow plots, basal cover of grasslike plants was greater under rest-rotation grazing. Except for the ephemeral lake site the reverse was true for forbs. Buttercup (Ranunculus) species made up much of the forb values on the plots grazed season-long. There were no differences in cover values of the clover (Trifolium longipes) found in the meadows. This indicates that grass-like plants are replacing some forbs on those plots under rest-rotation grazing. Successionally, this is a desirable trend.

Species composition data for a particular species reflects the relative competitive stance of the species and the relative influencing competition it must face. Hence, if the better plant species are increasing and spreading out under rest-rotation, this would reflect a higher stage of succession because the better "climax" species would be in stronger control of and face less competition in controlling the site.

Evidence from our species composition data shows that: (1) relative to plots grazed season-long, the competitive position of primary species is stronger, of secondary species is as strong, and of low value species is weaker under rest-rotation (Table 7); (2) except for the meadows, some of the better grasses and the grass group are in relatively stronger competitive positions under rest-rotation (Table 8); (3) the position of forbs is much stronger under season-long grazing; but those of grasslikes and shrubs are equal; and (4) under rest-rotation grass-like species presently have the upper hand on meadows. Thus in general, the evidence supports the expectation of a better species composition and hence a higher successional stage with rest-rotation grazing.

Table 7.--Average differences in percent of species composition for primary, secondary, low value, and other plants for each major vegetation type and all types considered.

(Harvey Valley plot value - other plot value)

| Vegetation type | Plant Grouping | | | |
|---|---|---|---|---|
| | Primary | Secondary | Low value | Others |
| Ponderosa pine-bunchgrass | 5.53***[1] | 1.43 | -6.96*** | .00 |
| Open grasslands | 9.05*** | 3.60 | -12.67*** | .02 |
| Open shrub-grass | 1.86 | -1.38 | -.54 | .06 |
| Meadows | 20.73*** | -4.53*** | -16.14*** | -.06 |
| All types | 7.96*** | .46 | -8.43*** | .01 |

1/ *** = Proportions in stand significantly different at the 95% level of probability by Chi-square.

Table 8.--Differences in species composition of some important plant species and species groups on upland plot pairs.

| Species or group | Number of plot pairs | Percent composition RR 1/ | Percent composition SL | Average diff. in percent composition (RR-SL) 2/ |
|---|---|---|---|---|
| Bottlebrush squirreltail | 21 | 6.68 | 3.98 | 2.70* |
| Idaho fescue | 19 | 10.29 | 8.60 | 1.69 |
| Junegrass | 10 | 3.01 | .62 | 2.38* |
| Western needlegrass | 21 | 18.56 | 19.90 | -1.34 |
| Sandberg bluegrass | 11 | 5.14 | 4.25 | .89 |
| Ross sedge | 17 | 11.62 | 11.45 | .17 |
| Shorthair sedge | 9 | 25.39 | 23.57 | 1.82 |
| Grasses | 22 | 39.61 | 33.65 | 5.96* |
| Grasslikes | 22 | 21.08 | 19.91 | 1.17 |
| Forbs | 22 | 25.24 | 30.50 | -5.26* |
| Shrubs | 22 | 14.07 | 15.93 | -1.86 |

1/ RR = Rest-rotation, SL = Season-long

2/ * = Significant at the 95percent level of probability by Chi-square

Hormay and Talbot (1961) stated: "In effect, grazing is eliminated as an environmental factor under rest-rotation grazing." However, in actuality grazing is an important factor under rest-rotation grazing. Periods of full use are planned so that less desirable as well as the most desirable vegetation is grazed. Grazing is employed as a method of planting seed. During the rest periods plants regain vigor, seedlings become established, and the species are free to compete with each other. Thus grazing and rest are combined to permit succession to proceed on a course toward more desirable climax species.

Annual plants.--Ellison et al. (1951) stated: "Natural vegetation on high range-watersheds in good condition consists of a mixture of many species practically all of which are perennials." The number of annual plant species present on study plots made up no larger percentage of the total number of species encountered under rest-rotation than under season-long grazing. However, based on their percentage composition, annual plants were 60 percent more prevalent under season-long grazing in the open grasslands (Table 9). For the meadows and open shrub-grass type annual plants were about one-third more prevalent. Thus we have additional evidence that the wet meadow, open shrub-grass, and open grassland vegetation types are in higher stages of succession and better range condition under rest-rotation than under season-long grazing.

Table 9.--Average percentage composition of annual plants by treatment and major vegetation type, Harvey Valley Evaluation.

| Major vegetation type | Treatment | | Difference |
|---|---|---|---|
| | Rest-rotation | Season-long | |
| | Percent | | |
| Wet meadow | 8.9 | 12.2 | -3.3*** 1/ |
| Open shrub-grass | 22.3 | 29.2 | -6.9*** |
| Open grassland | 14.6 | 23.3 | -8.7*** |
| Pine bunchgrass | 11.6 | 13.0 | -1.4 |

1/ *** = Diff. significant above 95% level of probability by Chi-square tests

Nutrient status of soils and leaf tissues.--Results from soil analyses indicate that rest-rotation grazing at Harvey Valley has had little effect on soil nutrient status. Phosphorus was the only nutrient for which a significant difference was found. Higher phosphorus content on the Harvey Valley plots occurred in the second soil horizon of pine-bunchgrass plots.

There was more calcium (.01 percent) and more magnesium (.01 percent) in leaf tissue from the pine-bunchgrass plots under rest-rotation. However, under both systems of grazing, the calcium and magnesium contents were above the livestock requirements given by Morrison (1957). Hence, it is unlikely that such differences could affect cattle gains. No differences were found for phosphorus, sodium, or potassium.

Cultural improvement work.--Range seeding and sagebrush control at Harvey Valley were planned to complement the effects of the management system in improving the resource. Sagebrush was controlled on 3,655 acres, and 497 acres were reseeded. This work was accomplished without requiring periods of non-use, and the seedings have been maintained without special fencing.

The actual extent to which this cultural work has contributed to improvement of areas of native range cannot be determined. However, the seeded areas are highly preferred (Ratliff, 1962), and tend to lessen the grazing pressure on native range areas during the early part of the grazing period.

## DISCUSSION AND CONCLUSIONS

Vigor of the key forage species, Idaho fescue, is higher on the members of comparable plot pairs on Harvey Valley. All plot pairs considered, there have been gains on the plots under rest-rotation in basal cover of primary and secondary species--grasses and grasslikes have significantly higher cover values under rest-rotation than under season-long grazing. Nearest ~~plant~~ species composition data shows a better ~~species~~ composition and hence a higher successional stage with rest-rotation grazing--relative to plots grazed season-long. The competitive position of primary species is thereby stronger, of secondary species is as strong, and of low value species is weaker under rest-rotation. Given a good year for seedling establishment, more seedlings of perennial grasses were found under rest-rotation.

The amount of surface covered by litter on Harvey Valley averaged 14 percent greater and the amount of exposed soil 33 percent less than on the other allotments. Herbage yield averaged 18 percent greater, water absorption 15 percent faster, and fall soil compaction less on Harvey Valley. Except in the pine type, annual plants made up from 1/3 to 2/3 more of the species composition under season-long grazing. Thus far, there have been no important changes in soil and plant nutrients because of rest-rotation.

Thus, rest-rotation grazing is doing much of what was expected at Harvey Valley. And we conclude that: 1) compared to season-long grazing, rest-rotation grazing is an ecologically sound system of grazing management, and 2) relative to nearby allotments, range health at Harvey Valley is better and range condition trend upward.

The response to rest-rotation has not been as dramatic at Harvey Valley as in some other areas of the West. For example, Kirk[5/] reported a ten percent increase in the number of cattle after only one year of rest-rotation grazing. This was on a range grazed yearlong and with only 9 inches of precipitation annually.

There are at least two factors involved in what appears to be a slow response at Harvey Valley which must be considered. First, drought occurred in five of the first nine years of rest-rotation. In order to provide forage for the cattle this necessitated grazing units which were scheduled to be rested. Second, seedlings must become established if there is to be a rapid increase in basal area of perennial bunchgrass plants (Hormay and Talbot, 1961). As in much of California, the summers at Harvey Valley are usually hot and dry. This along with frequent spring drought, means few favorable years for seedling establishment.

using "rested" units for this purpose is an accepted practice under rest-rotation grazing (Hormay, 1970).

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5/ Kirk, P. A. 1968. Rest-rotation grazing in Southwestern New Mexico. Paper presented at Annual Meeting A.S.R.M. at Albuquerque, New Mexico, Feb. 1968. Copy on file at Pacific SW Forest & Range Exp. Sta., Fresno, Calif.

Considering factors working against improvement, rest-rotation grazing has performed well, bringing about better range condition on Harvey Valley as compared with nearby allotments during the first decade of its use. With this past improvement and the advent of more favorable weather, we expect greater and more rapid improvement in the future at Harvey Valley.

## CATTLE WEIGHT GAINS

To the resource manager improvement in range health is a sign that a particular system of grazing management is good. But to ranchers the amount and quality of beef produced is the final proof of value of any grazing system. As has been shown, rest-rotation grazing is good for the resource. The system has also produced acceptable cattle weight gains at Harvey Valley.

## METHODS

Except where noted, cattle were weighed individually. Weights were obtained on an unshrunk basis from 1954 through 1959, but starting in 1960 they were held overnight in the corrals without food or water. Tests made with steers in 1954 indicated that shrinking overnight would result in about 4% reduction in weight. Hence, the early data were adjusted by this percentage to make them more comparable to the more recent data. Cattle showing negative gains for a full season were assumed to have been sick and were therefore excluded from computations.

## TRENDS IN CATTLE WEIGHT GAINS

During the period of rest-rotation grazing (1954-1966, incl.) individual animal weight gains have neither tended to increase nor decrease on the Harvey Valley allotment. Gains were often significantly higher or lower from one year to the next (Fig. 5). In 7 cases gains were down in successive years and up in 4 cases. The only case where two or more years started to show a significant trend was with heifers from 1957 through 1959. However, while no heifer weight gain data were obtained in 1960, their gains were back up in 1961. The depression of heifer gains in 1964 resulted from markedly lower gains than usual after midseason--they just held their own. Lower heifer gains in 1966 are likely the result of drought that year. Drought was also likely the major factor in the drop in steer and cow as well as heifer gains in 1959 as compared with 1958. The sharp increase in cow gains in 1960 over 1959 is primarily the result of the calves being sold at midseason; this in turn would result in the cows making greater gains than usual the second half of the season. The lowest (465 lbs.) and highest (703 lbs.) average starting weights of steers occurred in 1957 and 1959, respectively. Hence, while starting weight was likely a factor in yearly differences, age and condition of the steers at the start of the season likely played the major role in the apparent drop in gains from 1954-55 ~~as compared to~~ to 1957-58.

Figure 5.--Year to year differences in daily gains of cattle on the Harvey Valley allotment, 1954-1966 inclusive.

Large differences in the quantity of forage available from year to year may be expected. Hormay and Talbot (1961) found the yield per acre to be 37% above average in 1948 and 40% below the following year. Such differences in yield, with a constant stocking rate, results in different utilization which may in turn affect weight gains from year to year.

## GAINS COMPARED FOR REST-ROTATION AND SEASON-LONG GRAZING

Gains made by yearling replacement heifers on the Harvey Valley allotment in 1965 equalled and in 1966 exceeded the gains of their sisters on neighboring allotments grazed season-long (Table 10). Taken together, these results indicate that over a series of years the cattle weight gain balance sheet will look better for Harvey Valley than for its neighboring allotments. Results from the Gray's Valley comparison show that while two units of the Harvey Valley allotment were rested from grazing, in the remaining portion of the allotment forage quality and quantity were good enough to give weight gains equal to those where heifers had free choice over the entire Gray's Valley allotment. In addition, Harvey Valley heifer gains were only 12 percent less in the 1966 drought year than they were the year before. Thus, the 1966 Lower Pine Creek comparison gave an indication that availability of additional emergency feed in rested units in Harvey Valley will improve gains over season-long ranges in poor forage years.

Table 10.--Comparison of starting weights and daily gains of replacement heifers on the Harvey Valley and two neighboring allotments (1965 and 1966).

| Test Year | Allotment | Grazing Management System | Number of Head | Average Starting Weight | Average Daily Gain |
|---|---|---|---|---|---|
| | | | | Pounds | |
| 1965 | | | | | |
| | Gray's Valley | Season-long | 27 | 649 ± 17 1/ | 1.27 ± .09 |
| | Harvey Valley | Rest-rotation One unit | 28 | 642 ± 18 | 1.29 ± .08 |
| | Harvey Valley | Rest-rotation Two units | 24 | 677 ± 22 | 1.18 ± .08 |
| 1966 | | | | | |
| | Lower Pine Creek | Season-long | 25 | 696 ± 27 | 0.61 ± .10*** |
| | Harvey Valley | Rest-rotation Two units | 28 | 671 ± 21 | 1.09 ± .09 |

1/ 95% confidence interval.

*** Significantly different at 95% level of probability from the 1966 Harvey Valley group.

## FULL AND HALF SEASON'S GAINS

If year-to-year variations in gains continue about as in the past--given similar age and conditions of cattle--we can expect seasonal gains to be similar to those presented in Table 11. That for the area around Harvey Valley these gains are satisfactory is indicated by the comparisons with neighboring allotments previously discussed. Also, when one takes regional climatic and vegetational differences into account, cattle gains at Harvey Valley compare reasonably well with those from the Starkey Experimental Range in northeastern Oregon (Forest Serv., 1957 and 1958, and Harris and Driscoll, 1954) and the Manitou Experimental Forest in Colorado (Currie, 1966 and Smith, 1967).

During the 4-month season in 1961 and 1962 yearling heifers at Harvey Valley made 73 percent of their gain before August 1 (Table 12). They had 81 percent of their gain before August 15 during the 5-month seasons of 1963, '64, and '65. It is no surprise that the rate of gain was much less during the second half of the season. Hormay and Talbot (1961) stated herbage was most nutritious just before flowering in early July. Thus, in late June and early July cattle on Harvey Valley and neighboring allotments can be expected to make their most rapid weight gains. As herbage matures, or is hit by late season frosts, gains slow to the extent that in some years, September and October weight losses occur.

Table 11.--Average starting weights and daily gains of cattle on the Harvey Valley allotment, and expected weight gain for a June 1-September 30 (120 day) season.

| Class | Number of Head | Years of Data | Average Starting Weight | Average Daily Gain | Expected Gain |
|---|---|---|---|---|---|
| | | | Pounds | | |
| Steers | 365 | 5 | 561 ± 10.4 1/ | 1.20 ± .03 | 145 |
| Heifers | 588 | 8 | 623 ± 9.6 | 1.12 ± .02 | 135 |
| Wet cows | 490 | 5 | 820 ± 10.8 | .66 ± .03 | 80 |
| Dry cows | 120 | 1 | 664 ± 23.2 | 1.54 ± .05 | 185 |
| Calves | 469 | 4 | 214 ± 8.1 | 1.39 ± .03 | 170 |

1/ 95% confidence interval.

Table 12.--Gains of replacement heifers [1] the first and second half of the grazing season, Harvey Valley Allotment.

| Grazing Season | First Half [2] | | Second Half [3] | |
|---|---|---|---|---|
| | Days | Average pounds daily gain | Days | Average pounds daily gain |
| 1961 | 51 | 1.71 | 65 | .85 |
| | 51 | 1.94 | 65 | .74 |
| 1962 | 56 | 1.82 | 57 | .74 |
| | 56 | 2.00 | 57 | .24 |
| | 56 | 1.99 | 57 | .57 |
| 1963 | 68 | 1.62 | 78 | .85 |
| | 68 | 1.83 | 78 | .65 |
| 1964 | 70 | 1.68 | 74 | .08 |
| | 70 | 1.69 | 74 | .04 |
| 1965 | 73 | 1.91 | 60 | .50 |
| | 73 | 1.90 | 60 | .31 |
| Averages | 63 | 1.83 | 66 | .51 |

1/ Data for all groups for each year are presented because they grazed different units or represent breed differences.

2/ Dates of first half: Until 1963, June 1 - August 1; after 1963, June 1 - August 15.

3/ Dates of second half: Until 1963, August 1 - September 30; after 1963, except for 1965, August 15 - October 31.

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Table 3 shows a .38 pound range between the highest and lowest gains for the first half of the season. But the range is .81 of a pound for the second half. This indicates that gains the first half tend to be more stable from year to year than gains the second half of the season. A slowing of rate of gain in the latter part of the season has also been reported from both the Starkey Experimental Range (Forest Serv., 1957) and the Manitou Experimental Forest (Johnson, 1953).

As an example of how such information can be used by ranchers, the permittee on Harvey Valley arrived in 1963-65, in early June with steers weighing about 550 pounds average (Table 13). The steers gained just over 140 pounds by an early to mid-August date when they were sold. These steers were weighed, five head at a time, on an unshrunk basis when they entered the allotment and as they went on the trucks. Also, in 1963 a group of market type yearling heifers gained 1.9 pounds per head per day. Their average starting weight was 541 pounds, and they averaged 671 pounds 68 days later.

It will be noted that both these steers and heifer gains are much higher than average seasonal gains. Keeping them on the range past mid-August to add additional pounds at a lower rate of gain may have resulted in a lower selling price. To get use from the allotment after mid-season, non-market classes such as dry cows and replacement heifers, rather than market classes, should be grazed.

Table 13.--Average weights[1] and gains of yearling steers planned for market on August 15, Harvey Valley Allotment.

| Grazing Season | Days on Allotment | Starting Weight | Final Weight | Weight Gain | Gain Per Day |
|---|---|---|---|---|---|
| | | Pounds | | | |
| 1963 | 69 | 532 | 673 | 141 | 2.04 |
| 1964 | 68 | 545 | 687 | 142 | 2.08 |
| 1965 | 75 | 586 | 728 | 142 | 1.88 |
| Averages | 71 | 554 | 696 | 142 | 2.00 |

1/ Weights on an unshrunk basis.

Rigid rotation of cattle to fresh units is now considered unnecessary. Rattler, Hormay (1970) recommends opening gates at the appropriate times and letting the cattle drift into the fresh units. Doing so will eliminate weight loss from forced moving and also the expense of gathering at mid-season.

## ALL SEASON IN ONE UNIT VERSUS MOVING

The management plan for Harvey Valley required that most of the cattle be moved at mid-season. We compared gains made by animals moved to a fresh unit at or near mid-season with those of animals remaining season-long in one range unit.

In 4 out of 14 comparisons cattle moved between range units gained less than those not moved (Table 14). In no case did cattle grazed season-long in one range unit gain significantly less than those that were moved. Assuming this pattern continues at Harvey Valley about one-third of the time, 7 to 20 percent greater gains can be expected for cattle not moved.

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## LIVESTOCK PRODUCTION AND WORTH PER ACRE

The pounds of gain per usable acre (Table 15) produced on the Harvey Valley allotment were estimated using the average daily gain (Table 11) for each class of cattle. Except for calves, which were included with wet cows, the assumption was made that only one class of cattle was on the allotment and used its entire grazing capacity. Calves gained 3.8 pounds per acre of the 5.6 pounds for cows and calves (Table 15).

On the animal unit basis the value produced per usable acre for cows and calves--at 15 cents and 25 cents per pound for cows and calves respectively--was $1.23 per acre. The largest part, 96 cents, came from the calf gains. The value of the gain for steers--at 24 cents per pound--was $1.32 per acre. For heifers, at the same price per pound, it was $1.15. Under these conditions (dry cows excluded) there appears to be some advantage to grazing steers at Harvey Valley compared to other classes.

With a steer operation, stocking on the animal unit basis would give a return of $11.50 per AUM (animal-unit month) of grazing. It would cost around $6.90 per AUM to produce this return.

Table 14.--Comparisons of starting weights and daily gains of cattle grazed in one range unit and cattle grazed in two or more range units, Harvey Valley Allotment.

| Class | Grazing Season | Grazing Treatment: One Range Unit: Number of Head | One Range Unit: Average Starting Weight | One Range Unit: Average Daily Gain | Two or more range units: Number of Head | Two or more range units: Average Starting Weight | Two or more range units: Average Daily Gain |
|---|---|---|---|---|---|---|---|
| | | | ----- Pounds ----- | | | ----- Pounds ----- | |
| Steers | 1958 | 63 | 538 | 1.21 | 131 | 549 | 1.17 |
| Heifers | 1957 | 24 | 446 | 1.41 | 54 | 471 | 1.20* |
| | 1959 | 34 | 514 | .86 | 27 | 547 | .83 |
| | 1961 | 26 | 528 | 1.22 | 23 | 529 | 1.27 |
| | 1965 | 28 | 642 | 1.28 | 24 | 677 | 1.18 |
| Wet cows | 1956 | 50 | 721 | .86 | 126 | 735 | .71* |
| | 1957 | 26 | 839 | .73 | 24 | 903 | .53 |
| | 1958 | 26 | 894 | .55 | 117 | 924 | .67 |
| | 1959 | 35 | 803 | .38 | 34 | 796 | .34 |
| Dry cows | 1956 | 43 | 664 | 1.56 | 77 | 664 | 1.53 |
| Calves | 1956 | 49 | 145 | 1.57 | 134 | 144 | 1.46* |
| | 1957 | 26 | 257 | 1.52 | 21 | 292 | 1.44 |
| | 1958 | 27 | 236 | 1.39 | 122 | 269 | 1.22* |
| | 1959 | 45 | 258 | 1.35 | 45 | 237 | 1.39 |

* Value significantly different at the 95% level of probability from the corresponding value for cattle grazed in one range unit.

Table 15.--Estimated allotment capacity and livestock production by class of cattle, Harvey Valley Allotment.

| Class of cattle | Animal unit rating | Animal days to use capacity 2/ | Estimated pounds gain per acre 3/ |
|---|---|---|---|
| Cows and calves 1/ | 1.25 | 49,440 | 5.6 |
| Steers | .75 | 82,400 | 5.5 |
| Heifers | .80 | 77,250 | 4.8 |
| Dry cows | .90 | 68,667 | 5.9 |

1/ Cows = 1.00 animal units; calves = .25 of an animal unit.

2/ Capacity of the Harvey Valley allotment was 61,800 animal unit days.

3/ There were 17,956 acres usable for grazing on the Harvey Valley allotment in 1960.

However, if the counter basis of stocking is to be used in place of the animal unit basis the situation reverses and a cow-calf operation appears more advantageous at Harvey Valley. Using the counter basis, all cattle over six months of age count as one animal unit regardless of age or size, and cattle under six months don't count at all. Stocked on this basis, cow-calf gains would have a value of $1.54, while steer gains would have a value of 99 cents per acre.

Put another way, stocking on the animal unit basis would, with a steer operation, return the rancher about $11.50 per AUM (animal-unit month) of grazing--using the 2,060 AUM capacity estimate. Stocked on the counter basis the value of one AUM would be only $8.60. By either method of stocking, it costs the permittee around $6.90 per AUM of grazing to produce these returns.

## CONCLUSIONS AND IMPLICATIONS

The Harvey Valley cattle allotment on the Lassen National Forest has been under a system of rest-rotation grazing since 1954. Studies of livestock weight gains on the Harvey Valley allotment show that:

1) Individual animal performance has neither increased nor decreased during the period of rest-rotation grazing.
2) Daily cattle gains for full and half seasons appear to be as good as can currently be expected in the Harvey Valley vicinity.
3) First half rate of gain for yearling replacement heifers is 3-1/2 times the rate during the second half of the season.

4) In some years cattle grazing in one range unit all season will make better gains than those grazing two or more units.

5) Value of grazing in Harvey Valley, expressed as gain per acre, is slightly better for steers than heifers or cows and calves. ~~when the animal unit basis of stocking is used.~~

6) Creaming the forage with a market class such as steers and then cleaning up with dry cows appears an efficient way of using the Harvey Valley allotment.

That availability of forage in "rested" units may improve weight gains in poor forage years in comparison with season-long use was indicated by the greater gains made by yearling heifers on Harvey Valley versus the gains of those on the Lower Pine Creek allotment in 1966. If the additional gain (.48 lb./head/day) can be ascribed to the reserve forage, at 15 cents per pound on non-market cattle, the availibility of this forage was worth around $8.64 per head to the permittee.

Due to a lack of forage, cattle were removed well before the end of the grazing season from some neighboring season-long allotments during the drouth years of 1959-61. While the forage is low in protein during September and October, there has always been ample roughage, and the cattle stayed at Harvey Valley for the entire season. This points to another possible value of having forage available in "rested" units in poor forage years.

An additional factor regarding rest-rotation, important to ranchers, is that the management system provides for cultural as well as ecological improvement. Standard Forest Service practice would require a period of non-use following cultural improvement work such as seeding or sagebrush control. At Harvey Valley it has been shown that such work can be fitted into the rest-rotation pattern without non-use being required.

Thus it is likely that over the years, rest-rotation grazing has resulted in greater beef production at Harvey Valley than would have continued season-long grazing. With the past improvement in range health considered, we recommend a ten percent increase in the permitted animal-unit months of grazing for the Harvey Valley allotment.

## ECONOMIC CONSIDERATIONS

While rest-rotation grazing produced better relative range conditions and acceptable cattle weight gains; was the system, as practiced at Harvey Valley, economically practical? The following discussion answers the question from the stand-points of the Forest Service and the livestock permittee.

## WHAT WAS SPENT AT HARVEY VALLEY?

The original study plan for Harvey Valley called for cultural range improvement practices, development of additional water, additional fencing, and cattle handling facilities. Costs from 1951 through 1965 for these improvements were $71,364. The expenditures are itemized in Table 16. About 30 percent ($21,412) of the total expenditure went for cultural improvements such as artificial seeding and sagebrush control. These improvements were planned to complement the effects of the grazing system in restoring the range to high production. Fencing, gates, and cattleguards were needed for boundary control and to divide the allotment into range units for the proper operation of the grazing system. These improvements cost a little over $40,933 or about 57 percent of the total. Additional water had to be developed to provide adequate stock water in all range units. These developments cost around $3,750 or somewhat more than 5 percent of the total expenditures. A corral-scale-holding field setup was needed to facilitate experimental work with cattle. This set-up cost $5,269, about 7 percent of the total.

In addition, maintenance costs were $18,219, range rider salaries were about $7,680, and planning costs were estimated as $6,169. Thus the total National Forest System budget expenditures for the Harvey Valley program from 1951 through 1965 were $103,433.

Table 16.--Range improvements at Harvey Valley, 1951-1965.

| Improvement | Units | Average Unit Cost | Total | Percentage of Total Costs |
|---|---|---|---|---|
| Artificial seeding | 497 acres | $ 14.24 | $ 7,074.95 | 9.9 |
| Sagebrush control | 3,655 acres | 3.59 | 13,107.50 | 18.4 |
| Grasshopper control | 100 acres | 5.00 | 500.00 | .7 |
| Drainage improvement 1/ | 300 acres | 2.00 | 600.00 | .8 |
| Gully erosion controls | 1 mile | 130.00 | 130.00 | .2 |
| Fences | 17.71 miles | 1,584.42 | 28,060.00 | 39.3 |
| Gates (metal) | 11 each | 44.00 | 484.00 | .7 |
| Cattleguards | 12 each | 1,032.42 | 12,389.00 | 17.4 |
| Corral, scales and holding fields | 1 setup | 5,269.00 | 5,269.00 | 7.4 |
| Spring developments | 1 each | 1,200.00 | 1,200.00 | 1.7 |
| Water pits | 11 each | 151.75 | 1,669.28 | 2.3 |
| Extra troughs at windmills | 2 | 440.36 | 880.72 | 1.2 |
| Total cost of all improvements | | | $71,364.45 | 100.0 |

1/ Unit costs estimated.

## METHODS OF ANALYSIS

The first step was to decide which improvement and cultural treatments were required only for the operation of rest-rotation and which ones would have been required with the best possible season-long grazing management. These decisions were reached through discussions with the District Ranger, Mr. Fred Alberico, in charge of the allotment. Also, estimates of the life expectancies of improvements and cultural treatments (Table 17) were discussed and agreed upon with Mr. Alberico and Mr. Phil Lord, formerly Grazing Staff officer for the Lassen National Forest. Cost figures for the maintenance of the improvements and treatments, and the original investment values were provided by the Lassen National Forest. For investments made before 1951, their depreciated values at the start of 1951, were used as the original investments.

Total costs of the Harvey Valley program were broken into three parts: (1) those costs associated with standard Forest Service grazing management practices, which it was assumed would have been incurred had the allotment been equally developed and remained under season-long grazing; (2) those costs, including most of those in (1) above, incurred to develop and manage the allotment by the rest-rotation system; and (3) associated costs (costs associated with the program but rightly charged to research requirements, demonstration activities, adjacent allotments, and other uses). Boundary fence costs were divided between Harvey Valley and adjacent allotments. Cattleguards were considered as unnecessary to proper operation of grazing management and were charged to demonstration activities and other uses.

Not New paragraph.

See pg. 61

Table 17.--Life expectancies and annual maintenance costs for range improvements and cultural treatments at Harvey Valley.

| Improvement or treatment | Life expectancy[1] : years | Annual Dollar Maintenance Cost |
|---|---|---|
| Fences | 20 | 25/mile |
| Wood gates | 20 | ——— |
| Metal gates | 80 | (2/) |
| Cattleguards | 80 | 5 each[3] |
| Spring developments | 80 | 40 each |
| Well developments | 75 | 40 each |
| Reservoirs & water pits | 100 | 5 each |
| Extra water troughs | 40 | 5 each |
| Corral and scales | 50 | 47/set |
| Artificial seedings | 50 | ——— |
| Sagebrush control | 10 | ——— |
| Grasshopper control | 1 | ——— |
| Erosion control | 100 | ——— |
| Drainage improvement | 100 | ——— |

1/ Expected years of life when given normal National Forest maintenance equal to annual maintenance cost.

2/ Gates are included in cost of fence maintenance.

3/ One extra large cattleguard figured at $10/year.

Not next paragraph see pg. 59

Corral costs were charged to research requirements. For the purpose of comparison, analyses were made at four levels of interest charges--3, 4, 5, and 6 percent. In the following discussion we considered the results obtained using an interest rate of 5 percent.

For each investment the depreciated value as of 1966 was determined. This depended on the years of use through 1965 and the life expectancy of the improvement. The initial time used was either the beginning of 1951 (for investments made before 1951) or the year in which the investment was made. Straight line depreciation was assumed, and amortizing and compound interest factors were used to calculate average annual costs of depreciation and interest respectively. The logic of this method is explained using the following simple example. Assume we invest $1,000 in an improvement that will last 20 years. The investment is made in 1961, and at the beginning of 1966 one-fourth (or $250) of the value of the improvement is used up. The remaining value of the improvement at the beginning of 1966 is $750. The $250 is treated as an investment which is exhausted in five years, and the appropriate amortization factor is used to calculate average annual cost of depreciation and interest. The $750 on the other hand is treated as an investment which did not depreciate and on which annual interest rate accrued, and the average annual interest cost (using 5-percent compound interest as an example) is ($750 x .2763)/5 yrs. = $41.44. The average annual depreciation and interest costs for all investments are presented in Table 18.

Table 18.--Investments, depreciated values, and estimated average annual costs to National Forest Administration for the Harvey Valley program, 1951-65 inclusive.

| Economic item | Chargeable to-- Grazing Management: Season-long 1/ | Rest-rotation (A) | Associated costs (B) | Total cost of program (A + B) |
|---|---|---|---|---|
| Investments | $42,752.58 | $52,330.72 | $27,731.25 | $80,061.97 |
| Depreciated values-1966 | 18,131.05 | 22,817.04 | 19,418.55 | 42,235.59 |
| Average annual depreciation and interest (1) | 3,184.84 | 3,843.98 | 1,560.32 | 5,404.30 |
| Average annual maintenance (2) | 638.75 | 932.93 | 342.43 | 1,275.36 |
| Average annual planning costs (3) | 354.07 | 433.39 | 969.25 | 1,402.64 |
| Total average annual cost (1 + 2 + 3) | 4,177.66 | 5,210.30 | 2,872.00 | 8,082.30 |

1/ Estimated costs, etc., if allotment had remained under season-long management, including costs required to fence seedings.

Maintenance costs were assumed to occur annually for each investment. Average annual maintenance costs for all investments presented in Table 18 include a 5-percent interest charge on the basic average annual maintenance cost.

Total planning costs for season-long and rest-rotation management were estimated by multiplying total investments by 8.6%. Planning costs for the Harvey Valley program ($6,169) amounted to 8.6% of the total cost of improvements ($71,364) from 1951 to 1965 inclusive. Planning costs for associated costs included the salary of the range rider. Estimated average annual planning costs appeared to be reasonable to the people involved in the planning activities.

Permittee costs were developed on the assumption that the permittee must cover all his costs and pay interest on all money used each year. Thus costs and interest charges were not compounded. The permittee paid 6.5 percent interest on the funds used for this part of his operation; hence, this figure was used in computing yearly interest charges. It was assumed that interest charges would be made for an entire year in order to simplify calculations. While this procedure tends to overestimate interest costs (using a 6.5-percent interest rate), total interest costs would be reduced very little by a more detailed breakdown of time intervals during which interest would either be paid on loans or earned on alternative uses of the money.

## RESULTS

A. From the standpoint of National Forest Administration

Costs.--Total estimated average annual cost of the Harvey Valley program from 1951 to 1965 inclusive was $8,082 (Table 18). The estimated depreciated value of the total program investments by 1966 was $42,235. Depreciation and interest charges on the $80,062 investment accounted for 67-percent of the total average annual cost. Maintenance and planning costs accounted for 16 and 17-percent of the total average annual cost respectively.

~~Depreciation and interest, maintenance, and planning costs--chargeable as associated costs--made up 36-percent of the total average annual cost.~~ The total management system (rest-rotation) ~~costs made up for the remainder of~~ 64-percent of the total average annual cost. Associated costs made up the remainder. However, of the $5,210 average annual cost for rest-rotation ~~management~~ grazing, only $1,032 or 13-percent of the total average annual cost of the program could be directly charged as an increase in the standard National Forest costs as the result of the rest-rotation system. The remainder, $4,178 or 52-percent of the total average annual cost of the program would have been incurred had Harvey Valley been equally improved and remained under season-long grazing. Turning this around, the added cost of rest-rotation ~~management~~ grazing was 25-percent of the cost of season-long grazing.

Returns.--Direct monetary returns to National Forest Administration during the 15-year period 1951-1965, amounted to an estimated $18,540. This was determined on the basis of a $1,236 average annual income (60-cent charge per cow-month and an allowable use of 2,060 cow months grazing per year). Thus the unpaid average annual cost at Harvey Valley was $6,846 for the entire program, $3,974 for rest-rotation, and $2,941 for season-long grazing.

In order for average annual income to equal average annual costs for rest-rotation grazing the fee per cow month would have had to be $3.92 ($2.53 (Table 19). ~~Subtracting associated costs, the required fee would have been $2.53.~~ However, $2.03 would have been required to pay the standard National Forest costs under season-long grazing. Therefore, the additional costs of rest-rotation grazing would have required another 50 cents. For this extra expense of rest-rotation grazing to be a break-even proposition for the National Forest Administration on the Harvey Valley allotment, using a grazing fee of 60 cents per cow month, grazing capacity would have to increase from 2,060 to 3,781 cow months--an increase of about 84-percent. The other alternative would be to charge 50 cents more per cow month of grazing. Thus on a strictly monetary cost/return basis, rest-rotation grazing has not paid its way during its first 15 years of use on the Harvey Valley allotment. Equally important, however, is the fact that had this allotment remained under season-long grazing the monetary returns at current grazing fees would have fallen short of paying for the costs by $1.43 per cow month. In fact, if no charge were made for interest and depreciation, break-even grazing fees per cow month would have had to be 48 cents for season-long grazing and 66 cents for rest-rotation grazing. In all of these calculations, no interest was charged on the value of the rangeland. This is equivalent to assuming that the rangeland has no value.

Table 19.--Estimated grazing fee requirements to have paid the average annual costs for rest-rotation and season-long grazing at the Harvey Valley Program.

(Based on an allowable use of 2,060 cow months of grazing per year and a 5% interest rate)

| To pay costs per C.M.[1] for-- | Required grazing fee Dollars |
|---|---|
| ~~Total Harvey Valley Program~~ | ~~3.92~~ |
| ~~Associated activities~~ | ~~1.39~~ |
| Rest-rotation grazing | 2.53 |
| Season-long grazing | 2.03 |
| Extra cost of rest-rotation grazing | .50 |

1/ Cow month.

The estimated depreciated value of the seedings in Harvey Valley was $5,425 (Table 20) in 1965. Rest-rotation grazing resulted in less cost for the seedings than would have season-long grazing with special fence protection. Had the seedings in Harvey Valley been done under season-long grazing, standard Forest Service practice on the Lassen National Forest would have required that they be fenced.

A charge to season-long grazing which could not be charged to the actual (rest-rotation) system ~~would have been a~~ was an estimated cost for fencing the seedings. This would have been $11,275 for depreciation, interest and maintenance on an estimated 7.8 miles of fence. The estimated cost of protecting the seedings made up 36 cents of the $2.03 estimated grazing fee required to pay the cost of season-long grazing.

Not all the seeding in Harvey Valley was done in one year, and some small areas, 18 acres for example, apart from others were seeded. Such a seeding program is feasible and practical under rest-rotation management; it would be impractical under season-long grazing due to fence costs. Also, fenced seedings must be managed apart from native range on season-long allotments. Under the rest-rotation system, seedings may be managed along with areas of native range.

Table 20.--Economics of seedings under rest-rotation grazing compared with season-long grazing.

| Economic item | Grazing system: Rest-rotation | Season-long |
|---|---|---|
| Investment | $7,074.95 | $14,874.95 |
| Depreciated value at end of 1965 | 5,425.41 | 8,545.41 |
| Depreciation and interest thru 1965 | 6,392.75 | 15,210.45 |
| Maintenance (fence) | ---- | 2,457.00 |
| Net Cost | $6,392.75 | $17,667.45 |

One could argue that the costs of the division fences at Harvey Valley should be charged to seeding protection under rest-rotation. However, while the division fences are rightly charged to rest-rotation, they were put in to control livestock movement and facilitate the rotation of grazing. They were not put in for the purpose of protecting the seedings. That past cultural work such as seeding or sagebrush control could be fitted into the pattern of rotation without the requirement of non-use or special fence protection must be considered a benefit to both the Forest Service and the permittee.

B. From the standpoint of the livestock permittee

Costs.--Average yearly costs to the livestock permittee for his Harvey Valley operation were estimated to be $14,281 (Table 21). Of this total, 80-percent would be incurred with season-long grazing. Extra costs incurred because of rest-rotation grazing were 18 percent of the total. Research activities cost the permittee $213 per year or less than 2 percent of the total.

Included under "regular costs" were grazing fees, overhead, and transportation. Potentially, these costs could vary if the grazing capacity were to change. Under present management an increase in grazing fees, resulting from an increase in permitted numbers, would, for example, be chargeable to rest-rotation grazing.

Table 21.--Average yearly costs to permittee for his Harvey Valley operation--1954-65 inclusive.

| Cost item | Average yearly cost net of interest | Interest charge at 6.5% | Average yearly cost | Percent of total cost |
|---|---|---|---|---|
| I Regular costs to run on allotment without rest-rotation: | | | | |
| Maintenance | $ 208.00 | $ 13.52 | $ 221.52 | 1.6 |
| Riding | 880.00 | 57.20 | 937.20 | 6.5 |
| Grazing fees | 1,236.00 | 80.34 | 1,316.34 | 9.2 |
| Livestock overhead | 4,120.00 | 267.80 | 4,387.80 | 30.7 |
| Loss in products | 2,317.50 | 150.64 | 2,468.14 | 17.3 |
| Livestock transportation | 2,060.00 | 133.90 | 2,193.90 | 15.4 |
| Subtotals | 10,821.50 | 703.40 | 11,524.90 | 80.7 |
| II Extra costs incurred because of rest-rotation grazing: | | | | |
| Maintenance | 185.00 | 12.02 | 197.02 | 1.4 |
| Riding | 658.00 | 42.77 | 700.77 | 4.9 |
| Loss in products | 1,545.00 | 100.43 | 1,645.43 | 11.5 |
| Subtotals | 2,388.00 | 155.22 | 2,543.22 | 17.8 |
| III Extra costs incurred because of research activities: | | | | |
| Riding | 130.00 | 8.45 | 138.45 | 1.0 |
| Weighing cattle | 70.00 | 4.55 | 74.55 | .5 |
| Subtotals | 200.00 | 13.00 | 213.00 | 1.5 |
| Grand Totals | $13,409.50 | $871.62 | $14,281.12 | 100.0 |

Included in the cost figures under both regular costs and rest-rotation are late season losses in animal products. The permittee estimated that his cattle lost about 50 pounds per head during late September and October. Of this, he estimated that 20 pounds were lost due to the "forced feeding" characteristics of the rest-rotation system. The other 30 pounds of estimated loss were due to dry forage lacking in protein and would have occurred under season-long grazing. The value of the late season weight loss, since it was lost on non-market type animals, was figured at 15 cents per pound. If the permittee's estimate of weight loss due to "forced feeding" is correct, a loss in animal products of $1,545 per year, 12 percent (with interest added) of the total average yearly cost, may be charged to rest-rotation grazing 6/. The other 30 pounds of weight loss must be considered a regular cost. This amounted to 17 percent of the total average yearly cost.

We know (Hormay and Talbot, 1961) that weight losses can be expected in the area starting around the first of October. However, we have no research data to support or refute the permittee's estimate of weight loss due to "forced feeding" under rest-rotation. Thus the question of whether this is a legitimate charge to rest-rotation remains open.

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6/ The loss was calculated as follows:

(515 head x 15 cents/lb. x 20 lbs.) = (515 head x $3.00/head)

(515 head x 15 cents/lb. x 30 lbs.) = (515 head x $4.50/head)

Returns.--With a 515-head permit, what return per head was necessary for the permittee to break even?

To pay all annual costs, including late season loss of products, (costs attributable to research activities excluded) the return per head from Harvey Valley would have to be $27.73 or $6.93 per cow month. Forty-one cents of this $27.73 was needed to pay that part of the permittee's costs attributable to research activities. The return per head needed to pay his costs, had the allotment been under season-long grazing, was $22.38. An additional return of $4.94 per head ($1.74 without the loss in product) was needed in order for the permittee to pay his extra costs due directly to the rest-rotation grazing.

If we assume that all of the returns to the permittee under rest-rotation would have been realized under season-long grazing, then it has not, in a direct monetary way, paid the permittee to operate under rest-rotation grazing. For him to profit from the system, the individual livestock performance would have to be 22 percent greater than under season-long grazing. Results from our studies of cattle weight gains show that individual animal performance has not increased. Thus, in this case the only way for the permittee to profit from rest-rotation grazing is for an increase in grazing capacity to result. With a return per cow month of grazing of $11.00 (estimated from cattle gains) a capacity increase of about 13 percent would give the permittee a break-even arrangement.

## DISCUSSION

A house properly maintained will last for many years, but uncared for it will soon deteriorate. In the end, it may cost the owner less to properly maintain the house than to permit it to deteriorate and then decide to restore it. So with our range resources. For many rangelands, including Harvey Valley, we are faced with a restoration rather than a maintenance problem. And the public must expect restoration to cost more than maintenance of range health.

As shown above, in terms of short run monetary cost/returns on the Harvey Valley allotment rest-rotation grazing was not (in its first 15 years) an economical practice for either the Forest Service or the permittee. However, the decision to use or not to use a rest-rotation grazing system should be based on the consideration of two types of returns. The first are the monetary returns from grazing, i.e., grazing fees and cattle sales. The second type are returns resulting from resource improvement (including aesthetic values). These returns cannot presently be given realistic dollar values. Because of this they could not be included in making this analysis. However, we feel that it is in the context of cost/resource improvement relationships that the public can best decide whether its money is well spent. Had it been possible to include these relationships, a more favorable cost/return picture would likely have developed.

Insert B
New paragraph

The public and our ranchers alike should recognize that mans economic time scale is not the same as natures ecologic time scale. Thus, while rest-rotation grazing has not been monetarily profitable program in the short view, it is bringing about an increased grazing capacity and a better range resource condition. And rest-rotation grazing will be more likely to pay the rancher and the public dividends in the long view.


## SUMMARY ABSTRACT

Rest-rotation grazing (Hormay and Talbot, 1961) was fully operational in 1954 on the Harvey Valley allotment. This allotment is in the southern Cascades and part of the Lassen National Forest. Nearby allotments have continued to be grazed by the season-long system.

Studies of relative range conditions on Harvey Valley and nearby allotments were made ten years after the start of rest-rotation grazing. Results showed that range condition was better and apparent condition trend upward on Harvey Valley. Therefore, compared with season-long grazing, rest-rotation grazing is an ecologically sound system of grazing management. Studies showed the following for Harvey Valley relative to nearby allotments: 1) improved vigor of the key forage species, Idaho fescue; 2) greater basal cover of the better plants; 3) a higher successional stage as indicated by a better species composition; 4) more grass seedlings; 5) 14 percent more litter cover and 33 percent less exposed soil; 6) 18 percent greater herbage yield; and 7) less soil compaction, and 15 percent faster water absorption.

Cattle weight gains on the Harvey Valley allotment were as good as could currently be expected in the vicinity. In addition non-use was never required during periods of cultural improvement work, and there was always ample roughage for cattle needs.

However, during the period 1954 through 1966 cattle gains neither increased nor decreased on Harvey Valley. And in some years cattle grazing two of the five range units made lower gains than cattle grazing only one of the range units for the entire season.

In one of two allotment comparisons, heifers on Harvey Valley gained ½ pound per day more than on a nearby allotment grazed season-long (a poor forage season). But in the other test gains were the same (a good forage season). These results indicate that over a series of years cattle gains would prove better under rest-rotation grazing.

Other studies showed that a rancher can get a two pound gain per day from yearling stockers the first half of the grazing season. Keeping them past mid-August adds pounds but at a much lower rate. After mid-season, non-market classes should be used to harvest the less nutritive forage.

During the first 15 years of use, rest-rotation grazing management was not (in terms of short run monetary cost/returns) economically practical for either the Forest Service or the livestock permittee on the Harvey Valley allotment. Using a five unit rest-rotation system with a given level of cultural improvement cost the Forest Service 25-percent more than would have season-long grazing on the same area with the same level of cultural improvement. To have paid this extra cost would have required that grazing fees be 50-cents more per cow month than on season-long grazing allotments. Rest-rotation cost the livestock permittee 22-percent more than would have season-long grazing. For him to have a break-even arrangement the grazing capacity would have to increase by about 13 percent. Two-thirds of the permittee's extra costs were based on his estimate of cattle weight losses in September and October.

On the positive side, rest-rotation grazing resulted in less cost for range seedings than would have season-long grazing with special fence protection. In addition, had the Harvey Valley allotment remained under season-long grazing the monetary returns at current fee levels would still have fallen $1.43 per cow month short of paying the cost of management.

Rest-rotation grazing is primarily a system for restoring range health, and restoration can be expected to cost more than maintenance of range health. Also, one should not expect that in one decade rest-rotation grazing would recover the loss in range condition and grazing capacity experienced from 1870 to 1948.

However, rest-rotation is doing much of what was expected, and a ten percent increase in use for Harvey Valley has been recommended. With past improvements in range condition we expect greater and more rapid improvement in the future.

Rest-rotation is not a panacea for all ranges and all range problems. But, at present, it is the best and most ecologically sound grazing system available for managing many western ranges. Rest-rotation grazing works and is building a more healthy resource for the future at Harvey Valley.

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