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Light Grazing—is it Economically Feasible as a Range-Improvement Practice[1]

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Light grazing of range vegetation has been recommended for many years as a grazing-management practice for the improvement of deteriorated native ranges, Cotton (1905), Jardine and Anderson (1919), Sampson (1914), and Smith (1895). Rangeland operators have not generally realized the possibilities for improvement in the yield and quality of their forage through the management of livestock grazing. Stocking for light utilization of deteriorated native vegetation to give it a chance to recover its productivity, has been used little. Most of the reasons advanced for not using light grazing more, relate to the economic feasibility of its use.

Rangeland operators and managers should and do very properly want answers to several questions concerning recommendations for changes in their grazing operations before adoption. Questions such as; what will it cost, can it be used for my ranges, how long will it take to obtain results, can it be expected to pay off, have high priority in their thinking about changes in grazing operations. A majority of rangeland operators and managers are willing, we believe, to apply range-improvement procedures, when they realize that forage production is not what it might be, and information on practical improvement procedures is available to them.

There are limitations in the application of light grazing as a range-improvement practice. These limitations are no more restrictive, however, than those for other methods that might be used for range improvement. Light grazing has not received the consideration it merits for the improvement of deteriorated perennial range vegetation.

Investigation of this thesis requires a clear understanding of a few fundamental concepts of rangeland operation. The growth of palatable herbage produced each year is the renewable natural resource of rangelands. It is the crop. The domestic livestock and wild game that graze this herbage are the harvesting and marketing media. Financial profits are the prime motive for range-livestock operations. Maintenance of the resource is essential to continuing profits. Efficient rangeland management maintains or improves the resource and then pays a good return for the forage that is removed by grazing animals.

Definition of Terms and Conditions

Grazing management is the science and art of using livestock to harvest and market range and pasture forage. It is a highly important segment of the broader field of range management. Grazing management is very closely interrelated with other segments of range management, such as; soil and water management, and undesirable plant control; in their effects on the volume of palatable herbage produced on rangelands and on the economy of rangeland operation. It is applicable wherever grazing animals are used to harvest range vegetation.

Deteriorated ranges are those on which the desirable native forage species are still present, well distributed, and have fair frequency but owing to low plant vigor, poor ground cover, competing unpalatable species, or combinations of these conditions, the annual production of palatable herbage is below the site capacity. Depleted native ranges, in contrast, are those on which the desirable native forage species have been almost or entirely killed out or are severely suppressed by undesirable species. Abandoned plowed lands are included with depleted ranges, as offering little opportunity for improvement in her-

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bage production by grazing-management practices alone.

Definitions of grazing intensities also are pertinent to this discussion. Three terms (heavy-, moderate-, and light-grazing) have been used widely in range-management literature to designate broad differences in intensities of herbage utilization by livestock. Heavy grazing as used herein means a degree of herbage utilization that does not permit the desirable forage species to maintain themselves. Its continued application leads to deterioration of the range vegetation. Moderate grazing means a degree of herbage utilization that allows the palatable species to maintain themselves but usually does not permit them to improve in herbage-producing ability. Moderate grazing leads to the stabilization of existing range conditions. Light grazing means a degree of herbage utilization that leaves to the palatable species, sufficient of their current growth to develop herbage-producing ability to the maximum of the site capacity. Light grazing leads to the improvement of deteriorated range condition up to the site capacity.

Gross forage income per acre, as used in this analysis, is the value returned per acre by the livestock that grazed the range vegetation. A rangeland manager can compute this value with little difficulty for each grazing unit he operates, as well as, for his entire grazing operation.

Range Improvement from Light Grazing

The effects of light grazing on deteriorated range take several forms, increased little cover, retarded water runoff and increased water infiltration into the soil, reduced soil erosion, improved vigor of palatable plants, increased herbage growth, and improved variety and quality of the forage. Not all of these effects are to be expected from every application of light grazing. Rangeland operators naturally are more interested in increased yields and quality of forage than in other effects of light grazing. The other effects should not be ignored by rangeland operators, however, in making decisions concerning light grazing for range improvement.

Range herbage yields as affected by grazing intensity have been reported from a few grazing-intensity studies in recent years. Johnson et al. (1951) grazed west-central South Dakota midgrass range vegetation with cows and calves at heavy, moderate, and light intensities 1942 through 1950. Three-year (1942-1944) average yields of air-dry herbage were 1399, 1409, and 1636 pounds per acre respectively from heavily-, moderately-, and lightly-grazed pastures early in the experiment. Corresponding 3-year (1948-1950) average yields were 974, 1454, and 2157 pounds per acre. Heavy grazing reduced yields over 400 pounds per acre, moderate grazing maintained yields and light grazing allowed yield increases of over 500 pounds per acre.

Launchbaugh (1957) grazed yearling beef cattle on west-central Kansas short-grass range vegetation at stocking rates of 2.0, 3.4, and 5.1 acres per head-season, 1946 through 1956. He used a May 1-October 28 grazing period and vegetation condition was considered uniform among pastures in 1946. Herbage yields determined in 1956 were 1096, 1245, and 1963 pounds per acre, respectively from the heavily-, moderately-, and lightly-grazed pastures. Water infiltration rates on his pastures after 7 years application of the grazing treatments were 0.73, 1.19, and 1.58 inches per hour, respectively, for heavy, moderate, and light grazing.

North-central Colorado short-grass range vegetation was grazed at 3 intensities by yearling heifers during a 6-months warm season, 1940 through 1953 in studies conducted by Klipple and Costello (1960). Three-year (1940-1942) average yields of air-dry blue grama *(Bouteloua gracilis)* and buffalograss *(Buchloe dactyloides)* herbage were 668, 654, and 591 pounds per acre respectively from the heavily-, moderately-, and lightly-grazed pastures early in the experiment. Similar 3-year (1946-1948) average yields, six years later, were 470, 668, and 657 pounds per acre. Herbage yields from the heavily-grazed pastures were significantly less than they had been in the earlier period. Yields from the moderately-grazed pastures were practically the same as in the earlier period. Yields from the lightly-grazed pastures had increased to approximate equality with those from the moderately-grazed pastures. Herbage yields from the taller midgrasses, such as; western wheatgrass *(Agropyron smithii)*, needle-and-thread *(Stipa comata)*, alkali sacaton *(Sporobolus airoides)*, sand dropseed *(Sporobolus cryptandrus)*, and prairie sandreed *(Calamovilfa longifolia)* were not obtained in the early years owing to their low production. Midgrass yields were obtained after 1948. Their collective average yields in 1949 were 62, 122, and 243 pounds of air-dry herbage per acre respectively from the heavily-, moderately-, and lightly-grazed pastures. The yield of midgrass herbage from the lightly-grazed pastures was significantly larger than the midgrass herbage yield from the moderately-grazed pastures that year, and this relationship was repeated in 9 of the 10 following years, (unpublished data available to the authors).

The effects of light grazing on deteriorated short-grass vegetation were investigated by the Rocky Mountain Forest and Range Experiment Station, in a heretofore unreported study at Central Plains Experimental Range,[3] Nunn, Colorado, from 1943 through 1952. The deterio-

rated vegetation on three half-section pastures received light utilization by yearling steers during an early-May to early-November grazing season each year. Data, from pastures in another study that were stocked with yearling steers for moderate utilization of shortgrass vegetation in good range condition during the same grazing season, were available each year to give vegetation response, cattle weight gain, and price data comparisons with the data from the pastures that were lightly grazed.

Yields from the palatable grasses on the lightly-grazed pastures averaged 560 pounds of air-dry herbage per acre in 1943. Yields from the same grasses that year on the moderately-grazed pastures averaged 800 pounds per acre. Average yields from the palatable grasses in 1951, a year when average herbage production was similar to that of 1943, were 740 pounds per acre on the pastures that had been moderately grazed and 815 pounds per acre on the pastures that had been lightly grazed. Moderate grazing had approximately maintained herbage-producing ability while light grazing had fostered a 45 percent increase in the herbage-producing ability of the range vegetation that had been in a deteriorated condition in 1943. Increased stocking was required after 1949 to obtain the planned 25 percent utilization of the forage, on the lightly-grazed pastures. This increased herbage-producing ability of the vegetation on those pastures has been maintained under moderate utilization of the vegetation during 6 recent years, (unpublished data available to the authors).

Johnson's (1953) grazing-intensity study on the ponderosa pine-bunchgrass ranges of the Colorado front range did not develop measured differences between herbage yields from moderately- and lightly-grazed pastures. Light grazing did, however, develop a larger percentage of the herbage from the more desirable species than the percentage developed by moderate-grazing.

These research results demonstrate that the application of light grazing does effect improvement in the yielding ability of deteriorated range vegetation. They indicate also that most of this improvement is obtained in the first 5 to 7 years of its application, and that added improvement in range condition from light grazing alone is very small after 7 years of its application.

Evaluation of Costs and Returns from Application of Grazing-Management Practices

Simple and easy methods have not been developed to evaluate the costs of or the returns from the application of range-improvement procedures, Caton et al. (1960). The necessity of using livestock to harvest and market range forage has contributed materially to these difficulties. A number of indirect costs and returns accompany livestock grazing operations. Most of these indirect items are often very similar for the two or three grazing-management practices that a rangeland operator can use.

Under those conditions differences in gross forage income per acre appear to be fair criteria to evaluate the economic possibilities of applying one or another of the grazing-management practices that could be applied. Dollar and cent values per acre of rangeland also are the most realistic expressions of these types of data.

In this connection rangeland operators and managers, in choosing between or among available grazing practices, should make their computations and comparisons in relation to the deteriorated range vegetation on which they plan to use the practice. The grazing procedures under consideration should be compared on the basis

Table 1. Gross forage incomes per acre developed from applying three methods of obtaining cattle to harvest and market forage to average data from recently published grazing-intensity studies.

Authority and grazing intensities	Methods of obtaining cattle[1]		
	a	*b*	*c*
	— — — (Dollars) — — —		
Johnson, W. M. (1953)			
Heavy (5 mos.)	1.24	0.74	0.88
Moderate (5 mos.)	1.10	0.88	1.48
Light (5 mos.)	0.63	0.49	1.05
Launchbaugh, J. L. (1957)			
Heavy (5.3 mos.)	7.95	6.89	—3.65
Moderate (5.8 mos.)	5.12	6.51	4.97
Light (5.9 mos.)	3.54	5.14	5.21
Klipple, G. E. and D. F. Costello (1960)			
Heavy (6 mos.)	1.88	1.41	1.54
Moderate (6 mos.)	1.12	1.20	1.93
Light (6 mos.)	0.73	0.86	1.41

[1] *a.* A rental fee of $3.00 per head-month of yearling grazing; adpoted as representative of western range practice, from average data for the 1957, 1958, and 1959 grazing seasons provided by the Crop Reporting Board, Agricultural Marketing Service, U.S.D.A.
b. One-half of the cattle weight gain per acre at the fall price of the cattle.
c. Spring purchase and fall sale of the cattle.

[3] *Operated by Agricultural Research Service, in cooperation with Forest Service, U. S. Department of Agriculture. Formerly operated by the Rocky Mountain Forest and Range Experiment Station, Forest Service, in cooperation with the Soil Conservation Service, U. S. Department of Agriculture.*

of stocking rates that would apply them to the herbage production of the deteriorated range vegetation.

Rangeland operators and managers who have forage to harvest and market can obtain livestock to do it under any one of a wide variety of arrangements. Three methods that are in use in the range states, have been used in this analysis to compare gross forage incomes per acre obtained from light and other intensities of grazing with yearling cattle. These are:

a. A grazing rental fee per head-month of grazing.
b. A fee per head-season computed from one-half the cattle weight gain per acre at the fall price of the cattle.
c. Spring purchase and fall sale of the cattle.

These methods of marketing range forage are referred to hereafter in this analysis as methods *a, b,* and *c* respectively. The indirect items furnished and received by the party who controls the forage are very similar for each intensity of stocking under each method, but these items differed among methods. Forage incomes per head were divided by acres of rangeland grazed per head to give per acre gross forage income values produced by grazing intensities.

A few grazing-intensity research studies have reported, in recent years, data applicable in this analysis, Johnson (1953), Launchbaugh (1957), and Klipple and Costello (1960). Forage incomes per acre were computed by methods *a, b,* and *c* for the average data reported by these studies (Table 1), on the assumption that the average herbage productions per acre on the pastures were nearly equal early in the experiments. These methods also were applied to data, from the previously unreported study with yearling steers, carried out at Central Plains Experimental Range and cited above, to give year by year (1943-1952) comparisons of gross forage incomes from stocking for light and moderate utilization of deteriorated range vegetation. Ten-year averages, only, are reported.

Method *a* data, in Table 1, make stocking for heavy utilization of the range vegetation appear to be the most profitable grazing procedure to use. They indicate also why abuse of the vegetation has been frequent under this method of marketing forage, and why many cattle owners demand acreage guarantees per head-season in connection with paying a fee per head-month of grazing. Marketing range forage by method *a* has contributed materially, we believe, to rangeland operators' beliefs that stocking for light grazing for range improvement has little chance of paying off.

Method *b* data, where cattle weight gains and cattle prices were included in the forage income computations, show that the advantage of heavy grazing over moderate grazing disappeared for one study and was materially reduced for the other two. The small differences in favor of heavy grazing could have been offset easily by deterioration in the range resource. Differences between forage incomes from moderate grazing and those from light grazing were reduced slightly under method *b* as compared with those under method *a*.

The possible highly-variable costs, for the use of cattle to do the grazing, as influenced by stocking rates were accounted for in the method *c* forage incomes. Moderate grazing returned larger forage incomes than heavy grazing in all three studies. Forage incomes from light grazing were larger than those from heavy grazing in two of the three studies, and only slightly smaller in the third study. Light grazing also produced a higher forage income per acre than moderate grazing did in one study.

Light grazing of deteriorated range vegetation at Central Plains Experimental Range was obtained in 1943, 1944, and 1945 with an average stocking rate of 21.5 acres per yearling steer for a 180-day season. Acres per head season varied from 22.5 in 1943 to 17.8 in 1952, and averaged 20.5 acres. It was computed that stocking this vegetation for moderate grazing would have required a uniform rate of 16 acres per steer season. Method *a* annual forage incomes per acre from moderate grazing would have ranged from 32 cents to 11 cents larger and averaged 24 cents larger than those obtained from light grazing during the 10 years 1943-1952 (Table 2). Method *b* annual forage incomes per acre from moderate grazing would have varied from 35 cents to 5 cents larger and averaged 17 cents larger than those obtained from light grazing during the same years. Method c annual forage incomes per acre from moderate grazing were larger than those from light grazing in 5 of the 10 years, and the relationship was reversed during the other 5 years. Light grazing averaged 7 cents larger income for the 10-year period. These data demonstrate that rangeland operators can apply light grazing for range improvement at relatively low costs per acre. Those who are harvesting forage with cattle they own can apply light grazing to a grazing unit for a few years with little or no reduction in gross forage income from the unit.

Comparative Costs of Alternate Range-Improvement Practices

Rangeland operators who have deteriorated native range to manage could apply one of several procedures in its management. They could continue the management that has produced the deterioration, graze moderately to stabilize the deteriorated condition, graze lightly to allow the

Table 2. Ten-year average gross incomes per acre from the forage on deteriorated rangeland marketed through grazing yearling steers at a light intensity of herbage utilization, 1943-1952, at Central Plains Experimental Range; and the gross incomes per acre that the same range would have made had the pastures been stocked for moderate grazing during the same years, as determined by three methods of selling range-forage.

Method of obtaining use of cattle	Forage income per acre		
	Grazing intensity		
	Light	Moderate	Difference
	(Dollars)		
a	0.88	1.12	—0.24
b	1.70	1.87	— .17
c	2.75	2.68	.07

desirable forage species to recuperate, change the season of use, defer and rotate grazing, or select one or more of several alternate range-improvement practices. Alternate methods often recommended for range improvement are non-use for 2 or 3 years, control of undesirable species to reduce competition, mechanical treatments like pitting or contour furrows to reduce water runoff, fertilization, and reseeding to more productive species. The major elements involved in selecting a method are the condition of the range, costs of applying the method, time required to get results, and the value of the probable increase in herbage production. What are the costs of using some of these alternate methods?

Non-use eliminates all income for the years it is applied, and fixed charges have to be met. Its annual cost for the four studies discussed previously would have been three to many times the cost of applying light grazing.

Control of undesirable speices to reduce competition takes several forms; mowing, burning, and chemical and mechanical treatments. Numerous reported costs range from as low as 50 cents to as high as 15 dollars per acre. Furthermore, damage to the desirable forage species by the control method may require a year or two of non-use, light grazing, or reseeding of the treated area for desirable species to take control of the site again.

Mechanical treatments such as pitting, chiseling and contour furrowing require equipment and power to pull it. Cash outlays ranging from 2 to 4 dollars per acre usually are required. The desirable forage species are damaged to some extent, and they may require a year or more to regain their before-treatment production of herbage.

Fertilization requires cash outlays for material, transportation, equipment use, and labor. Costs range upward from a minimum of approximately five dollars per acre. Furthermore chemical fertilization to be effective requires good moisture conditions.

Plath (1931) reported reseeding costs of 4 to 15 dollars per acre for eastern Oregon ranges. The need and methods used for removal of competing vegetation was the largest variable factor in costs. Bleak and Plummer (1954) stated that reseeded ranges in the intermountain region represent an outlay of 5 to 12 dollars per acre. Two to four years of protection for stand establishment was required in addition to the initial outlay. Pingrey and Dortignac (1957) found that seeding depleted rangelands in northern New Mexico cost 6 to 9 dollars per acre and that seeding croplands cost 7 to 8 dollars per acre. Sitler (1958) estimated the cost of seeding cropland to crested wheatgrass *(Agropyron desertorum)* in eastern Colorado to be $10.50 per acre, after a credit of $7.00 per acre for the first-year sorghum crop was allowed. This cost did not include any failure or fencing costs.

Reseeding trials on stabilized abandoned croplands at Central Plains Experimental Range, and on nearby ranches and Land-Utilization-Project lands, under a 12-inch average annual precipitation, show a wide range of costs per acre of satisfactorily seeded stands. Failures and near failures have been frequent. A few satisfactory stands have been obtained at costs of less than 10 dollars per acre, while others have cost more than 50 dollars per acre, the cost depending on the number of failures. Deteriorated native ranges cannot be reseeded any cheaper than abandoned plowed lands.

There are, no doubt, conditions on western rangelands, under which each of these alternate range-improvement practices is appropriate. All require substantial cash costs. These cash costs must be liquidated by net profits from increased yields before any financial benefits accrue to profits from the application of the improvement practice. Careful consideration of cash costs and probable net profits are required in the selection of the practice to apply.

Discussion

The logical time to apply light grazing for range improvement is before the deterioration of the range condition is such that other more-expensive methods have to be used to effect satisfactory recovery. The low cost of light grazing and favorable results obtained from its use make it entirely feasible for use on native ranges that have stands of desirable forage species that control the site, but are poor producers owing to low vigor of the plants. Light grazing is effective also on ranges with poor cover of desirable forage species if competition from undesirable species is not a problem. Grazing

units can be gradually returned to moderate utilization of the herbage as the density and vigor of the desirable forage plants approximate the site capacity.

The cost of applying light grazing for range improvement on deteriorated native ranges is low compared with the costs of other range-improvement procedures. This is especially true for the rangeland operator who harvests his forage crops with livestock that he owns. Light grazing can be applied to existing grazing units without additional fencing costs and with some reduction in other grazing costs. Income from the forage is received each year to meet fixed charges on the grazing unit. Additional capital outlay is not required. Alternate methods for range improvement seldom are accompanied by these advantages during the early years of their application. Light grazing is an effective and economical procedure for the improvement of deteriorated native ranges.

Light grazing alone is not effective on ranges if competing undesirable species control the site. Also, there are millions of acres of western rangelands so depleted of desirable forage species that reseeding will be required for their rehabilitation. A combination of light grazing and selective chemical-control methods for undesirable plants, however, should be given consideration before mechanical control and reseeding are used for areas where fair stands of desirable forage species are still present, but suppressed by the competition.

Summary

Light grazing has been used only infrequently by rangeland managers as a range-improvement practice. Their reasons for not doing so arise from doubt on their part as to its economic feasibility and its effectiveness. Results from a number of controlled grazing-intensity studies reported over the past 20 years are analyzed in relation to the validity of these doubts.

Light grazing for a few years does increase the herbage-yielding ability of deteriorated native ranges. The cost of applying light grazing is low in comparison with costs of other methods often used for range improvement. The logical time to use light grazing for range improvement is before the range has become depleted. Light grazing cannot do the job alone when competing undesirable vegetation dominates the site. Results of grazing-intensity studies demonstrate that light grazing is economically feasible when results are expressed in dollars received for the forage per acre of rangeland.

LITERATURE CITED

BLEAK, A. L. AND A. PERRY PLUMMER. 1954. Grazing crested wheatgrass by sheep. Jour. Range Mangt. 7:63-68.

CATON, DOUGLAS D., CHESTER O. MCCORKLE, AND M. L. UPCHURCH. 1960. Economics of improvement of western grazing land. Jour. Range Mangt. 13:143-151.

COSTELLO, DAVID F. 1942. Maintaining short-grass ranges. Colorado Ext. Bul. D-33, 11 pp.

COTTON, J. S. 1905. Range Management in the state of Washington. Bur. Pt. Ind. Bul. 75, 28 pp.

JARDINE, J. T. AND N. ANDERSON. 1919. Range Management on the national forests. U. S. Dept. Agr. Bul. 790. 119 pp.

JOHNSON, LESLIE E., LESLIE A. ALBEE, R. O. SMITH, AND ALVIN L. MOXON. 1951. Cows, calves and grass. So. Dak. Agr. Exp. Sta Bul. 412. 39 pp.

JOHNSON, W. M. 1953. Effects of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunchgrass range of the front range of Colorado. U. S. Dept. Agr. Circ. 929. 36 pp.

KLIPPLE, G. E. AND DAVID F. COSTELLO. 1960. Vegetation and cattle responses to different intensities of grazing on short-grass ranges of the Central Great Plains. U. S. Dept. Agr. Tech. Bul. 1216. 82 pp.

LAUNCHBAUGH, J. L. 1957. The effect of stocking rate on cattle gains and on native shortgrass vegetation in west-central Kansas. Kans. Agri. Exp. Sta. Bul 394. 29 pp.

PINGERY, H. C. AND E. J. DORTIGNAC. 1957. Cost of seeding Northern New Mexico rangelands. New Mexico Agr. Exp. Sta. Bul. 413. 43 pp.

PLATH, C. V. 1951. Cost guides for range reseeding. Ore. Agr. Exp. Sta. Circ. of Inf. 497. 14 pp.

SAMPSON, ARTHUR W. 1914. Natural revegetation of rangelands based on growth requirements and life history of the vegetation. Jour. Agr. Res. 3:93-148.

SITLER, HARRY G. 1958. Economic possibilities of seeding wheatland to grass in eastern Colorado. U. S. Dept. Agr., Agr. Res. Ser., ARS 43-64. 33 pp. proc.

SMITH, J. G. 1895. Forage conditions of the prairie region. U. S. Dept. Agr. Yearbook. 309-324.

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