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Effects of Strip Versus Continuous Grazing on Diet Parameters and Performance of Steers Grazing Eastern Oregon Native Flood Meadows[1]

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Abstract

Native flood meadows in the northwestern U.S. are typically managed for hay production. However, management for use by grazing livestock is receiving increased interest. Irrigation water is primarily supplied by surface runoff from snowmelt occurring at higher elevations surrounding the meadows. This experiment was conducted to compare strip (SG) and continuous grazing (CG) effects on livestock diet quality and subsequent performance. On May 1, groups of 20 steers (253 kg) were randomly allotted to two replicates of SG and CG treatment pastures (5.6 ha each). Animals in SG pastures were confined by electric fence to an area large enough to provide approximately 65% utilization after a 5- to 7-d grazing period. Average strip size was .5 ha, and varied from .23 to 1.15 ha. Herbage allowance was between 305 to 1131 kg/AU under CG, and 72 to 198 kg/AU for SG treatments, as measured on d 1 in each strip.

Biweekly esophageal extrusa samples and total fecal collections showed that over the grazing season, average CP of extrusa samples from CG tended to be higher than SG (P = .14), at 13.9 and 10.9%, respectively. Crude protein declined significantly between May and September. Diet IVDDM varied between treatments (P = .07), at 64.6 and 60.7% on CG and SG, respectively. Grasses were more frequent in extrusa samples from SG than CG (P = .06), at 49 and 35%, respectively. Meadow foxtail was the most common grass on the meadows and was more frequent in SG extrusa samples (P = .05). Forage intake was similar (P = .42) for both treatments, at about 2.1% of body weight per day. Steers were weighed biweekly. Steer average daily gain was greater under CG (P = .09) (1.16 kg/day) than SG (.77 kg/day).
(Key Words: Grazing System, Beef Cattle, *Alopecurus pratensis*.)

Introduction

Approximately 1.6 million ha have been classified as mountain meadows in the 11 western states, of which slightly less than half is privately owned (6). In eastern Oregon, most of these native flood meadows (NFM) produce hay and are irrigated by stream flow. In the Harney Basin, control of water is minimal, resulting in an uncontrolled flooding system (23) which often prevents haying until forage has become mature. Traditional management of NFM involves haying in summer, with grazing of aftermath and regrowth in the fall, prior to winter hay feeding. Meadows are often fertilized with nitrogen in early spring, with hay fields of about 3400 kg/ha. Regrowth potential after haying is low (9, 23) because soils dry rapidly after surface flooding ceases in late June.

Meadows in this area were historically dominated by *Juncus* and *Carex* species, but have recently shifted to stands dominated by meadow foxtail (*Alopecurus pratensis*), an introduced species. Meadow foxtail grows early in spring and produces

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high yields; however, it often reaches maturity in mid-June (10). Inability to control timing and duration of surface flooding usually prevents cutting for hay until early to mid-July, resulting in a lower quality hay.

Meadow foxtail recovers quickly after grazing (28) and will continue to grow as long as soil water is adequate. Grazing, therefore, may have considerable potential for improving management of NFM which contains meadow foxtail. One objective would be to remove flowering culms and stimulate development of vegetative tillers. Short-duration grazing (SDG) uses elevated stock density to improve distribution of livestock. Savory and Parsons (25) stated that SDG could be used to realize increased livestock and forage production; however, interactions with stocking rate have been reported (20). Highly productive areas appear to be well adapted to intensive management (29). Strip grazing is analogous to SDG in that animals are confined to small portions of the pasture; however, a movable fence is used with strip grazing which allows greater flexibility in controlling grazing area and location. Research in Great Britain (13, 35) indicated that animal production per ha could be increased when strip sizes were sufficient to provide a 1 d supply of forage. In New Zealand, two strips per day provided similar results (17). In Oregon, hay was harvested and raked into bunches which were left in place on the meadows (34). These bunches were then strip grazed on 5-d intervals by beef cattle in winter. Strip grazing management provided nearly complete utilization of hay and excellent animal performance, which suggests that SG may be an efficient way to harvest standing forage.

Grazing of meadows containing meadow foxtail would therefore appear to be a viable alternative to harvesting for hay only. Objectives of this research were to determine if diet quality, diet botanical composition, intake, and animal performance were similar under strip (SG) or continuous (CG) grazing management.

Methods

Study Area. The study was conducted on a 23-ha native flood meadow at the Eastern Oregon Agricultural Research Center 6 km south of Burns, OR, elevation 1230 m. Dominant grasses are meadow foxtail, saltgrass (*Distichlis stricta*), reed canarygrass (*Phalaris arundinacea*), quackgrass (*Agropyron repens*), and Nevada bluegrass (*Poa nevadensis*). Sedges (*Carex* spp.) and rushes (*Juncus* spp.) are also important components. Common forbs include hesperochiron (*Hesperochiron pumulus*) and common dandelion (*Taraxacum officinale*), with arrowgrass (*Triglochin maritima*) scattered in small quantities throughout the pasture.

Treatments. In April, the 23-ha meadow was fenced into four equal pastures of about 5.6 ha. Treatments were CG and SG, with two replications each. Steers on CG had access to the entire pasture at all times, while animals on SG treatments were restricted to subunits of the pasture (strips) by portable electric fencing. Fences were moved to a new ungrazed area on 5- to 7-d intervals, when forage was visually estimated to be 65% utilized. Strip size was determined as detailed below and decreased as forage standing crop increased.

Animals. Eighty yearling steers (253 ± 17 kg) were stratified by weight into four groups, with each group randomly assigned to treatments. In each group, 15 steers were used to collect performance data, 3 were used for total fecal collection, and 2 with esophageal fistulas were utilized to collect extrusa samples. The 15 steers were weighed biweekly after overnight restriction from feed and water.

At weaning the previous fall, steers had received clostridials, infectious bovine rhinotracheitis, and bovine viral diarrhea vaccinations. Prior to placing animals on treatment, all steers received zeranol and were revaccinated for the clostridials. Insecticidal ear tags were applied, and animals were maintained on meadow vegetation for 4 wk prior to study initiation.

Sampling. Quantity of live standing crop was estimated by clipping ten .19-m² quadrats to ground level at biweekly intervals on the CG treatment and on the first and last days of grazing in each SG unit. Ungrazed exclosures (10 by 33 m) within each pasture were sampled concurrently with CG clipping dates using similar procedures. Forage availability was expressed as herbage allowance (HA) (kg/AU) and represents the ratio of forage mass per unit animal demand at any point in time (26, 27). For strip-grazed pastures, HA was calculated from forage availability on d 1 of each grazing period.

Diet sampling was conducted approximately bi-weekly to coincide with the second day of grazing in each strip. Collections were made in each pasture on two consecutive days. Esophageal fistulated steers were fasted overnight, fitted with screen bottom collection bags, and released to graze for 35 to 40 min. Following grazing, bags were removed and extrusa was stirred and subsampled for determinations of diet quality. Extrusa was placed in plastic bags and immediately frozen for later laboratory analyses. Extrusa samples were later dried at 55 C and ground to pass a 1-mm screen. After determination of dry matter (DM), ash was determined by combustion at 500 C in a muffle furnace (2). Nitrogen percentage was determined by macro-kjeldahl digestion and reported as crude protein (CP = N × 6.25) (11). Digestible dry matter (IVDDM) was determined by 48 h in vitro digestion (33).

Total fecal collections began the day following diet collections. Fecal bags were placed on the animals by 0700 and remained in place for 24 h. Upon removal, fecal bags were weighed and the quantity of feces determined. After stirring, two samples were obtained and used for later determination of botanical composition and DM. Fecal samples for DM determination were dried at 65 C and weighed to the nearest gram at 24-h intervals until two identical weights were recorded, at which time the samples were considered dry. Dry matter intake was calculated from IVDDM and total fecal DM output at each sampling date.

Fecal subsamples used for estimation of diet botanical composition were immediately suspended in 100-ml sample jars containing 40 ml ethyl alcohol. Later, these samples were used to determine diet composition by microhistological analysis (31). Ten fields on each of two slides were examined for each animal at each date. Samples were not pooled across animals. Plant material was classified as grasses, sedges, rushes, and forbs. Within the grasses, meadow foxtail, quackgrass, Nevada bluegrass, and reed canarygrass were also quantified.

Statistical Analysis. The experiment was established as a randomized complete block, with blocking based on 1988 hay production figures. Data were analyzed as a split plot in time (32), using block by treatment as whole plot error. Sampling periods (n = 9) were subplots, with block by treatment by period as subplot error. Analysis of variance was conducted using general linear models procedures (24). Predetermined mean separations between treatments by period were determined by nonorthogonal contrast using Bonferroni (Dunn) t statistics. This procedure does not require a prior significant difference between means in the main effects because the total probability of a Type I error (α) is divided among the number of designated comparisons (7). Comparisons were made between the calculated t and tabular critical values of t, where $t = \alpha/C$ (C = number of contrasts compared). Nine comparisons were made (nine collection periods) and tested against tabulated values of t (8) at significance levels of $P \leq .05/9$, .01/9, .005/9, and .001/9.

Results and Discussion

Forage. Winter snowpack is critical for summer forage production because irrigation is provided by surface runoff. Streamflow from snowmelt was 117% above average as of April 1, 1989. Spring precipitation and above-average flooding resulted in forage yields 2 to 3 times normal. Forage growth was extended into August because of rain in late July and early August. Forage production was slow in May and early June because of cool temperatures. Live standing crop increased significantly ($P < .05$) during the 2-wk period from June 12 to June 26 and peaked at 9300 kg/ha on July 10, at more than twice the average for this area (Figure 1). Hay production during average years has ranged from about 3400 kg/ha (9) to 2250 kg/ha in early grazing studies on native flood meadows (4). Standing crop on the CG treatment peaked about July 1 and then began to decrease as forage growth rate decreased. Ungrazed standing crop ranged from 1170 kg/ha the first week of May to 7097 kg/ha on June 20, 1 wk before returning to regrowth.

Herbage allowance on CG pastures reflected the increase in standing crop (Figure 2) which occurred in June and July. This curve is typical for seasonally grazed pastures, although the magnitude was affected by the above-average level of

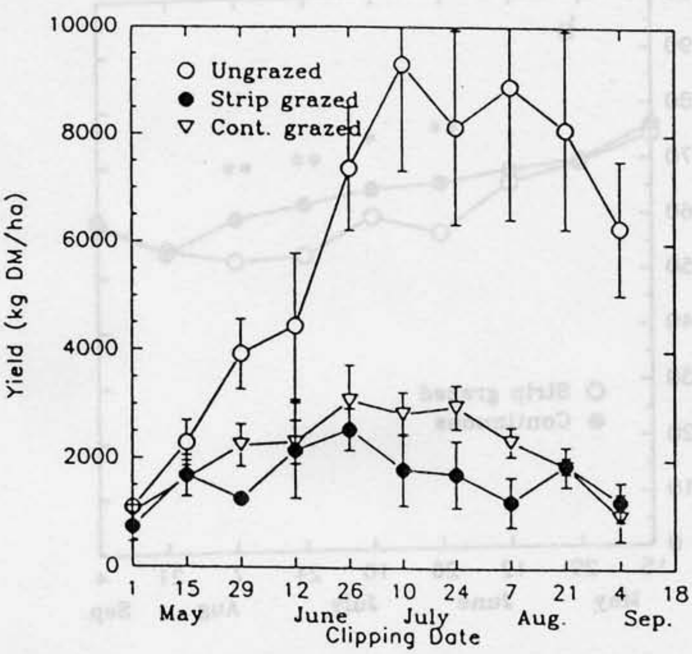

Figure 1. Standing crop of ungrazed, strip-grazed, and continuously grazed native meadow forage during 1989. Data from strip-grazed plots are from the last day of grazing in a strip, except for May 1 which was the first day of the study.

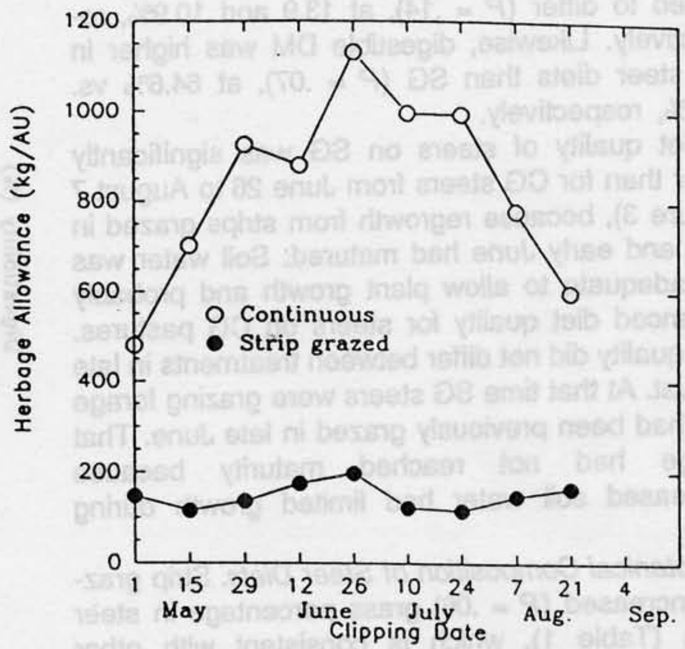

***Figure 2.* Herbage allowance (kg/AU) on strip-grazed versus continuously grazed native meadow. One AU represents a forage demand of 12 kg/day.**

production. By contrast, HA remained relatively constant through the spring and summer for SG pastures, which indicates that grazing pressure on d 1 of grazing in each strip remained relatively constant. Lower HA in SG pastures resulted in more uniform removal of reproductive stems during grazing in each strip from May through early June. By contrast, steers in CG pastures were able to select regrowth from areas grazed earlier and consumed relatively fewer reproductive stems. Ungrazed plants in CG pastures grew to maturity and were not efficiently utilized later in July and August.

Pasture size and stocking density for this study were based on average forage production estimates from past year's data and indicated that an initial stocking density of about 2 AU/ha would be appropriate. However, above-average growing conditions resulted in understocking of both treatments. By mid-June, standing crop of ungrazed plots already exceeded typical end-of-season forage yields. Additional livestock were not available to increase rate of demand for forage. As a result, on June 26 forage in ungrazed portions of the SG treatment was reaching maturity, and regrowth forage in strips grazed in May was flowering. Based on these observations, the remaining ungrazed forage in the SG treatment was cut for hay, and steers were returned to the strips grazed on May 1 to begin the second rotation. Data from the hayed area were not included in later analysis of forage or livestock production. However, removal of this area from grazing did decrease the pasture area grazed by SG steers and was reflected in calculations of animal production per unit area. Lucas and McMeekan (17) described a similar situation with break grazing (strip grazing) on New Zealand pastures. These researchers believed that break grazing acted to conserve forage in a portion of the pasture in quantities suitable for salvage as hay or silage.

Diet Quality. Dietary CP and IVDDM both declined significantly ($P < .05$) over the summer (Figure 3), which is a typical result of advancing plant maturity (18, 21, 23). Decreases in forage quality were likely minimized for CG steers by greater HA, which allowed animals to select higher quality regrowth tissues (22). The SG steers did not have this advantage because HA was maintained at much lower levels (Figure 2), and access to previously grazed areas was prevented. Between

CG and SG treatments, seasonal means for CP tended to differ (P = .14), at 13.9 and 10.9%, respectively. Likewise, digestible DM was higher in CG steer diets than SG (P = .07), at 64.6% vs. 60.7%, respectively.

Diet quality of steers on SG was significantly lower than for CG steers from June 26 to August 7 (Figure 3), because regrowth from strips grazed in May and early June had matured. Soil water was still adequate to allow plant growth and probably enhanced diet quality for steers on CG pastures. Diet quality did not differ between treatments in late August. At that time SG steers were grazing forage that had been previously grazed in late June. That forage had not reached maturity because decreased soil water had limited growth during July.

Botanical Composition of Steer Diets. Strip grazing increased (P = .06) grass percentage in steer diets (Table 1), which is consistent with other reports of floristic changes in animal diets under intensive grazing management (13, 15, 22, 29).

The rush and sedge component of steer diets tended to be greater for CG animals (63%) than for SG (49%) (P = .14). Forbs represented only minor amounts in steer diets (<1%), and no differences were detected in forb consumption between treatments. Meadow foxtail was significantly greater (P = .05) in SG (43.9%) than in CG (27.1%) diets. Holmes et al. (13) reported that strip grazing of highly productive summer pasture favored the more vigorous grasses. Regrowth potential of native sedges and rushes is low (23) but meadow foxtail has been shown to produce regrowth (28). Therefore, strip grazing may have increased the standing crop of meadow foxtail relative to sedges and rushes, and influenced percentages of grass in steer diets. However, as strips were moved across the pasture, relative percentages of meadow foxtail in the stand changed based on changes in soil type and flooding depth. This was probably the most important factor determining changes in botanical composition of SG diets as steers moved from one strip to the next. By contrast, CG animals were able to graze freely among all available plant communities. Figure 4 illustrates the change in botanical composition of animal diets at each collection period with respect to these vegetation classes. Strips

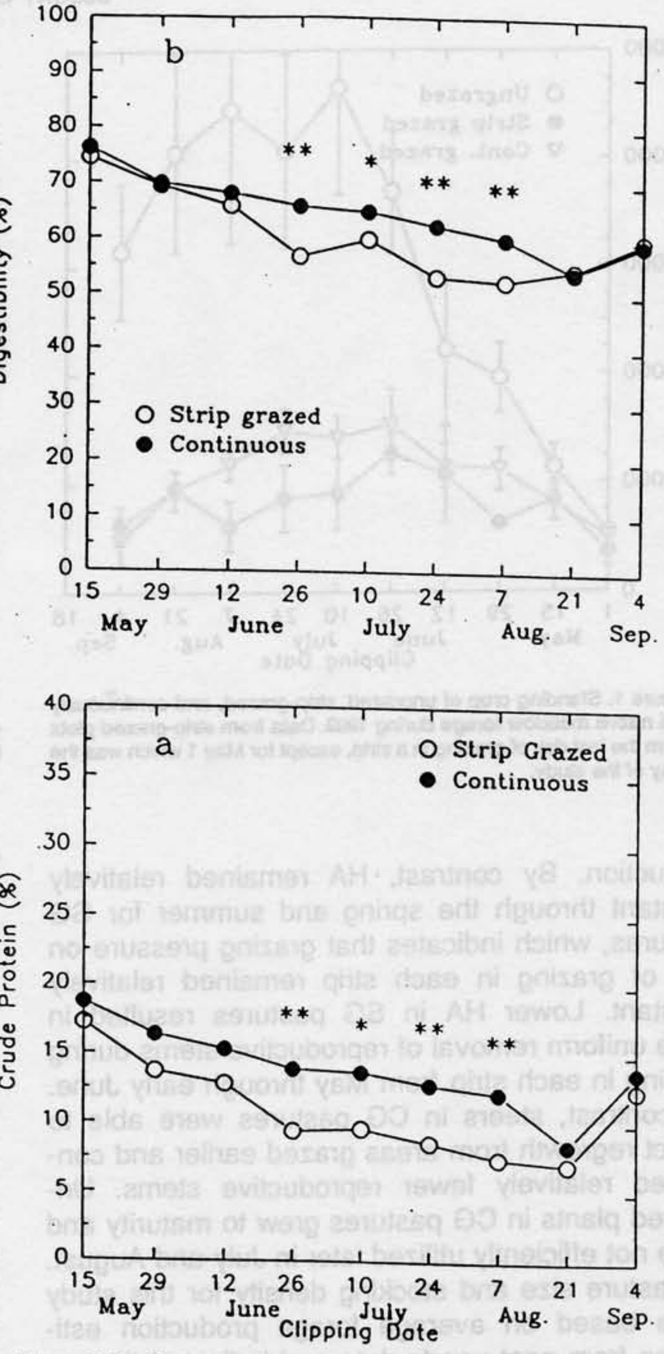

Figure 3. Crude protein (CP) (a) and in vitro digestible dry matter (IVDDM) (b) of steer diets on continuous or strip-grazing systems. Asterisks (*, or **) indicate grazing treatments differ at $P \leq .05$, or .01, respectively.

in early May were located in an area that was dominated by sedges and rushes, while later, in June, strips were dominated by meadow foxtail.

Grass in the CG diets remained relatively constant through June, but steers appeared to select

TABLE 1. Percentages of grass, rush/sedge, or forbs observed in fecal samples of steers grazing in continuous or strip-grazed pastures from May 1 to Sept 4, 1989.

Plant category	Treatment		
	Continuous	Strip	SE
	%		
Grasses	35[a]	49[b]	4.0
Rushes/sedges[c]	63	49	5.4
Forbs	<1	<1	>0.1

N = 16.

[a,b]Row means differ when followed by different letters ($P<.10$).

[c]Grazing treatment means tended to differ ($P = .14$).

for sedges and rushes during mid-July, concurrent with peak selection for those species by SG steers. Advancing maturity of meadow foxtail during this period may explain changes in plant preference by steers in both treatments. Changes in plant preference at different times in the grazing season have been reported by others (5, 12, 15, 30).

Intake and Performance. Daily DM intake was analyzed as kg DM/d on a percentage of body weight (BW) basis. There was no difference between treatment means (Table 2) for daily DM intake ($P = .42$), at 2.0 and 2.1% of BW for SG and CG steers, respectively, which is similar to intake estimates from other intensive grazing studies conducted on meadow (30) and rangeland (1, 19). Intake (kg DM/d) increased between May and September as a result of increased body mass and rumen capacity (3).

Steers in the CG treatment tended ($P = .09$) to perform better on an individual basis than SG steers (Table 2). Mean ADG was 1.2 kg for continuous and .8 kg under strip grazing. Steer performance under SG was similar to the .78 kg ADG by yearling steers grazing the same meadows over the summer of 1954 (4). Increased performance exhibited by CG steers is likely a result of the higher plane of nutrition noted previously. Similar conclusions by other researchers (15, 30) support a diet-related decrease in animal performance under intensive grazing management. Despite equal or reduced individual performance of animals under intensive grazing management, total production per unit area is often greater (14, 16, 30). In our study, superior individual steer performance under CG was offset by the smaller pasture area grazed under SG management (5.6 vs. 4.4 ha, respectively). Gain per hectare did not differ between treatments when compared on a total production basis ($P = .17$), at 26 and 22 kg/ha for CG and SG, respectively.

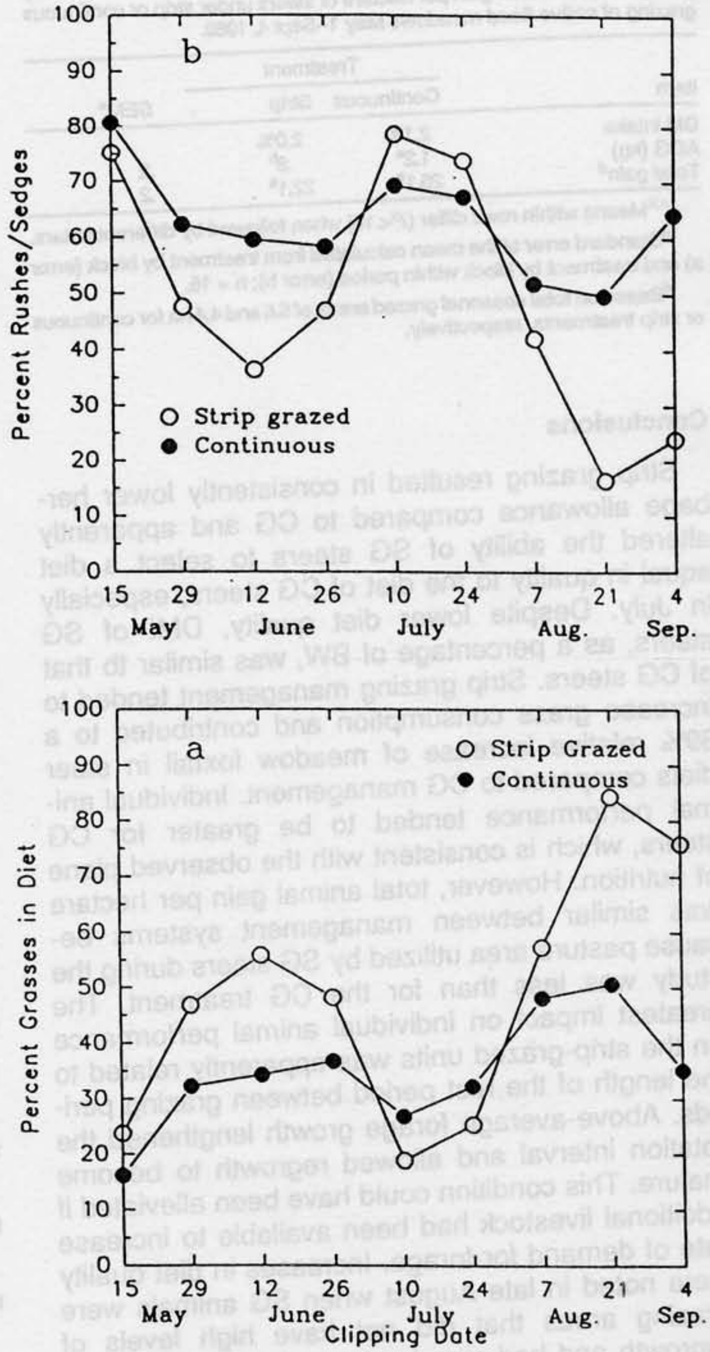

Figure 4. Percentage of grasses (a) or rushes and sedges (b) in fecal samples obtained from steers grazing native flood meadow vegetation under continuous or strip grazing during 1989.

TABLE 2. Dry matter (DM) intake (percent of body weight), average daily gain (ADG), and total gain per hectare of steers under strip or continuous grazing of native flood meadows May 1–Sept 4, 1989.

Item	Treatment		SEM[c]
	Continuous	Strip	
DM intake	2.1%	2.0%	
ADG (kg)	1.2[a]	.8[b]	.2
Total gain[d]	26.1[a]	22.1[a]	.2

[a,b]Means within rows differ ($P < .10$) when followed by different letters.

[c]Standard error of the mean calculated from treatment by block (error a) and treatment by block within period (error b); n = 16.

[d]Based on total seasonal grazed areas of 5.6 and 4.4 ha for continuous or strip treatments, respectively.

Conclusions

Strip grazing resulted in consistently lower herbage allowance compared to CG and apparently altered the ability of SG steers to select a diet equal in quality to the diet of CG steers, especially in July. Despite lower diet quality, DMI of SG steers, as a percentage of BW, was similar to that of CG steers. Strip grazing management tended to increase grass consumption and contributed to a 39% relative increase of meadow foxtail in steer diets compared to CG management. Individual animal performance tended to be greater for CG steers, which is consistent with the observed plane of nutrition. However, total animal gain per hectare was similar between management systems because pasture area utilized by SG steers during the study was less than for the CG treatment. The greatest impact on individual animal performance on the strip-grazed units was apparently related to the length of the rest period between grazing periods. Above-average forage growth lengthened the rotation interval and allowed regrowth to become mature. This condition could have been alleviated if additional livestock had been available to increase rate of demand for forage. Increases in diet quality were noted in late August when SG animals were grazing areas that did not have high levels of regrowth and had remained vegetative. This might indicate that if animal demand had been increased to shorten rotation interval, diet quality might have improved for SG animals in July. This study demonstrated that native flood meadow vegetation containing meadow foxtail can produce excellent animal performance, and that strip grazing will provide similar animal gain/ha while reducing the total land area required. Further research is needed at several stocking densities to determine the effect of increased stock density on performance of steers grazing wet meadows in spring.

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Literature Cited

1. Allison, C. D., M. M. Kothmann, and L. R. Rittenhouse. 1982. Efficiency of forage harvest by grazing cattle. J. Range Manage. 35:351.
2. AOAC. 1984. Official Methods of Analysis (14th Ed.). Association of Official Analytical Chemists, Washington, DC.
3. Bruckental, I., A. R. Lehrer, M. Weitz, J. Bernard, H. Kennit, and H. Neumark. 1987. Faecal output and estimated voluntary dry-matter intake of grazing beef cows, relative to their live weight and to the digestibility of the pasture. Anim. Prod. 45:23.
4. Cooper, C. S., R. R. Wheeler, and W. A. Sawyer. 1957. A comparison of gains of calves and yearlings when summering on native flood meadows and sagebrush-bunchgrass range. J. Range Manage. 10: 172.
5. Denny, R. P. and D. L. Barnes. 1977. Trials of multi-paddock grazing systems on veld. 3. A comparison of 6 grazing procedures at 2 stocking rates. Rhod. J. Agric. Res. 15:129.
6. Forest-Range Task Force. 1972. The nation's range resources. For. Serv., U.S. Dep. Agric. For. Resources Rep. No. 19.
7. Gill, J. L. 1978. Design and Analysis of Experiments in the Animal and Medical Sciences. Iowa State Univ. Press, Ames, IA.
8. Glass, G. V. and K. D. Hopkins. 1984. Statistical Methods in Education and Physchology. Prentice-Hall, Inc., Englewood Cliffs, NJ.
9. Gomm, F. B. 1978. Growth and development of meadow plants as affected by environmental variables. Agron. J. 70:1061.
10. Hannaway, D. B. and W. S. McGuire. 1981. Growing meadow foxtail for forage. OSU Ext. Bull. FS264.
11. Harris, L. E. 1970. Nutrition research techniques for domestic and wild animals. Vol. 1. Utah State Univ. Dept. of Anim., Dairy, and Vet Sci., Logan, UT.
12. Holechek, J. L., M. Vavra, J. Skovlin, and W. C. Krueger. 1982. Cattle diets in the blue mountains of Oregon, I. Grasslands. J. Range Manage. 35:109.
13. Holmes, W., R. Waite, D. L. Fergusson, and J. I. Campbell. 1950. I. A comparison of the production obtained from close-folding and rotational grazing of dairy cows. J. Agric. Sci. (Camb.)40:381.
14. Holmes, W., R. Waite, D. L. Fergusson, and D. S. Maclusky. 1952. Studies in grazing management. IV. A comparison of close-folding and rotational grazing of dairy cows on intensively fertilized pasture. J. Agric. Sci. (Camb.)42:304.
15. Joblin, A.D.H. 1963. Strip grazing versus paddock grazing under tropical conditions. J. Br. Grassl. Soc. 18:69.
16. Jung, H. G., R. W. Rice, and L. J. Koong. 1985. Comparison of heifer weight gains and forage quality for continuous and short-duration grazing systems. J. Range Manage. 38:144.
17. Lucas, I.A.M. and C. P. McMeekan. 1959. The effect of stocking upon a comparison of break and rotational paddock grazing for dairy cows. New Zealand J. Agric. Res. 2:707.
18. Nelson, M. L., J. W. Finley, D. L. Scarnecchia, and S. M. Parish. 1989. Diet and forage quality of intermediate wheatgrass managed under continuous and short-duration grazing. J. Range Manage. 42:474.

19. Olson, K. C. and J. C. Malechek. 1988. Heifer nutrition and growth on short duration grazed crested wheatgrass. J. Range Manage. 41: 259.
20. Pitts, J. S. and F. C. Bryant. 1987. Steer and vegetation response to short duration and continuous grazing. J. Range Manage. 40:386.
21. Raleigh, R. J., C. B. Rumburg, and J. D. Wallace. 1964. Digestibility of native flood meadow hay at different stages of growth. Proc. West. Sec. Am. Soc. Anim. Sci. Vol. 15:LVI.
22. Ralphs, M. H., M. M. Kothmann, and L. B. Merrill. 1986. Cattle and sheep diets under short-duration grazing. J. Range Manage. 39:217.
23. Rumburg, C. B. 1963. Production of regrowth forage on native flood meadows. Agron. J. 55:245.
24. SAS. 1987. SAS User's Guide. Statistics. SAS Inst., Inc., Cary, NC.
25. Savory, A. and S. Parsons. 1980. The Savory grazing method. Beef Cattle Sci. Handb., Agric. Services Found., Clovis, Calif. 17:215.
26. Scarnecchia, D. L. 1985. The relationship of stocking intensity and stocking pressure to other stocking variables. J. Range Manage. 38: 558.
27. Scarnecchia, D. L and M. M. Kothmann. 1982. A dynamic approach to grazing management terminology. J. Range Manage. 35:262.
28. Seamands, W. J. 1973. Increase production from Wyoming mountain meadows. Wyo. Agric. Ext. Serv. Bull. 441.
29. Sharrow, S. H. 1983a. Forage standing crop and animal diets under rotational vs. continuous grazing. J. Range Manage. 36:447.
30. Sharrow, S. H. 1983b. Rotational vs. continuous grazing affects animals performance on annual grass-subclover pasture. J. Range Manage. 36:593.
31. Sparks, D. R. and J. C. Malechek. 1968. Estimating percentage dry weight in diets using a microscope technique. J. Range Manage. 21: 264.
32. Steel, R.G.D. and J. H. Torrie. 1980. Principles and Procedures of Statistics. McGraw-Hill Book Co., New York.
33. Tilley, J. M. and R. A. Terry. 1963. A two stage technique for the in vitro digestion of forage crops. J. Br. Grassl. Soc. 18:104.
34. Turner, H. A. and R. F. Angell. 1987. Systems for reducing dependency on harvested forage for wintering cows. Proc. West. Sec. Am. Soc. Anim. Sci. Vol. 38:197.
35. Waite, R., W. Holmes, J. I. Campbell, and D. L. Fergusson. 1950. II. The amount and chemical composition of herbage eaten by dairy cattle under close-folding and rotational methods of grazing. J. Agric. Sci. (Camb.)40:392.