EFFECTS OF SEASON OF USE ON BEEF CATTLE DISTRIBUTION PATTERNS AND SUBSEQUENT VEGETATION USE IN MOUNTAIN RIPARIAN AREAS

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Summary

To quantify the effects of season of use on beef cattle distribution relative to the riparian area, 52 cow/calf pairs were assigned randomly to 2 years of three replications of the following treatments: (1) early season (ES) grazing (mid-June to mid-July), and (2) late season (LS) grazing (mid-August to mid-September). Based on previous years, DM production estimates, pastures were stocked to achieve 50 percent utilization after 28 days of grazing. Livestock observation points, livestock activities, and ambient temperatures were recorded hourly during two 4-day periods in each season of use. Locations then were transcribed to a geographical information system (GIS) for the study area on Oregon State University's Hall Ranch in northeastern Oregon. Cow weight and body condition score (BCS), calf weight, ocular vegetation utilization estimates, forage quality, and fecal deposits within 1 meter of the stream were recorded pre- and/or post-grazing. During ES, cattle were further from the stream ($P < 0.01$) than during LS grazing, averaging 161.41 and 99.4 m for ES and LS, respectively. Grazing distribution also displayed a diurnal response ($P < 0.01$) with increasing ambient temperatures resulting in decreased cattle distance from the stream. Fecal deposits within 1 m of the stream tended ($P = 0.13$) to be greater following LS than ES grazing. Forage quality varied ($P < 0.01$) between seasons, with ES forage having lower DM, greater CP, lower fiber, and greater IVDMD compared with LS forage. Livestock activity (grazing, ruminating, or drinking) and grazing times, min/day, were not affected by season of use. However, forage utilization was influenced by season of use, with ES grazing having lower riparian vegetation use and higher upland vegetation use as compared to LS grazing ($P < 0.05$). In summary, grazing season affected cattle distribution relative to the riparian area, with LS having more concentrated use of riparian vegetation.

Introduction

Improper use of riparian areas by livestock can result in removal of woody vegetation, over-utilization of streamside vegetation, soil compaction, increased soil erosion, reduced water quality, as well as streambank degradation (Buckhouse and Gifford, 1976; Thomas et al., 1979). Federal laws such as the Threatened and Endangered Species Act (1973) and the Federal Water Pollution Control Act (1972) are making it increasingly difficult for enterprises such as logging, mining, recreation, and ranching to utilize our natural resources. These factors make it increasingly important to create management strategies that promote improved livestock distribution patterns, more uniform vegetation utilization, and sustainable riparian ecosystems. One such strategy may be grazing of riparian areas early in the spring while forage quality is high and ambient air temperatures are still low. However, there is currently a lack of quantifiable research data detailing the effects of this strategy on livestock grazing distribution patterns and subsequent use of riparian vegetation.

This project was designed to provide a replicated, quantitative assessment of the effects of season of use on beef cattle distribution patterns relative to the riparian area. The hypothesis of this study was that livestock distribution, behavior, and performance, and associated vegetation utilization patterns, could be influenced by the time of year that a riparian meadow and adjacent uplands were grazed.

Materials and Methods

This study was conducted in the foothills of the Wallowa Mountains in northeastern Oregon on the Eastern Oregon Agricultural Research Center's Hall Ranch. The elevation of this site is approximately 1,015 meters above sea level, with average annual precipitation of 35 cm, with the majority occurring between October and June. This results in very dry summers allowing for very limited vegetative re-growth during the months of July through September.

The portion of the Hall Ranch that was utilized for this research project consisted of 109 hectares of riparian meadows and adjacent uplands bordering Milk Creek. The site was cross-fenced, with electric fences, into nine pastures. Each pasture contained approximately 12 hectares and a 260-meter stretch of Milk Creek. The vegetation was classified within each pasture into four vegetation types: riparian grass (RG), riparian sedge rush (RS), gravel bar (GB), and upland (U).

The study consisted of a randomized complete block design with repeated measures. There were three pastures of each of the following two treatments: (1) early season (ES) grazing (mid-June to mid-July), (2) late season (LS) grazing (mid-August to mid-September), and (3) control (C) with no grazing. Each treatment was assigned randomly to one pasture during each season of use within each of the three blocks. Fifty-two cow/calf pairs were assigned randomly to one of three pastures per season of use per year. Cows used in the 1998 trial were all 2-year-old primiparous crossbred heifers. During 1999, we also used 2-year-old primiparous crossbred heifers, with the exception of three mutiparious 3-year-olds. All cows averaged roughly 500 kg at the beginning of the trial. Based on previous years' DM production estimates, pastures were stocked to achieve 50 percent utilization after 28 days of grazing. Stocking rates averaged 0.68 AU/ha.

Data collected during two 4-day periods (second and third week of each grazing season) included livestock observation points (recorded on geographically corrected aerial photos), livestock activities and ambient temperatures all recorded hourly, and minutes per hour spent grazing measured with vibracorders (grazing clocks). Measurements taken pre- and/or post-grazing include cow weight and body condition score (BCS), calf weight, ocular vegetation utilization estimates, and fecal deposits within 1 meter of the stream. Ocular vegetation utilization estimates were collected using modified methods set forth by BLM (1996). The following were the utilization breakdowns: 0 = 0 percent use; 1 = 1 to 25 percent use; 2 = 26 to 50 percent use; 3 = 51 to 75 percent use; and 4 = 76 to 100 percent use. Forage quality samples were collected at the end of the third week of each grazing period. Livestock distance from the stream and forage type occupied at each hourly observation were calculated using *Idrisi for windows*$_{Tm}$, an onscreen digitizing program.

Data were analyzed as a randomized complete block-repeated measures design using the GLM procedure of SAS (1996). Block was treated as the random variable in all GLM procedures, with pasture being the experimental unit and season of use being the treatment. Data were considered significant at the ($P < 0.05$) level.

Results and Discussion

Season of use had an affect on livestock distribution patterns, with ES cattle spending more time away from the stream than LS cattle. During ES, cattle were observed further from the stream ($P < 0.01$) than LS cattle, averaging 161.4 and 99.4 m for ES and LS respectively. Grazing distribution displayed a diurnal response ($P < 0.01$), with increasing ambient temperatures resulting in decreased cattle distance from the stream (Figure 1). There was a trend ($P = 0.13$) for the number of fecal deposits within 1 meter of the stream, a measurement of livestock density, to be lower following the ES season than LS grazing, averaging 0.13 and 0.28 fecal deposits per meter, respectively.

Ambient daytime temperatures had a significant impact ($P < 0.01$) on distribution patterns of cattle (Figure 1), as well as when and how long cattle grazed (Figure 2). During LS grazing, cattle tended to congregate closer to the riparian area and grazed later into the morning while temperatures were still low.

Water intake of a given class of cattle in a specific management regime is a function of dry matter intake and ambient temperature (Kellems and Church, 1998). Early season ambient temperatures averaged 16.4° C while LS temperatures averaged 21.4° C. At these temperatures, a 450-kg lactating beef cow requires 55 and 64 liters of water per day respectively (NRC 1984). At 2.5 percent of body weight intake and 40 percent forage DM (ES), a 450-kg cow is consuming 27 kg of forage, as fed. Of this 27 kg, 11.3 kg are dry forage and the remaining 15.7 kg are water. So ES forage is providing 15.7 kg, or 16.5 liters of water per day, leaving 38.5 liters of water needed to meet a cow's requirement. During LS grazing with increased temperatures and increased forage DM (70 percent), a 450-kg lactating cow requires 64 liters of water (NRC 1984), and because of higher forage DM, the forage is providing only 4.7 liters of water. Therefore, LS cattle must utilize the stream for most if not all of their required water.

Livestock performance measured by cow weight change, and BCS change along with calf ADG, did not differ between seasons of use even though there was a forage quality difference between seasons.

Forage quality varied ($P < 0.01$) between seasons with ES forage having lower DM, greater CP, lower fiber (NDF, ADF and lignin), and greater IVDMD compared with LS forage (Table 1). Livestock activity (grazing, ruminating or drinking) and grazing time, measured as minutes per day, were not affected by season of use. However, grazing time, measured as minutes per hour, did differ between seasons (Figure 2). Vegetation utilization patterns differed ($P < 0.05$) between seasons of use, with ES having lower riparian vegetation use and higher upland vegetation use as compared to LS grazing (Table 2; Figure 3). Likewise, vegetation utilization within the riparian area increased and vegetation utilization in the uplands decreased with decreased cattle distance observed with late season grazing. Vegetation stubble height inversely mirrored ocular vegetation utilization estimates, suggesting stubble height measures can be accurate in estimating utilization of forage providing a sufficient number of samples are taken.

Implications

Implementation of early season grazing of riparian areas into a grazing management system can be very effective in altering the distribution patterns of cattle grazing a riparian area and its adjacent uplands. During the early season, when forage quantity and quality are not limiting and daily ambient temperatures are low, livestock distribution patterns are more evenly distributed and vegetation utilization patterns are more uniform. As the grazing season progresses, however, daily ambient temperatures increase, forage DM increases, livestock distance from the stream decreases, and fecal deposits within 1 meter of the stream increase. These factors could lead to over-utilization of riparian vegetation and woody browse, increased bank trampling, and potentially decreased water quality. In summary, as long as early use does not cause problems due to wet saturated soils, early season grazing of riparian areas may be less detrimental to riparian areas due to improved livestock distribution and more uniform vegetation use.

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Table 1. Effect of season of use and pasture vegetation classification on quality and quantity of available forage.

	Early		Late			Orthogonal Contrast[h]		
Item	Rip[a]	Uplnd[b]	Rip	Uplnd	SE[c]	Sea[d]	Veg[e]	Sea[d] x Veg[e]
Dry Matter	42.98	40.68	68.23	70.29	3.57	0.01	0.97	0.56
Neutral Detergent Fiber	61.94	61.35	68.40	67.13	1.01	0.01	0.39	0.74
Acid Detergent Fiber	32.69	34.04	38.83	37.40	0.73	0.01	0.96	0.11
Crude Protein	8.23	7.44	4.48	4.23	0.22	0.01	0.06	0.28
Lignin	4.24	5.91	7.12	6.51	0.65	0.04	0.44	0.13
ISDMD[f]	49.17	50.44	42.43	42.89	0.85	0.01	0.35	0.65
ISNDFD[g]	28.29	29.98	25.86	25.83	0.68	0.01	0.27	0.25
Forage Availability[i]	1654	972	1726	1065	239	0.74	0.03	0.97

[a] Rip = riparian vegetation
[b] Uplnd = upland vegetation
[c] SE = standard error (n=24)
[d] Sea = Early (mid June – mid July), Late (mid August – mid September)
[e] Veg = vegetation site (riparian or upland)
[f] ISDMD = in situ dry matter disappearance
[g] ISNDFD = in situ neutral detergent fiber disappearance
[h] Orthogonal contrasts expressed as probability (p-value)
[i] Forage Availability = random clip plots mid-way through grazing season (kg/ha)

Milk Creek study site at EOARC's Hall Ranch

Table 2. Influence of season of use on the utilization and post-season stubble height of upland and riparian vegetation.

Utilization %	Veg Type	1998 Early[a]	1998 Late[a]	1999 Early	1999 Late	SE[c]	Contrast[b] Yr	Contrast[b] Sea	Contrast[b] Sea x Yr
Riparian Vegetation	Green Line	27.9	56.8	44.3	62.2	2.82	0.01	0.01	0.05
	Gravel Bar	36.1	28.5	43.1	61.7	4.9	0.01	0.29	0.01
	Grass	37.1	41.7	44.0	51.9	1.89	0.01	0.01	0.16
	Sedge/Rush	21.7	37.7	32.5	43.5	2.49	0.01	0.01	0.29
Upland Vegetation	Open	42.5	35.6	43.9	38.1	0.86	0.02	0.01	0.54
	Covered	31.5	31.1	35.3	30.4	1.01	0.12	0.01	0.03

Stubble Height (cm)	Veg Type	1998 Early	1998 Late	1999 Early	1999 Late	SE[c]	Contrast[b] Yr	Contrast[b] Sea	Contrast[b] Sea x Yr
Riparian Vegetation	Green Line	13.5	12.2	10.9	8.6	1.45	0.04	0.21	0.81
	Gravel Bar	13.2	10.2	9.9	6.9	1.57	0.01	0.75	0.09
	Grass	14.9	20.6	10.2	9.4	0.71	0.01	0.01	0.01
	Sedge/Rush	33.3	25.9	21.1	17.0	2.13	0.01	0.01	0.44
Upland Vegetation	Open	12.9	16.3	11.4	14.2	0.36	0.01	0.01	0.49
	Covered	17.5	20.6	13.2	16.3	0.53	0.01	0.01	0.77

[a]Early (mid-June to mid-July), Late (mid-August to mid-September)
[b]Orthogonal contrast expressed as probability (P-value)
[c]SE = Standard error (n = 48)

Cory Parsons fitting cows with *Vibracorders* (grazing clocks) before turnout.

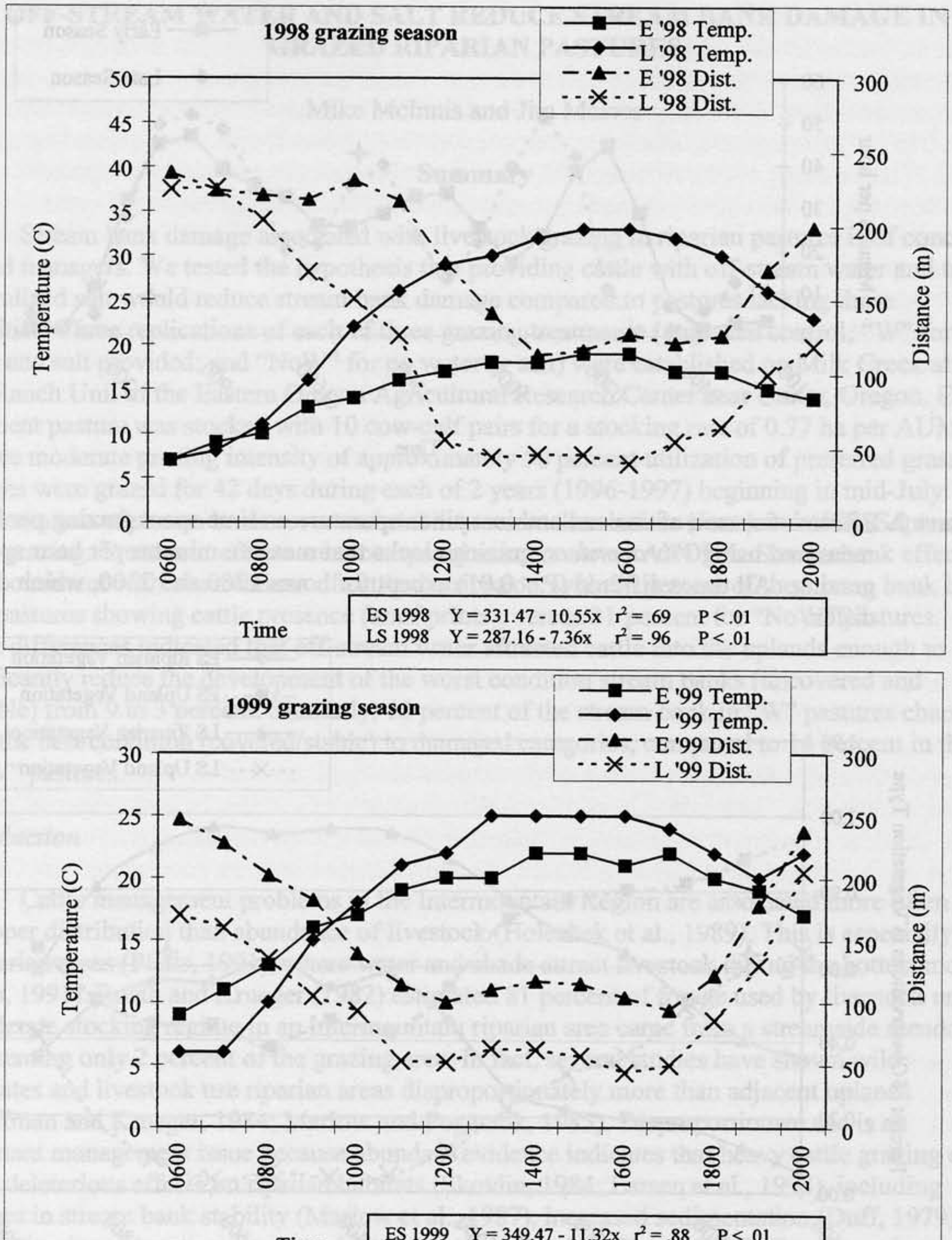

Figure 1. Effects of season of use and ambient air temperature on distance of cattle from stream. In the 1998 grazing season, all hourly distances differed ($P < 0.05$) except hours 600 and 700 which were not different. In the 1999 grazing season, all hourly distances differed ($P < .05$).

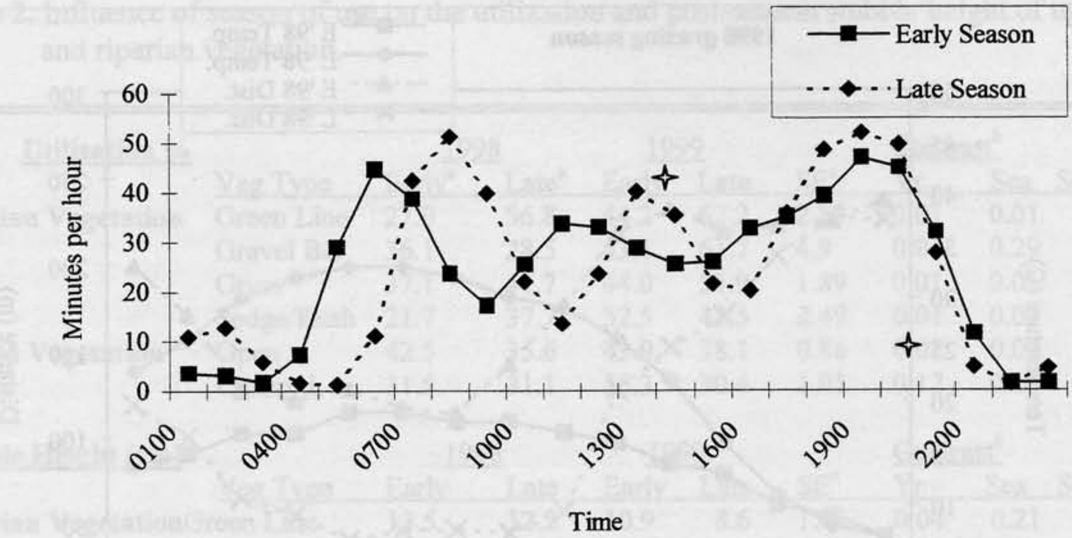

Figure 2. Effects of season of use and ambient air temperature on time spent grazing per hour, measured using *Vibracorders,* grazing clocks that measure minutes per hour spent grazing. All times differed (P < 0.01) except for hours 1700 and 2300, which did not differ.

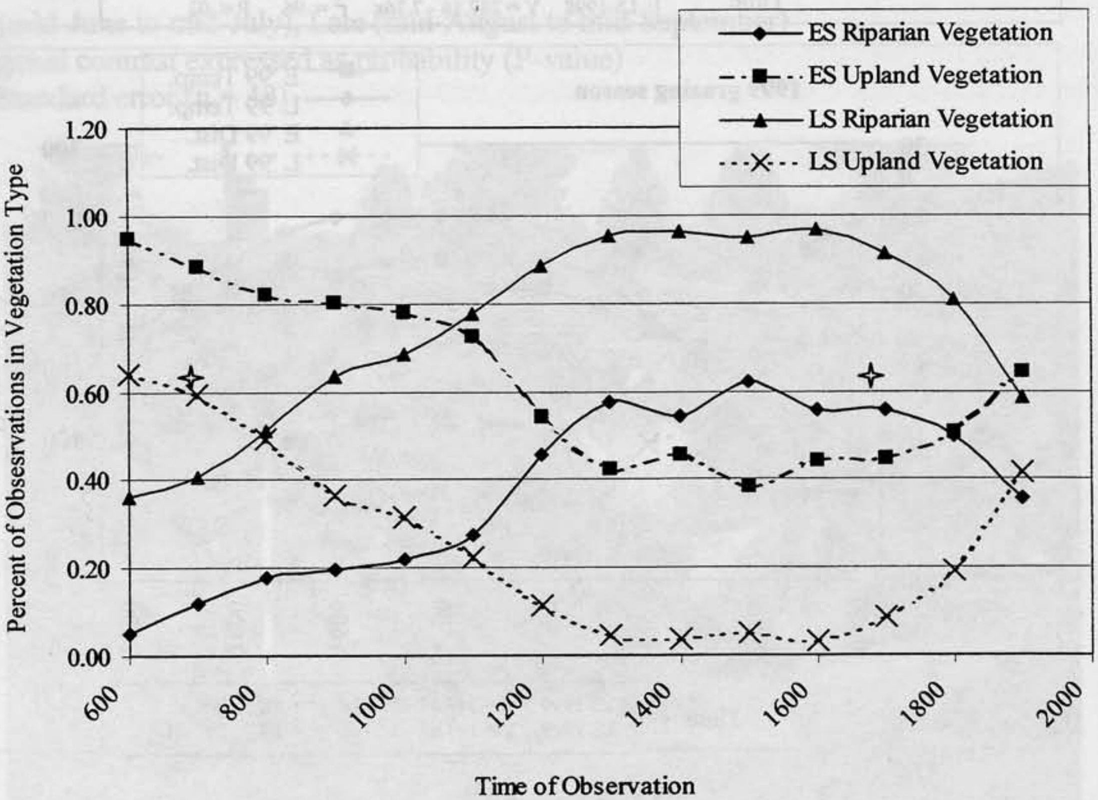

Figure 3. Effects of season of use and ambient air temperature on hourly beef cattle observations relative to occupied vegetation type. All times differed (P < 0.05) except for hours 800 (ES) and 1800 (LS), which did not differ.