OFFSTREAM WATER AND SALT AS MANANAGEMENT STRATEGIES FOR IMPROVED CATTLE DISTRIBUTION AND SUBSEQUENT RIPARIAN HEALTH

Marni L. Dickard, Patrick A. Momont, Timothy DelCurto, Neil R. Rimbey,
John A. Tanaka, and Michael McInnis

SUMMARY

This study, designed to quantify the effect of offstream water and trace mineralized salt (TMS) on cattle distribution relative to riparian areas, was conducted in response to the need of quantitative data on management strategies aimed at decreasing grazing pressure on riparian ecosystems. From 15 July to 26 August, 1996, and 1997; 60 cow/calf pairs were assigned to 1 of 9 pastures. These pastures represented 3 replications of 3 treatments, which included: 1) stream access with offstream water and TMS provided, 2) stream access with no offstream water and TMS provided, and 3) ungrazed control. Response of cattle to access to offstream water and salt was measured through visual observations of cattle distribution, grazing activity and travel distance, cow/calf performance, water quality, and fecal deposit distribution. Distribution patterns of cattle were influenced by the presence of offstream water and TMS, as cattle without offstream water and TMS began the day further from the stream than cattle with offstream water and TMS, but consistently moved closer to the stream after the morning grazing period (0600-0900). Grazing activity and travel distance of cattle was not affected by the presence of offstream water and TMS. Increased gains of 25.3 lbs for cows, and .31 lbs/day for calves, were observed in cattle with offstream water and TMS compared to those without. Water-quality analysis and fecal counts indicated no response of water quality to cattle grazing, or grazing treatment.

INTRODUCTION

Riparian areas are characterized by the presence of water, or conditions that are moister than adjacent uplands. These areas are dynamic systems that are commonly characterized by the presence of water, level terrain, and a high biomass of diverse vegetation. Characteristics such as these make these areas valuable fish and wildlife habitat and also make them attractive to livestock, who tend to use them at disproportionately higher rates than adjacent uplands. Pressure exerted by the public, and laws such as The Clean Water Act (1972), focuses on decreasing grazing pressure on riparian areas and controlling nonpoint source water pollution. This creates a need for management strategies that promote improved livestock distribution and sustainable riparian ecosystems. One such strategy may be the use of offstream water and trace mineralized salt (TMS); however, there is a lack of research that quantifies the effects of this strategy on cattle grazing distribution and subsequent riparian health. The objective of this study was to provide a replicated, quantitative assessment of the effects of offstream water and TMS on cattle distribution relative to the riparian area.

MATERIALS AND METHODS

The study was conducted in the foothills of the Wallowa Mountains in notheastern Oregon on the Eastern Oregon Agriculture Research Center's Hall Ranch, near Union. Elevation of the site is about 3330 feet above sea level, and average annual precipitation for this area is 13.78 inches, with July and August rainfall totaling 1.55 inches.

The study site was a riparian meadow with Milk Creek running through it. The approximately 270 acre riparian meadow and adjacent uplands were divided into 9 pastures, each containing about 29.64 acres and an 850-ft reach of Milk Creek. These pastures represented three replications of three treatments which included; 1) cattle grazing with access to Milk Creek with offstream water and TMS provided, 2) cattle grazing with access to Milk Creek without offstream water and TMS provided, and 3) ungrazed control. Sixty cow/calf pairs were randomly assigned to the six grazed pastures. Within each pasture the vegetation was classified into four vegetation types: riparian grass, riparian sedge rush, gravel bar, and upland. These vegetation types were used for further analysis of cattle distribution. A hydraulic ram pump (GRAVI-*CHECK*$_{TM}$; San Diego, Calif.) was used to pump water from the stream to water tanks in two of the pastures. A stockwater pond was used in the third pasture as a source of offstream water. Offstream water was located about 1300 ft from the stream, and feeders with TMS were placed about 15 ft from the offstream water source. Grazed pastures were stocked at about .32 AU/acre for 42 days from 15 July 15 to 25 August 1996 and 1997. Data were collected on animal distribution and behavior, water temperature, cow weight and body condition score, calf weight, water quality, fecal deposits, diet quality, and water and TMS consumption.

Animal Distribution and Behavior

Visual observations, vibracorders (grazing activity), and pedometers (travel distance) were used to monitor animal distribution and behavior during two 6-day intensive observation periods the second week (July 22-28, early season), and sixth week (August 19-25) of the grazing season. Visual observations were used to measure physical distribution of the cattle. Visual observations were conducted every 3 hours during daylight hours of the 6-day observation periods. Cattle locations were recorded on aerial photos for each observation by three observers. Following observations, Geographical Information Systems software, *Idrisi For Windows*$_{TM}$ (Clark University, Worcester, MA) was used to calculate the distance of each observation from the stream.

Vibracorders (devices used to measure grazing time of free ranging cattle) were placed on 4-randomly selected cows within each pasture, and recorded grazing activity for all 6 days of each period. Pedometers were used to monitor travel distance of the cows within each pasture. They were placed on the same randomly selected cows that received vibracorders, and recorded travel distance for the 6-day period.

Animal Performance

Animal performance variables measured were calf average daily gain, cow weight change, and cow body condition score change during the 42-day grazing period. Cattle were placed in a drylot, with no access to feed or water, overnight prior to weighing and condition scoring. Animals were weighed and condition scored pre- and post-grazing.

Water Temperature and Water and TMS Consumption

Water temperature was measured in the offstream water sources as well as the stream in the pastures with access to offstream water and TMS during the two 6-day observation periods each year. Temperature was read 3 times daily, during the morning, early afternoon, and evening observation periods.

Daily water disappearance and consumption of TMS in pastures with offstream water and TMS was measured over a 6-day period during the fourth week of the grazing season (August 5-11). Water was measured as daily disappearance because evaporation was not accounted for in the measurements.

Water Quality and Fecal Deposits

Water quality samples were collected at the downstream end of each pasture at the end of the 1996-grazing season, and at the beginning and end of the 1997-grazing season. Samples were analyzed for total phosphorus, ortho phosphorus, E. coli, and total coliform.

Fecal deposits were recorded in all treatments to represent relative amounts of time spent along the streambank, as well as the potential for fecal contamination of the stream. Fecal deposits located within one meter of the water's edge were counted on both sides of the stream in each grazed pasture. Counts were done at the end of the grazing season each year.

RESULTS AND DISCUSSION

Cattle Distribution and Behavior

Distinct differences in cattle distribution patterns were observed between cattle with offstream water and TMS and those without (Fig. 1). Cattle with offstream water and salt (W) displayed a more uniform average distance from the stream throughout the day, while cattle without offstream water and TMS (NoW) began the day further from Milk Creek than W cattle ($P < .05$), but moved in toward the stream as the day progressed. During the early evening hours NoW cattle began to move away from the stream again. Differences in daily grazing patterns between treatment groups were most pronounced during 1996, although similar patterns were observed in both years. The less pronounced response in 1997 may have been a response to less extreme weather conditions during 1997, as temperatures during July and August of 1996 were 96.4°F compared to 89.1°F for 1997.

Effects of offstream water and TMS on cow/calf distribution patterns were also reflected through the percentage of cattle observations in the riparian areas compared to the uplands (Fig. 2). Distribution in the different areas of the pasture followed the same pattern as average distance from the stream, as a larger proportion of W cattle were observed in the riparian area from 0600-0900 ($P < .05$), while in the afternoon a larger proportion of NoW cattle were observed in the riparian area ($P < .05$). This pattern occurred during early and late season; however late season distribution differences were less pronounced than early season differences.

The difference in distribution patterns of the two treatments appears to be a response to the tendency for cows to graze during the early morning hours, then search for water and finally seek shade, or graze less intensively during hot afternoon hours. During the search for water W animals were given a choice of two water sources, while NoW animals were forced to use the stream for water. Based on the daily distribution patterns cattle tended to spend the afternoon in the same areas as they drank, then move away during the evening period. Documentation of water disappearance from stock tanks during a 6-day period in early August showed that despite mean water temperatures of 69.3°F in the tank compared with 59.9°F in the stream, average daily disappearance of water from the tank was 5.7gal/pair per day and TMS consumption averaged .30 lbs/pair per day.

Vibracorders revealed no difference in grazing time of W and NoW cattle ($P = 0.25$). Cattle in both treatments followed a daily grazing pattern in which peak grazing occurred from 0601-0900 and 1801-2100. The period from 1201-1800 seemed to be part of the late afternoon/evening grazing period, accounting for about 34 percent of the daily grazing activity. This period coincides with the period of highest riparian area occupation for NoW animals, indicating that riparian areas in NoW pastures are receiving greater grazing pressure than W pastures during this afternoon period. Total daily grazing time did not differ between treatments ($P < 0.60$) as cattle grazed about 664.8 minutes/day. Cattle in both treatments appeared to graze more from 0301-0600 during the early season than the late season, and during the late season they grazed more from 0601-0900 than they did in the early season. This is probably a response to the decrease in daylight during the late season. Mean grazing time did not differ between years ($P = 0.55$). Travel distance, measured with pedometers, indicated that use of offstream water and TMS did not have an effect on daily travel distance ($P = 0.55$).

Animal Performance

Cow and calf weight gains were influenced by the presence of offstream water and TMS. Cows with access to offstream water and TMS gained 25.3 lbs more over the 42-day grazing period than cows without offstream water and TMS ($P < 0.05$; Table 1). Calves had a similar response, gaining 0.31 lbs/day more than calves with the stream as their only water source ($P < 0.05$). Body condition score was not significantly affected by the presence of offstream water and TMS; however, numerical differences in condition score changes of 0.18 in W cattle compared with 0.09 in NoW cattle were observed. Lack of significant differences may be due to a high degree of variation involved in condition scoring from pre-grazing to post-grazing.

Table 1. Effects of offstream water and trace mineral salt on cow weight gain and condition score, and calf weight gain over the 42-day study period (mean ± S.E.). Values are the average of both years.

	Treatment[1]	
	W	NoW
Cow		
Weight change (lbs)	64.24 ± 1.80[a]	38.94 ± 1.65[b]
Condition score change	0.18 ± 0.10	0.09 ± 0.09
Calf		
Weight gain (lbs/day)	2.22 ± 0.013[a]	1.91 ± 0.011[b]

[1]W= cattle with access to Milk Creek and offstream water and trace mineral salt, NoW= cattle with access to Milk Creek with no offstream water and trace mineral salt.
[ab]Values within a row with different superscripts differ ($P < 0.05$).

The reason for increased weight gain by W animals is unclear; however, distribution patterns differences indicate that more uniform grazing and less patch grazing may have occurred in W pastures. Additionally, greater vegetation production in W pastures compared to NoW pastures may have contributed to the weight differences.

Water Quality

Water quality measured as ortho phosphorus, total phosphorus, E. coli, and total coliform was not affected by livestock grazing or distributional changes brought about with offstream water and TMS for either 1996 or 1997 ($P < 0.44$; Table 2). Pre- and post-grazing sampling during 1997 revealed a greater amount of phosphorus before grazing than after grazing. Grazing did not influence E. coli or total coliform in comparison with water in ungrazed control segments ($P > 0.26$). A tendency for greater total coliform concentration pre-grazing was observed ($P = .17$), as pre-grazing total coliform ranged from 966-1666 colonies/100ml and post-grazing coliforms ranged from 192-850 coliforms/100ml. Seasonal differences may be attributed to the difference in runoff, and flow into and out of the stream during the different seasons.

Table 2. Effect of the presence of offstream water and trace mineral salt on chemical composition of water samples taken from Milk Creek (mean ± S.E.).

Treatment[1]	Total Phosphorus	Ortho Phosphorus	Total Coliform	E. coli
	Chemical Composition			
1996				
Post-grazing	--------------------($mg\ l^{-1}$)------------------		-----------------($\#\ 100ml^{-1}$)-------------	
C	0.090 ± 0.006	0.047 ± 0.003	1633.3 ± 133.33	766.7 ± 33.33
W	0.097 ± 0.007	0.050 ± 0.000	1400.0 ± 0.00	900.0 ± 251.66
NoW	0.087 ± 0.003	0.050 ± 0.000	1266.7 ± 133.30	766.7 ± 384.42
1997				
Pre-grazing				
C	0.070 ± 0.000	0.060 ± 0.003	1666.7 ± 33.33	183.3 ± 29.63
W	0.067 ± 0.003	0.057 ± 0.003	966.7 ± 405.52	223.3 ± 49.78
NoW	0.070 ± 0.000	0.060 ± 0.000	1633.3 ± 33.33	140.0 ± 43.59
Post-grazing				
C	0.063 ± 0.009	0.047 ± 0.003	850.0 ± 448.14	366.7 ± 269.71
W	0.060 ± 0.000	0.050 ± 0.000	192.0 ± 478.44	770.0 ± 154.16
NoW	0.063 ± 0.003	0.050 ± 0.000	613.3 ± 493.37	56.7 ± 26.67

[1]C= ungrazed control, W= access to Milk Creek with offstream water and trace mineral salt, NoW= access to Milk Creek with no offstream water and trace mineral salt.
[2]Pre- and post-grazing ortho phosphorus differs at $P < 0.05$ for 1997.
[3]Pre- and post-grazing total phosphorus differs at $P < 0.10$ for 1997.

The lack of treatment differences on E. coli and total coliform is consistent with similar number of fecal deposits along the streambanks in all grazed pastures. Fecal deposit counts revealed that the mean concentration of fecal deposits within 1 meter of the stream was 0.25 fecal deposits/m of stream averaged over years and treatments.

CONCLUSION

Implementation of offstream water and TMS resulted in different grazing patterns throughout of 24-hour period, as well as increased weight gains in cows and calves, compared to animals without access to offstream water and TMS. Treatment groups did not differ in the amount of time they spent grazing, or the distance they traveled. Water quality, represented by total phosphorus, ortho phosphorus, total coliform, and E. coli, did not differ between grazed and ungrazed pastures, or between grazing treatments; however pre-grazing phosphorus and total coliform concentration tended to be higher than post-grazing concentrations. Results from this study are valuable, and should be considered in developing management plans for specific grazing systems. Observation of cattle grazing patterns and habits in individual observation provides valuable information that is beneficial in adapting, and creating management plans aimed at achieving environmental goals while maintaining herd production.

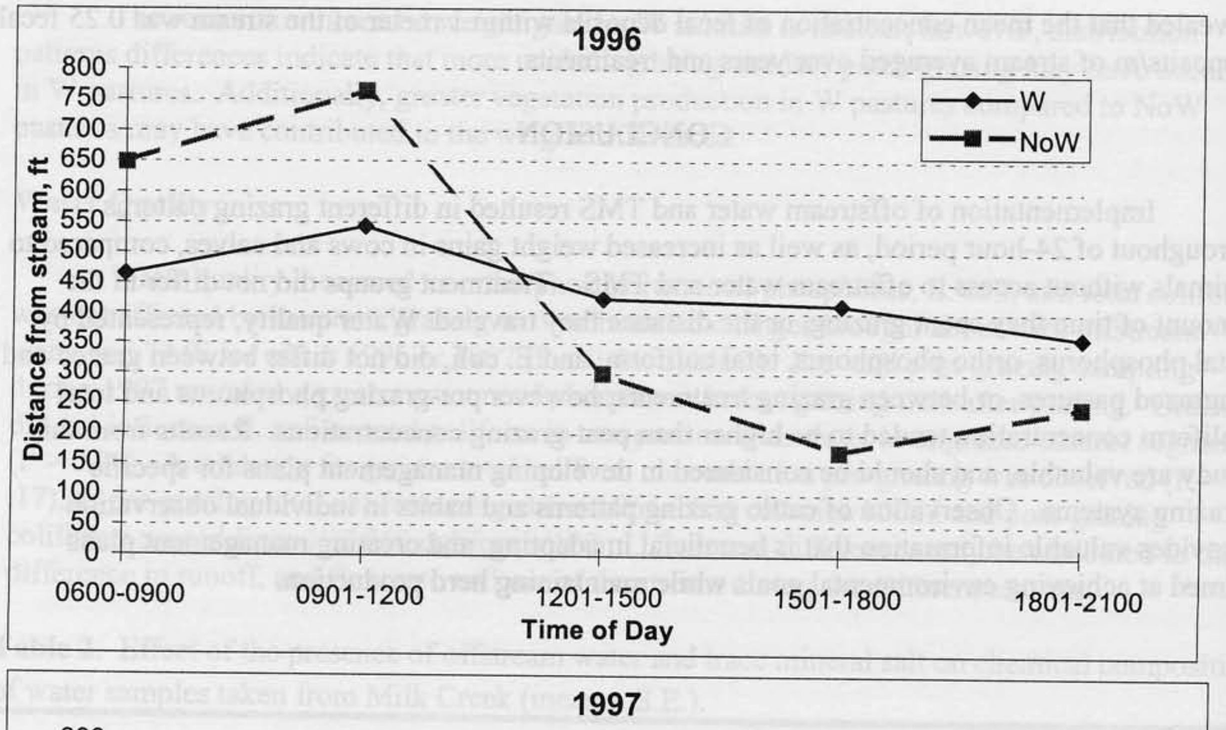

Fig. 1. Effects of offstream water and trace mineralized salt on the distance of cattle from the stream throughout the day during 1996 and 1997. Values are averaged over early and late season. Treatments include: 1) W = cattle with access to offstream water and trace mineral salt, and 2) NoW = cattle without access to offstream water and trace mineral salt.

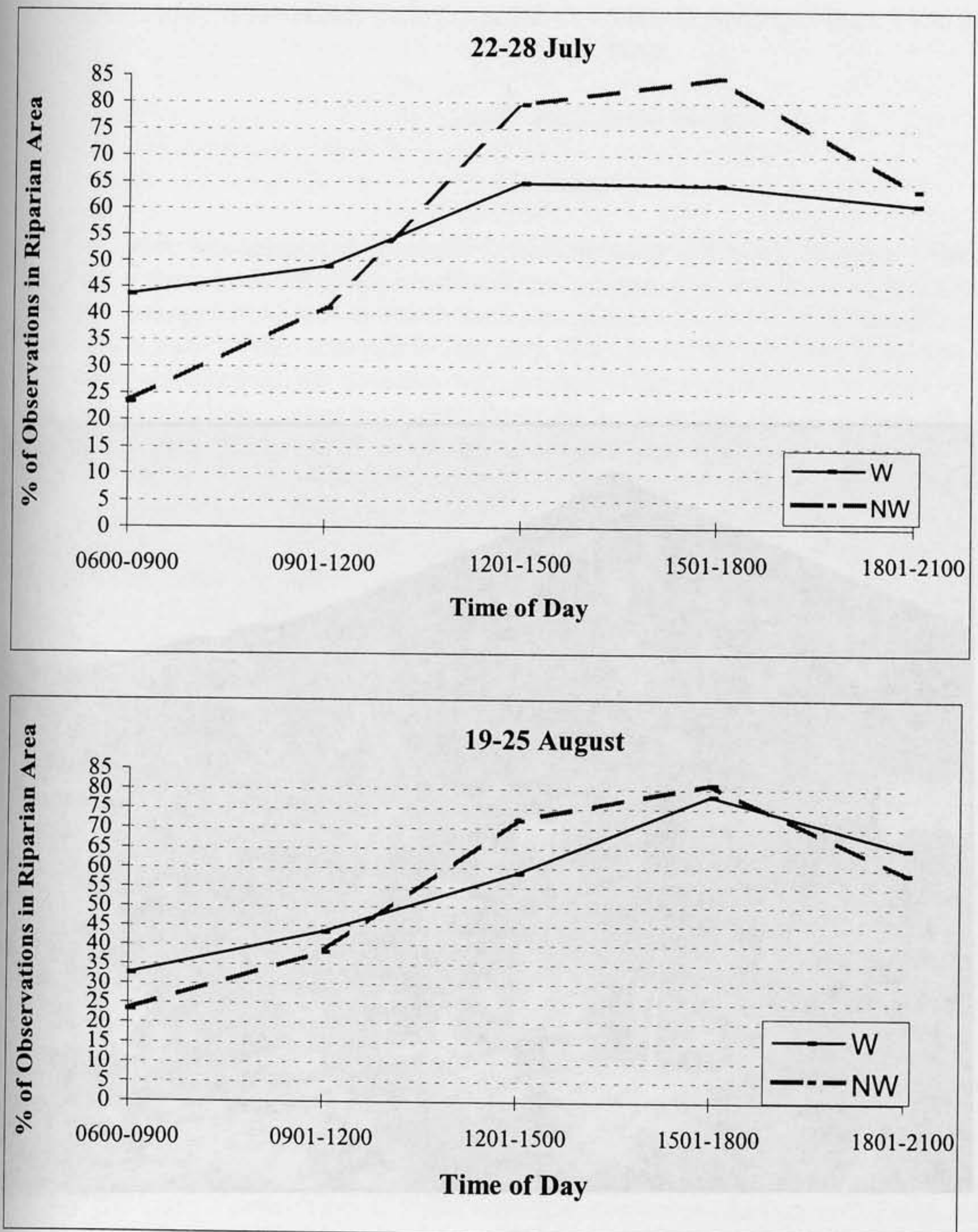

Fig. 2. Effects of offstream water and trace mineralized salt on the proportion of cattle observations in the riparian area during the early (22-28 July) and late (19-25 August) part of the grazing season. Values are averaged over 1996 and 1997. Treatments include: 1) W = cattle with access to offstream water and trace mineral salt, and NW = cattle without access to offstream water and trace mineral salt.