EVALUATION OF OFF-STREAM WATER SOURCE TO REDUCE IMPACT OF WINTER FED RANGE CATTLE ON STREAM WATER QUALITY

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ABSTRACT

One hundred and fifty cattle were split into two groups and fed hay during the winter of 1990. One group had access to drinking water at an off-stream stock tank as well as a stream. The second group watered only in the stream. Eight days of sun-up to sun-down observations showed the cattle in the pasture with the water tank only spent an average of 1.6 minutes per cow in the stream, while the second group, with only the stream as a water source, spent 25.6 minutes per cow/day in the stream. Alternative off-stream free choice waterer locations can reduce animal time in the stream and therefore lessen the impact on water quality.

The impact of grazing cattle on water quality is of considerable importance to water planning agencies. This is in part due to concerns that exists among recreation enthusiasts and sportsmen over health implications of grazing cattle along Western U.S. streams. The issue is important to livestock managers because the cost of limiting animal access to streams and providing an alternate water source may be sufficiently great to introduce a major disruption to current cattle grazing practices.

During most of the year on the western ranges, including the winter months, direct deposition of manure into the stream is the principal factor impacting bacterial water quality. The only time this is not the case is during overland flow events which occur during rainfall or snow melt that exceeds the infiltration capacity of the soil. However, overland flow events occur less than one percent of the time in most of the arid west (17). As a result, the most promising way to reduce the water quality impact of grazing cattle, or to increase the number of cattle that can be winter fed along a stream without exceeding water quality constraints, is to reduce the amount of time the animals spend in the stream. By minimizing time spent in the stream, there is less chance for direct deposition.

LITERATURE REVIEW

Bacteria from the enteric tract are the primary indicators of livestock grazing impacts on surface water quality. Though fecal coliforms (FC) and fecal streptococci (FS) are not pathogenic, they are easily measured and most commonly used to indicate the presence of pathogens (14). Most water quality regulatory agencies utilize the concentration of these organisms as their major criteria for regulatory purposes.

As recreational use of rangeland streams increases, the possibility of contracting a bacterial disease from water increases. Bacteria from animal manures can be transferred to humans from natural waters (5). The list of diseases for which waterborne transmission is of concern includes several common illnesses (2). Bacteria in fecal matter deposited on rangeland may remain viable for at least one grazing season (4). In order for water to be part of the transmission process, however, the fecal matter must reach the stream.

In the range areas of the Western U.S., rainfall or snowmelt events resulting in overland flow are relatively infrequent. An analysis of streamflow and weather data for the Bear Creek watershed in central Oregon revealed that in a six year period (1975-1982) there were 29 runoff events, an average of almost five per year (17). Of these twenty-nine events, six were related to snowmelt, six to rainfall on frozen or snow covered ground, and 17 due to rainfall. Two-thirds of the rainfall induced runoff events occurred during the summer months. This analysis indicated that for over 99 percent of the time, the water quality of a stream in a rangeland pasture is dominated by the direct deposition of animal fecal matter.

Direct deposition of feces into a stream causes bacterial contamination. Buckhouse and Gifford (94) and Johnson et al. (8) have demonstrated that as grazing intensity increases, coliform counts in streams also increase. Cattle standing in or immediately adjacent to a stream can deposit manure directly into a stream (8). Biskie et al. (3) showed that the majority of the bacteria in fecal matter deposited into a stream settle to the bottom where they are available for resuspension. Several months may be required for a stream previously grazed to have coliform counts return to pre-grazing levels (8, 16).

Total fecal output of cattle will range from 0.5 to 0.75 percent of body weight per day on a dry matter basis (12). Free ranging cattle will defecate an averages of twelve times per day (1, 7, 9, 10). Earlier work by Geldreich (6) and by Kenner, Clark and Kabler (11) gave daily FC and FS productions for cattle as 5.4 x 10**9 and 31 x 10**9. Thus on the basis of a flow rate of one cfs, each animal defecating in the stream represents an increased FC concentration of 38 per 100 ml if mixed with the water. As the research of Biskie et al. (3) shows, however, over 95 percent of these organisms settle to the bottom and a large fraction die entrapped in the sediment. On this basis, one animal defecation would increase the FC concentration of approximately two FC per 100 ml.

OBJECTIVE

The objective of this study was to evaluate the effectiveness of an off-stream water source in reducing the amount of time a group of hay fed, but free-ranging cattle spent in or immediately adjacent to a stream during the winter months. The logic was that if the presence of an alternate water source could reduce the amount of time the cattle spent in the stream it would in turn reduce the amount of manure directly deposited into the stream. Additionally, by causing the animals to spend time away from the stream, hence allowing for greater filtration at times of overland flow.

PROCEDURES

Mr. William McCormack, a rancher in Crook County Oregon agreed to participate in this study by allowing access to his pastures and animals. A site was selected along Bear Creek which was normally used as a wintering pasture. This site was selected because it is adjacent to an abandoned homestead which had an operating well that could be used to provide a continuous flow of water to a stock watering tank. A buried plastic water supply line was installed from this existing well to the tank which was located approximately 100 m from the stream. The existing pasture was divided to allow a comparison between pastures, one with both a water tank and stream access, the other in which the only water available to the cattle was from the stream.

The watering facilities and supplemental fencing were installed in the fall of 1989. Mild weather during the fall delayed the need to move the cattle into lower elevation pastures until mid-January at which time 150 hear of two year old pregnant heifers, of Hereford, Angus, and Shorthorn bloodlines were moved into the experimental pastures. These "first calf heifers" were a uniform group which were separated into two groups: 1) water available only from the stream; and 2) water available from both the stream and from the watering tank.

Shortly after the 150 animals were brought into the pasture, they were divided into two groups. Approximately 60 were placed in the smaller pasture with the water tank; the remainder were placed in the larger pasture where the creek was the only available water source. By January 22, those animals in the pasture with the water tank were judged to have acclimated sufficiently to the presence of the water tank and the first day of observation was begun. During the first four days of observing the cattle behavior, they were fed hay at a rate of approximately 6 kg per day at about 9 o'clock each morning. Those cattle in the pasture with the water tank were fed about 20 m upslope from the water tank. The tank was a much closer source of water than the creek for those cattle feeding on the distributed hay. Those animals in the adjacent pasture but without a water tank, were fed in a location about the same distance from the stream.

On those days in which cattle behavior was observed, the researchers positioned themselves outside the pasture at a point where they could observe the cattle both in the creek area and in the area of the water tank, but at a distance and sufficiently non-obtrusive position that their presence did not impact animal behavior. A minimum of two observers was used. The data collection strategy was to make an observation every minute at precisely 60 second intervals. Three bits of information were recorded: the number of cattle standing in the creek (pasture without water tank), the number of cattle standing in the creek (pasture with water tank), and number of cattle at the water tank (within one animal length of the tank). In addition, periodic note was made of air and water temperatures, weather and other observations that would help interpret the numerical data. Observations were made in the morning from as soon after daylight as was possible to monitor animal behavior, until sufficiently far into the evening to again preclude accurate observations. This period was nominally 7:30 a.m. until 5:00 p.m.

The original data collection plan was to observe the cattle for eight days to allow a statistically significant evaluation. However, it became quite obvious after the first four days of observations that the cattle in the pasture with the water tank were spending much less time in the riparian zone than were those in the pasture for whom the creek was the only source of drinking water. So, to further evaluate the impact of the water tank, the feeding location was moved for the final four days of evaluation. For the period February 6-9, the cattle in the pasture with the water tank were fed approximately mid-way between the water tank and the creek. Under this condition, it was approximately equal distant for the cattle to move to the water tank or to the stream.

OBSERVATIONS AND DISCUSSION

An example of the data that were collected for the two pastures is shown in Table 1. The data were grouped into thirty-minute intervals by adding together the number of animals in the creek or at the tank for that particular period. Table 1 is representative of the data collected during the entire period of observations in that the animals demonstrated a definite pattern in their behavior relative to drinking water, loitering and eating the distributed hay. Prior to 8 a.m. there was little activity as daylight approached.

Between 8 and feeding time, the animals were obviously waiting for the feed truck to arrive but tended to be distributed throughout the pasture area and to remain largely stationary. Approximately half of the in-stream animal time for that particular day was generated by one cow standing in the stream continuously for over an hour. Once the feed truck could be heard in the distance, the animals moved immediately from wherever they were grazing/loitering to the previous day's feeding area. They were typically fed about 9:45 a.m. each day.

Once the rancher began to distribute hay, eating the hay was the animals' major agenda item. The animals in the pasture without the water tank tended to spend the next two to three hours eating hay. When they began to leave the feeding area to go to the stream and drink, large numbers tended to go and only a small fraction returned to the feeding area. The others seemed to randomly distribute themselves around the pasture once they left the stream. In contrast, the animals in the pasture with the water tank tended to leave the feeding area sooner to drink at the tank. Then they tended to return to the feeding area until the hay was consumed.

Table 1. Observations of the amount of time cattle spent in the creek and at the water tank and one in which the creek was the only source of drinking water (1).
January 11, 1990

	Pasture without water tank	Pasture with water tank	
		In stream	At water tank
Cattle in pasture	90	48	
Time			
0730-0800	0	0	0
0800-0830	2	10	0
0830-0900	13	30 (2)	0
0900-0930	54	23 (2)	4
0930-1000	12 (3)	0	21
1000-1030	0	0	8
1030-1100	28	0	79
1100-1130	143	0	45
1130-1200	132	0	24
1200-1230	49	0	75
1230-1300	110	0	57
1300-1330	82	1	100
1330-1400	114	0	82
1400-1430	131	0	104
1430-1500	97	2	33
1500-1530	69	11	0
1530-1600	25	0	21
1600-1630	28	4	26
1630-1700	0	6	15
Total	1,089	87	694
Minutes per cow	12.1	1.8	14.5

Notes:

1. Air temperature: 31-39° F.
2. Largely attributable to one cow loitering in the stream.
3. Most of the cows occupied eating the freshly distributed hay.

Table 2 summarizes the observations made of the cattle in the two pastures for the eight days of observation. It is clear from the data in Table 2 that there is considerable variability in the amount of time animals spend in the proximity of the stream. This variability exists between days and among the hours within the day. During the first three days of observation, January 22, 23 and February 4, the animals in the pasture without supplemental water tank averaged 11.3 minutes per day in the stream. For the next five days, these animals in the same pasture averaged 34.1 minutes per day. There was no measured change in weather or other conditions that would seem to dictate such a change. The observation of the monitors would be that after the animals in that pasture completed their eating of the distributed hay, they tended to move in groups to the stream. Furthermore, they tended to remain in the stream area until something distracted them and caused them to move away. For some of the animals, this distraction was the residual hay in the feeding area; for others it was the passage of a vehicle.

There appears to be two types of animal activity that area measured as time spent in the stream. There is the time the cattle are in the stream in order to drink that could be associated with thirst after having eaten. There is also loitering in the stream because there was nothing that attracted the animals away from the stream. The data in Table 3 compares the amount of time cattle spent in the pasture with a supplemental water tank and those in a pasture with the creek being the only source spent in the stream during the four hours immediately after the supplemental hay was distributed. These would suggest that for the time in the stream motivated by thirst, the water tank was more than 99 percent effective in attracting the animals away from the stream. For the remainder of the day, the water tank was able to compete with the stream at an effectiveness of over eighty percent.

The strong preference which the animals demonstrated for the water tank leads one to speculate on its appeal. Perhaps it was temperature driven: the water in the tank was 2 to 6 degrees centigrade warmer than that in the stream. Perhaps it was ease of access: the tank was located on level ground and its overflow was piped well away from the tank. Therefore, the ground was dry and firm at the tank as compared to the steep, rough, and muddy access at the streamside. One is also forced to wonder if consumption of water might not also be higher at the tank. If so, it would follow that livestock performance, in terms of maintaining weight during a time of year when animals frequently lose weight, might not be improved since high volumes of water intake are necessary for animals to efficiently process dry feed. Perhaps a secondary benefit of economic rationality might be accompanying the ecological benefits demonstrated by the alternative water source. Clearly, additional research is appropriate.

CONCLUSIONS

Under winter feeding conditions, the amount of time cattle spent drinking or loafing in the area of the stream was dramatically reduced by the presence of a watering tank. The amount of time that the animals spent in the stream was reduced by more than 90 percent.

Table 2. Data summary, comparison of the time cattle spent in the stream and at a water tank (minutes per cow per day).

	Pasture without water tank	Pasture with water tank	
Date	In stream	In Stream	At water tank
January 22	12.1	1.8	14.5
January 23	10.7	0.9	14.7
February 4	11.2	4.2	10.8
February 5	24.0	1.5	19.3
Four day average	14.5	2.1	14.8
February 6	31.6	1.4	4.6
February 7	61.7	0.8	11.6
February 8	31.0	1.9	6.6
February 9	22.3	0.6	10.7
Four day average	36.6	1.2	8.4
Eight day average	25.6	1.6	11.6

Notes:

1. During the first four days of data collection, the water tank was located between the feeding area and the stream.

2. During the second four days of data collection, the feeding area was mid-way between the water tank and the stream.

Table 3. Comparison of time cattle from the two pastures spent in the creek (minutes/cow) within four hours of feeding.

Date	Pasture with creek as the only available water source	Pasture with water tank available
January 22, 1990	6.7	0.02
23, 1990	6.5	0.38
February 4, 1990	6.2	0.70*
5, 1990	8.7	0.0
6, 1990	21.3	0.22
7, 1990	24.2	0.03
8, 1990	25.9	0.0
9, 1990	16.2	0.0
Average	14.5	0.17

*Observation largely attributable to three animals that lingered in the riparian zone while the other animals watered at the tank.

Even when the feed source was placed equal distance between the water tank and the stream, the water tank was effective in reducing the amount of time the cattle spent in the stream.

In terms of water quality, the relationship between time spent at the stream and fecal pollution as indicated by bacterial counts is evident. Since it was possible under these conditions to eliminate ninety percent of the animals' winter use of the stream through the use of a watering tank, the economic and environmental implications suggest that this may be a viable alternative to the total exclusion of livestock along sensitive stream systems.

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