Will a water trough reduce the amount of time hay-fed livestock spend in the stream (and therefore improve water quality)?

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Background

The impact of grazing cattle on water quality is of considerable importance to water planning agencies. Many people are concerned over health implications of grazing cattle along Western U.S. streams. As 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. Bacteria in fecal matter deposited on rangeland may remain viable for at least one grazing season. In order for water to be part of the transmission process, however, the fecal matter must reach the stream.

Most fecal contamination in water courses occurs as a result of an animal defecating directly into the flowing water. Fecal material deposited on the streambanks will reach the water only under conditions of overland flow (when rainfall and/or snowmelt rates exceed the infiltration capacity of that particular soil). U.S. Weather Bureau records indicate, however, that overland flow events occur less than one percent of the time in most of the arid west. An analysis of streamflow and weather data for the Bear Creek watershed in central Oregon revealed in a six-year period (1975–1981) there were 29 runoff events, an average of almost five per year. Of these 29 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 indicates, 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, rather than fecal material which is "washed" into the stream during a runoff event.

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 generally considered to be pathogenic, they are easily measured and most commonly used to indicate the presence of pathogens. Most water quality regulatory agencies utilize concentrations of these organisms as their major criteria for regulatory purposes.

Total fecal output of cattle will range from 0.5 to 0.75 percent of body weight per day on a dry matter basis. Free ranging cattle will defecate an average of 12 times per day. Earlier work by several researchers places daily FC and FS production, per cow, at several billion. Our research shows, however, that over 95 percent of these organisms settle to the bottom and that over the next several weeks a large fraction die entrapped in the sediment.

In critical watersheds where even low levels of fecal contamination are of concern, it is logical to look for economical ways to limit livetock defecation directly into live streams. One promising way to reduce the winter water quality impact of grazing cattle, or conversely to increase the number of cattle that can be winter fed along a stream without exceeding the current water quality constraints, is to reduce the amount of time the animals spend in, or near, the stream. By minimizing time spent in the stream, the opportunity for direct fecal deposition into the water is correspondingly diminished. (This may also reduce potential silt loads from streambank degradation due to trampling.)

We evaluated 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. Our 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 encouraging the animals to spend time away from the stream, the manure would be a greater distance from the stream, hence allowing for greater filtration at times of infrequent overland flow.

The William McCormack family ranches in Crook County, Oregon, and as previous cooperators, agreed to participate in this study by allowing access to their pastures and animals. A site was selected along Bear Creek which they normally use 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 the well to the tank, which was located approximately 100 yards from the stream. The pasture was divided into two to allow a comparison between pastures, one with both a watertank and stream access and another, the control, in which the only water available to the cattle was the stream (Figure 1).

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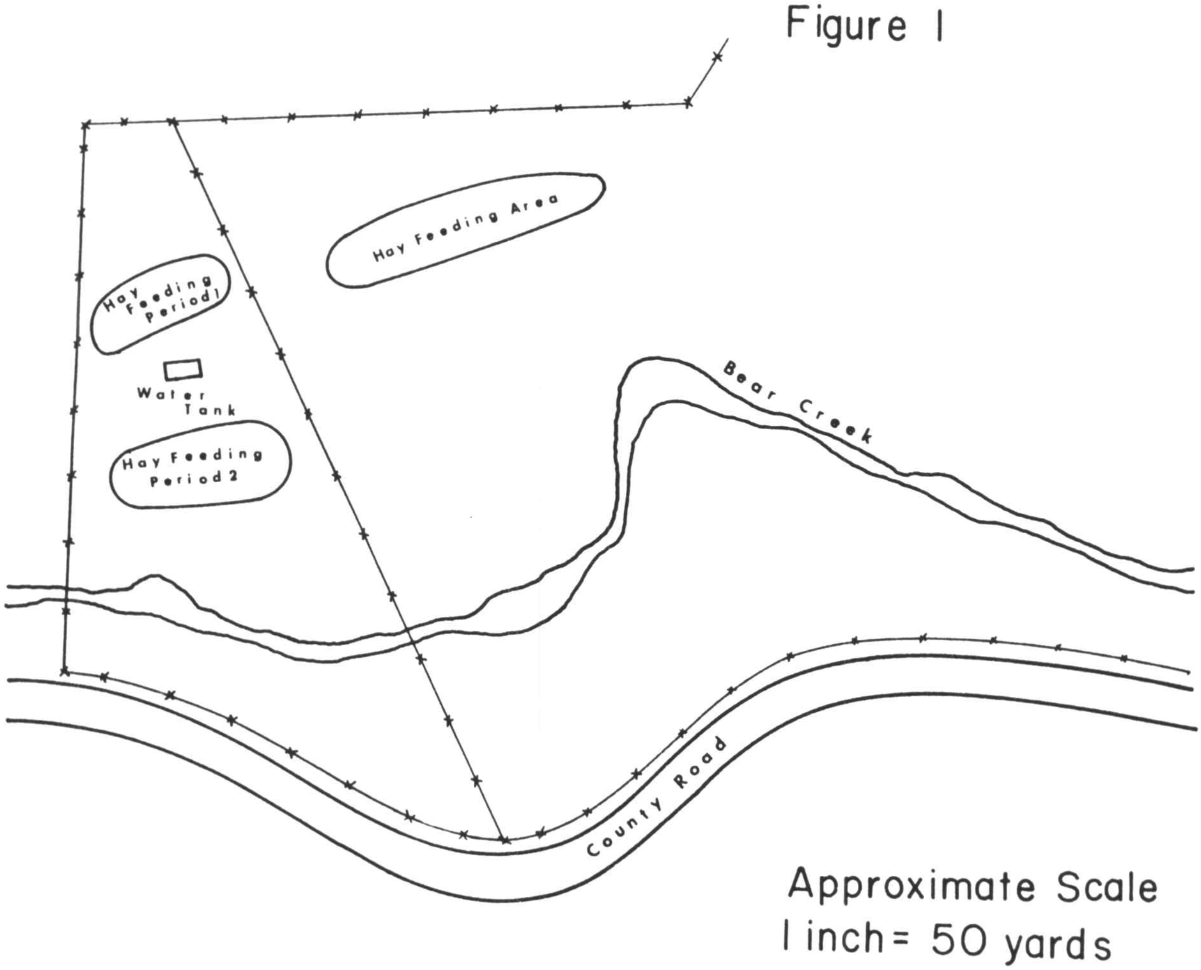

Fig. 1. *Schematic layoug of winter feeding area, creek, and supplemental water tank.*

The watering facilities and supplemental fencing were installed in the fall of 1989. The mild weather experienced during the fall delayed the need to move the cattle into these lower elevation pastures and begin the hay feeding phase of the McCormack ranch activities until mid-January 1990. In mid-January, 150 head 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 the control pasture (water available only from the stream) and the experimental pasture (water available from both the stream and from the watering tank).

Shortly after the animals were brought into the pasture, they were divided into two groups. Approximately 50 were placed in the smaller pasture with the watertank; the remainder were placed in the larger pasture where the creek was the only available water source. Within a few days, those animals in the pasture with the watertank were judged to have acclimated sufficiently to the presence of the watertank and observations were begun. During the first four days of observing the cattle behavior, they were fed hay at a rate of approximately 13 pounds per day at about nine o'clock each morning. Those cattle in the pasture with the watertank were fed about 20 yards upslope from the watertank. 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 watertank were fed in a location a similar distance from the stream. A second four-day period of observations was done using an identical set-up, but altering the hay placement so that the hay was midway between the trough and the stream.

On those days in which cattle behavior was observed, we positioned ourselves outside the pasture at a point where we could observe the cattle both in the creek area and in the area of the watertank but at a distance sufficiently non-obtrusive that our presence did not impact animal behavior. We always used a minimum of two observers. Our data collection strategy was to make an observation every 60 seconds. Three bits of information were recorded: the number of cattle standing in the creek (pasture without watertank), the number of cattle standing in the creek (pasture with watertank), and number of cattle at the watertank (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. We made our observations from daybreak until dark. This period was normally 7:30 a.m. until 5:00 p.m. We noted that there was very little animal activity during the hours of darkness.

Table 1. Data summary: Comparison of the time cattle spent in the stream and at a water tank (minutes per cow per day).

Date	Pasture without water tank	Pasture with water tank	
	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
4-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
4-day average	**36.6**	**1.2**	**8.4**
8-day average	**25.6**	**1.6**	**11.6**

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 1 summarizes the observations made during the eight days of observation.

Observations and Discussion

Between 8:00 a.m. 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. When 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.

Once the ranchers began to distribute hay, eating became the animals' major agenda item. The animals in the pasture without the watertank 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 watertank, tended to leave the feeding area sooner to drink at the tank. They then tended to return to the feeding area until the hay was consumed and the feeding area was thoroughly picked over.

It is clear from the data in Table 1 that there is considerable variability in the amount of time animals spend in the proximity of the stream. This variability existed between days and among the hours within the day. During the first three days of observation, January 22, 23, and February 4, 1990, the animals in the pasture without the supplemental watertank averaged 11.3 minutes per cow per day in the stream. For the next five days, these same animals in the same pasture averaged 34.1 minutes per cow per day. There was no measured change in weather or other condition that would seem to dictate such a change. Our observations were that after the animals in the stream-only pasture finished eating their 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 infrequent passage of a vehicle on the road several yards away.

There appeared to be two types of animal activity in the stream. One was that time which the cattle at the stream actually drank. The second type was loitering in the steam or on the adjacent stream bank since there was nothing that attacted those animals away from the stream. The data in Table 2 compare the amount of time cattle in the pasture with the supplemental watertank and those in the stream-only pasture spent in the creek during the four hours following hay distribution. These data suggest that the watertank was more than 99 percent effective in attracting the animals away from the stream during that period of the day when thirst was the animals' driving behavioral force. For the remainder of the day, the watertank was able to compete with the stream at an effectiveness of over 80 percent as a place to loiter.

Table 2. Comparison of time cattle 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.

The strong preference which the animals demonstrated for the watertank over the stream leads one to speculate on its appeal. Perhaps it was temperature driven: the water in the tank varied between 2–14° F warmer than that

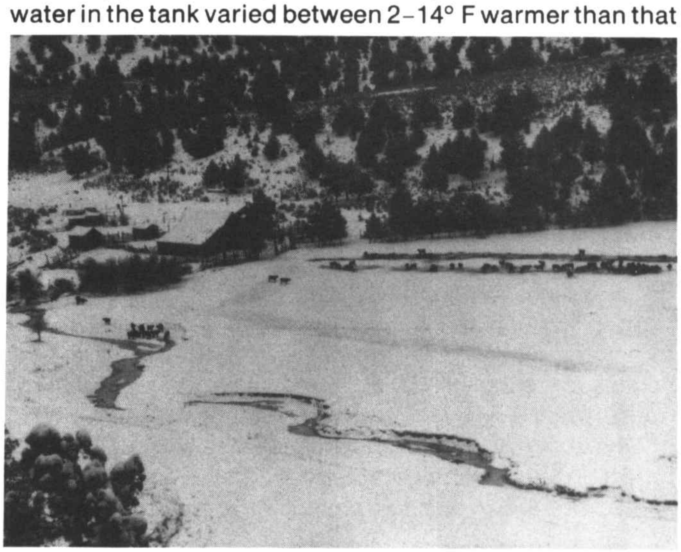

Fig. 2. *Snow-covered winter feeding ground on McCormack and Sons Ranch.*

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.

We also wondered if consumption of water might 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 be improved since high volumes of water intake are necessary for animals to efficiently process dry feed. This speculation is food for thought. Perhaps a secondary benefit with economic rationality accompanies the ecological benefits demonstrated by the alternative water source.

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.

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 in the stream and fecal pollution is evident. Since it was possible under these cold and snowy conditions to eliminate 90 percent of the animals' wintertime use of the stream through the use of a watering tank, economic and environmental implications suggest that this may be a viable alternative to the total exclusion of livestock along sensitive stream systems.

(References for livestock relationships to bacterial contamination of streams are available upon request from the authors.)

Building Consensus for Rangeland Uses

William C. Krueger

The people of the "Wild West" are largely urbanized. It is common for people living in cities to have no close relatives that live or work on ranches or farms. The family bonds that historically tied rural and urban people together are gone and with them a major communication link. Without the intense common understanding that characterizes close relationships of a family, fundamental beliefs and ways of evaluating natural resource issues among urban and rural groups have become increasingly different. Each group has lost information in this evolution of paradigms. Each group analyzes different, sometimes selected, information in a different logical framework and naturally, then, defines the truth differently. This has prevented a common understanding of many issues. One result has been generation of intense controversy concerning protection and use of natural resources.

Society has made little progress in bringing the visions of environmentalists and ranchers together to find consensus on resource issues of the western states. This is not surprising when we consider the way we generally do business in the United States. Our laws and policies are based on allocation of scarce resources. Society must be sure everyone gets a fair share of the resources, especially public resources, so we pass laws and make policy to allocate what we have according to certain priorities. A major assumption underpinning our laws and policies is that there is not enough for everyone and so each will get a share that is less than they want. Inevitably, allocation of any scarce resource leads to conflict and often to mistrust. This inevitably leads to fear. There is a fear that the representatives of other interests will be more skilled at negotiating their position and that they will get the best deal in allocation of the resources in the end. This leads to fear of losing the profitability of watershed-based businesses, fear of losing the sustainability of a resource, fear of losing the aesthetic values of a resource, and a multitude of other fears. One can see this by observing the relationships of environmental groups opposed to public land grazing and public land graziers.

Leritz (1987) describes a procedure for successful negotiating. He indicated negotiating from a basis of scarcity involves three assumptions: There is not enough, people are greedy and the best approach is better strategizing. Negotiating from a basis of abundance involves a different set of assumptions: There is more than enough, people are basically needy not greedy and understanding is the best strategy. The acceptance of one set of assumptions or the other has a major impact on relationships in negotiations. The former yields negotiations based on

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