thimble seeder to the deposit point behind the scalper using an airstream.

Bareroot stock of many native and introduced shrubs can be transplanted successfully with a hand-fed tree transplanter into 25-inch-wide by 9-inch-deep scalps made in heavy grass sod. Mountain big sagebrush can be successfully transplanted directly into heavy grass sod. Transplanting success of bareroot stock was found to be superior to container-grown stock.

# Ranchers Evaluate Contour Furrows for Livestock Grazing

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Contour furrowing is a land-surface treatment that has been used to increase herbage production and reduce runoff and erosion on western rangelands. In southeastern Montana, this mechanical treatment increased herbage production by as much as 165% on panspots range sites. Panspots are "areas of silty, clayey, or sandy soils in complex with shallow depressions of hard clays or other nearly impervious materials at or near the surface." Although the Bureau of Land Management contour furrowed 36,000 acres of Montana rangeland during the 1960's and early 1970's, only a few Montana ranchers have used this rangeland treatment. Many ranchers feel that contour furrowing has not had adequate economic evaluation. Although researchers haven't evaluated the problem, there is also a belief among ranchers that contour furrowing increases livestock losses, especially of sheep, because the animals are sometimes trapped on their backs in the furrows. Cattle and sheep normally lie on their side, but sometimes they roll over onto their backs in order to scratch and rub against the soil surface. Normally, the animal will roll completely over, but sometimes it becomes trapped against a rock or shrub or in a depression. When a ruminant is trapped on its back the esophagus often becomes plugged. This interrupts the normal process of eructation (belching of gas), and the animal soon dies of bloat. Suffocation is caused by either gas pressure or by the animal bloating to the point of vomit. Thus, if the animals become trapped on their backs in furrows, death could occur.

The purpose of this article is to identify livestock management problems on the contour-furrowed rangelands and to recommend practices to minimize the problems.

#### Information Sources

We used rancher survey and sheep observation studies to identify livestock management problems associated with grazing contour-furrowed rangeland. Both studies were conducted during the fall of 1979.



Contour furrowed panspot rangesite 8 years after contour furrowing with an Arcadia Model B-type contour furrower.

From BLM records, we identified 19 ranchers in southeastern Montana and northwestern South Dakota, who grazed livestock on contour-furrowed rangelands. We interviewed 15 of these ranchers concerning their experience with livestock grazing in contour-furrowed pastures.

In addition, we observed 62 sheep (ewes and lambs) in a 50-acre pasture for 8 days. Twenty-eight percent of the pasture had been contour furrowed in 1976, and the pasture had not been grazed since. Lister-type furrows of three different



Lister-type contour furrows.

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furrow widths-14-, 24-, and 34-inch-were equally represented in the furrowed area. Sheep were supplied by a local rancher prior to our study; these sheep had never grazed in contour-furrowed pastures. The sheep were given 2 days to explore the pasture and adjust to the two observers. An average of two sheep per day were selected for detailed observation during the next 6 days. The total observation period represented 12 sheep days, but included only 10 individual animals because two of the same ewes were watched on 2 different study days. The actual time spent grazing, walking, standing, and lying in the furrowed and nonfurrow area was recorded.

During the final 3 nights of the observation period, the sheep were corralled on the furrowed area—one night each on each furrow width-forcing the sheep to "bed down" in the furrows.

The study site was located about 20 miles south of Ekalaka, Montana, on a panspots range site. Local ranchers refer to this area as a "gumbo" site. Annual precipitation averages about 12 inches. Thickspike wheatgrass (Agropyron dasystachyum), western wheatgrass (A. smithii), blue grama (Bouteloua gracilis), prairie Junegrass (Koleria cristata), big sagebrush (Artemisia tridentata), and pricklypear cactus (Opuntia spp.) are the most common plants.

#### Results

## Rancher Experience

The ranchers did not have the actual use data needed to compare livestock losses in furrowed and nonfurrowed pastures. In a few incidents ranchers actually observed sheep trapped on their backs in furrows. Although ranchers had found an occasional dead cow in furrowed areas, they had never observed a cow trapped on its back in a furrow. Finding an animal dead in a furrowed area is not proof that the furrows were responsible for the animal's death. Thus, it was not possible to establish with certainty that the furrows were responsible for the death of any particular animal. Opinions expressed by the ranchers indicated that they suspected higher death losses in the furrowed than in nonfurrowed pastures.

Of the 15 ranchers interviewed, 12 rated contour furrowing very worthwhile, and the other 3 rated it fairly worthwhile even though 13 of the ranchers blamed contour furrows for some death losses. Apparently the ranchers felt that the increased forage production on contour-furrowed rangeland more than offset the associated animal losses. Thirteen ranchers wanted the BLM to do more contour furrowing on their allotments.

Results of the rancher survey indicated that kind and class of livestock, grazing season, percentage of pasture furrowed, and furrow depth may all affect the incident of livestock problems associated with grazing contour-furrowed pastures. It appears that kinds and classes of livestock have certain characteristics that make them differentially adapted to contour furrows. Six of the surveyed ranchers reported the following experience with sheep:

## Number of

## Management Decision

- Operators Was afraid to try grazing his sheep in furrowed 1 pastures
  - Reported no problems, but his sheep had 1 grazed in furrowed pastures for only one month.

- 3 Found sheep had too many problems in furrowed pastures, so now grazed cattle in them.
- Usually let his sheep graze in the furrowed 1 pastures during November (only 4% of the pasture had been furrowed).

In contrast, 11 ranchers who had grazed cows in contour-furrowed pastures reported the following experience:

#### Number of

#### Operators

poratoro	Management Deelelen
1	Reported no problems (but ran longhorn
	cows).
3	Found cows had too many problems in

furrowed pastures, so now grazed yearling cattle in them.

Management Decision

7 Continued to graze cows.

These responses suggest that cattle are better adapted to grazing contour-furrowed pastures than are sheep.

It also appears that yearling cattle are better suited for grazing contour-furrowed pastures than are cows. Six ranchers, who had grazed yearlings in furrowed pastures for a total of 25 years (an average grazing season of 2 months/year), reported no incidence of animals being trapped on their backs in the furrows.

Another interesting observation was that all of the deaths attributed to contour furrows occurred with dehorned or polled cows. This suggests that horned cattle may be more adapted to grazing furrowed pastures than cattle without horns-the horns may supply the necessary leverage to enable a cow to "right" itself from an "on-back" position. However, the number of horned cattled observed were only a small portion of the total; thus this observation may not be significant.

Grazing season may be critical in the management of contour-furrowed pastures. Contour furrows trap and store water in the spring, making them an undesirable habitat, especially for young animals and sheep heavy with wool. The "gumbo" sites in the northern Great Plains often produce an abundant spring crop of wild onions (Allium spp.). Ranchers report that sheep relish the onions and will eat too many when onions are available. Some ranchers believe that high onion consumption causes excessive gas in the sheep's rumen causing them to be uncomfortable and restless when lying down. This increases the probability of sheep getting trapped on their backs in the furrows. Also, the comparatively lush green forage often found in the furrows may aggravate the problem of acute bovine pulmonary emphysema, which is common in the study area.

One sheep rancher felt that grazing furrowed areas during the summer tick season increased the incidence of sheep becoming trapped on their backs in the furrows. He thought that ticks and other insects were to blame, because they irritated the sheep, and caused them to spend more time scratching and rolling onto their backs. He normally grazed his sheep in the furrowed pastures only during early winter when insects were not a problem.

The percentage of furrowed area appears to affect the incidence of livestock problems associated with grazing contour-furrowed pastures. Over a 10-year period, three ranchers blamed contour furrows for the loss of seven cows in a pasture that was 80% contour furrowed. During the same period, these three ranchers reported no losses in a similarly grazed pasture that was only 10% furrowed.

Furrow depth may have a critical effect on the problems associated with livestock grazing in contour furrowed pastures. Most of the BLM furrowing in the study area was done with an Arcadia model B furrower. This implement has rippers that fracture the soil to a 10- to 15-inch depth and offset disks that construct V-shaped furrows about 20 inches wide, and 6- to 10-inches deep. The furrow and interfurrow areas account for about 40 and 60% respectively, of the contour-furrowed area.



Arcadia model B-type contour furrows.

The model B furrows may be more likely to cause management problems than would lister-type furrows. The listerfurrower is built by butting two mold-board plows together, and it forms a flat-bottomed furrow designed to be 3- to 6-inches deep. One of the ranchers had a pasture that was 33% furrowed with this type of furrower. He had grazed cows in this pasture for a total of 4 months (during a 2-year period) and had not observed any management problems. Most ranchers also reported that livestock problems were most frequent during the initial years after the treatment and deferment period (the BLM had deferred livestock grazing for 2 years in most of the contour-furrowed pastures) and became less frequent as the furrows aged. This suggests that shallower furrows may reduce livestock management problems. However, furrows need to have adequate water storage capacity to be effective.

## Sheep Observation

Sheep observed during our study did not have any physical problems standing, walking, or grazing in the lister-type contour furrows. Even when the sheep were forced to bed in the furrows overnight, there was no indication that they had problems getting out of the furrows.

In this study the sheep preferred the nonfurrowed part of the pasture over the furrowed part. Even though 28% of the pasture was furrowed, ewes and lambs averaged only 16 and

11%, respectively, of the "grazing day" in the furrowed area. This is about half as much time in the furrowed area as would be expected had the sheep activities been randomly distributed within the pasture. These results may be somewhat confounded by the difference in available forage between the furrowed and nonfurrowed portions of the pasture. Portions of the furrowed area had been seeded with alfalfa (Medicago spp.), and Russian wildrye (Elymus junceus), which may have attracted the sheep to the furrows. In addition, the 10 sheep selected for detailed observation never stood or lay in the furrows during the grazing day. However, a few lambs did lie in the furrows for a few minutes while the rest of the the sheep were still grazing. We don't know whether the sheep were physically uncomfortable resting in the furrows, or whether they could not orient their bodies with the sun's rays. For example, sheep and cattle seem to prefer to lie parallel with the sun's rays on hot days. There was no apparent preference among the furrows of different widths.

The lambs spent twice as much time per day in the furrowed area during the final days of the study as they did at the start of the observation period. This may suggest that they were learning to tolerate the furrows and/or to appreciate the better forage that the furrows offered. There was no measureable change in the ewes' grazing behavior during the duration of the study.

#### Summary

All of the 15 ranchers interviewed rated contour furrowing as a worthwhile rangeland treatment, and 13 of the ranchers wanted the BLM to do more contour furrowing on their allotments even though they felt that furrows increased the incidence of livestock losses because animals got trapped on their backs. This suggests that the ranchers felt the extra forage production from furrowing offset the management problems. However, none of the ranchers had done any significant amount of contour furrowing on his own land. Unfortunately, livestock losses could not be counted because actual use records were not available and because actual causes of death had not been determined. Most of the ranchers changed kind or class of livestock in order to minimize the management problems. Yearling cattle appeared to be well-suited to grazing contour-furrowed pastures, whereas sheep were poorly suited during certain seasons. The furrows seemed to cause fewer management problems as they aged and became shallower.

Although the evidence is circumstantial, contour furrows do seem to cause management problems from grazing livestock, especially sheep. The results of this study suggest that the livestock problems associated with grazing contour furrows can be greatly reduced or eliminated by management practices that include: (1) modifying the furrow structure toward a shallow, flat-bottomed type furrow; (2) leaving islands of nonfurrowed areas interspaced with the furrows to provide a place for animals to rest; and (3) controlling the season of use and kind and class of grazing animal. In the past, emphasis has been on forage production and runoff as affected by contour furrowing. In the future, more consideration should be given to better utilization of this increased forage supply through furrow construction and grazing management.