# EFFECTS OF SELECTED GRAZING TREATMENTS ON CHANNEL MORPHOLOGY AND SEDIMENT WITHIN THE RIPARIAN ZONE OF FIFTEEN MILE CREEK


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TABLE OF CONTENTS

LIST OF TABLES

Page

## LIST OF FIGURES

# INTRODUCTION

This is the third annual report summarizing the effects of selected grazing treatments on channel morphology within the riparian zone of Fifteen Mile Creek. The purpose of this investigation is to relate changes in channel morphology, vegetation and sediment load to livestock grazing. The emphasis of this report has been to summarize results taken from the past two years in the following areas: livestock grazing, vegetation production, stream morphology and soil moisture.

Research activities on the site were initiated in May, 1984 and terminated in October, 1984. Most of the methods used to collect this year's measurements have been described in other annual reports (1982, 1983). Methodologies of studies used for the first time in 1984 have been described in this report.

We express our appreciation to the Wyoming Water Research Center and the Bureau of Land Management for their support in this research effort. In addition, we thank Jay Matthews for his cooperation by providing and moving cattle used in this study.

# LIVESTOCK GRAZING STUDIES

## METHODS

### Middle Fork Season of Use Studies

Thirty cow-calf pairs were grazed in each seasonal (May, July, September) pasture for 10 days each. Utilization of forages was determined by marking about 50 plants of all species in each pasture appearing to be sufficiently abundant to supply cattle forage. These included perennial and annual grasses as well as greasewood (*Sarcobatus vermiculatus*). The plants were located along two or more 100 m transects in each habitat and individually marked. The standing current annual biomass of each marked plant was estimated before and after each seasonal 10-day grazing period. Growth was assumed to be negligible during the 10 days. Observation of ungrazed plants during this period provided verification of the low growth assumption. The difference in biomass between observations on individual plants was used to determine utilization. Samples of 50-100g of each species were collected at each sampling date and fresh weight determined. Samples were later dried at 50° C and percent dry matter (DM) calculated. Dry matter was used to correct all estimates of biomass to dry weight before utilization was calculated. Dried species samples were used to determine % crude protein (CP) via Kjeldahl analysis on three subsamples.

Cattle distribution and activities were determined by location of all animals at 15 minute intervals for 6 days dawn to dusk during each seasonal grazing period. Animal location by habitat, activity, distance to shade and water, and environmental conditions were recorded. Habitats delineated were channel and 10 meters either side (channel), flood plain or first terrace encompassing the area between the channel and the topographic break where uplands began (terrace) and uplands including all higher elevation areas not potentially hydrologically influenced by the stream. Activities recorded were feeding, resting, and traveling.

As of this report, forage utilization and quality information have been summarized but no statistical analysis performed. Analysis of variance (AOV) procedures will be used to determine differences that may occur between species and between seasons. Cattle distribution without regard to activity or environmental condition has been summarized and analyzed by AOV for differences between seasons. T-tests have been used to compare cattle use of habitats with proportions of habitats in pastures. Additional analysis to separate activities within habitats, distribution and activity with respect to shade and water, and environmental effects will be performed. The additional work along with complete analysis of work reported here will constitute a major portion of a graduate student thesis due to be completed later this year.

## North Fork Stocking Rate Studies

Grazing studies will be conducted for a minimum of two years and up to five years depending on available funding. An inventory of vegetation and habitats in the two original North Fork pastures was conducted in 1983 and early 1984. The results of inventory indicated that the southern pasture contained the majority of stream side habitats or riparian type vegetation and was then chosen as the specific study site. A potential problem affecting the suitability of this site for proposed research was the apparent maturity or decadence of woody species due to age and/or failures of parts of the terrace system. Additionally the herbaceous vegetation of stream-side habitats varies in species composition somewhat from grazed sections of 15-Mile Creek probably because of the altered water regime and long exclosure from grazing. Nevertheless the site appears adequate to initiate this study with emphasis on utilization of woody vegetation as opposed to the largely dormant herbaceous vegetation present in mid-summer.

In June 1984 the study pasture was cross-fenced using a 3-wire electric fence system. Top wire is about 38-40 inches above the soil while the bottom wire is 18-20 inches high. Both are electrified while the middle wire is a ground. Heights and wire spacings of the fence will provide minimal interference with deer or antelope movements during the one month or less of yearly use and likely none when not electrified. The fence divides the pasture approximately in half and crosses a pond to provide common water for both replications.

In July 1984 transects for utilization studies were established in important types of vegetation in each replication. These include willow (*Salix* sp.), cottonwood (*Populus sargentii*), stream bank grass-forb, upland seeded terraces, and undisturbed saline upland. Generally two transects per type, 30 to 100 m long, were placed in each. Willows were found in only one location in the south replicate. Willow communities were generally of very limited size and found only where standing or subsurface water was evident. Transects in woody vegetation contained 20-50 marked plants with a total of 50-125 marked twigs while transects in herbaceous and/or low shrub (*Atriplix nuttalli* or *Artemisia spinescens*), vegetation contained 20-50 marked individuals. Utilization was based on the difference (oven dried) of marked twigs or plants between the initial pregrazed condition and later intervals when biomass was again estimated. Biomass of twigs or plants was estimated initially at weekly intervals and at cessation of grazing. The estimator trained by estimating twig or plant weights followed by harvesting and weighing of plants not on transects before each set of transect observations. Estimates averaging within 10% of harvested weight were an acceptable level of accuracy to begin observing transects. Density of suckers around marked woody plants was determined prior to grazing and will be done annually. Cattle grazing began in late July with 10 cow-calf pairs in each replicate. We estimated that forage would be available for about three weeks of grazing but adjustment in animal numbers can be made in subsequent years if necessitated by growing season conditions and actual use obtained. Grazing was terminated when utilization of willow and cottonwood reached 50% averaged over all transects.

During the grazing period for 2-3 days weekly, observations were made of habitat selection and cattle activity within habitats. Habitats for these observations included 1) within 10 m of channel (stream bank grass-forb, willow, and cottonwood vegetation), 2) first terrace (stream bank grass forb and sagebrush-rabbitbrush with no understory), 3) seeded terraces (seeded grass and willow) and, 4) saline upland. Activities recorded included grazing, traveling and resting. All animals within each replicate were observed at 1/2-1 hour intervals during daylight hours.

Analysis of variance procedures were used to compare utilization, habitat selection, and activity between weeks (grazing pressure) and between replications. T-tests have been used to compare % cattle observed in habitats with % of habitats available.

At this time utilization data has been summarized but not yet analyzed. Distribution data has been summarized and analyzed with respect to habitat selection. Additional summary and analysis of activities within habitats will be done and reported in the thesis to be completed this year.

Habitat Selection and Activities of Free Ranging Cattle

Study areas were established in two areas, 1) Middle Fork, 15-Mile Creek, in the vicinity of the season of use study pastures and, 2) Main Channel, 15-Mile Creek, below the confluence of important tributaries. The two areas provided replication of areas and two permittee cattle herds. The two areas were similar in the positioning of 15-Mile Creek channels off channel water sources. The channel was generally the southern edge of the areas surveyed each area had at least one reservoir in upland areas north of the channel. In the Middle Fork area livestock water was generally present in the reservoir spring through fall in average precipitation years while water was available in the channel only during flow events. In the Main Channel area the reservoir had water only in spring in average precipitation years but water was available in the channel spring to fall.

In each study area 20 each 40 ac sites were permanently located covering all habitats described for the Middle Fork Season of Use Study. These 40 ac sites were confined within a radius of water sources where cattle would be expected. Proportions of habitats within the areas observed was probably not representative of the entirety of the cattle allotments but similar to proportions of habitats in exclosure study pastures. Observations of the 40 ac sites were made twice, morning and afternoon, at two-week intervals, May-early October. Observations included: number of animals, number in each activity (feeding, traveling, resting/ruminating), distance to shade and water, environmental conditions and time of day.

Analysis of the data to date includes summary of numbers of animals and proportions in each habitat seasonally, analysis of variance of season and time of day affects, and t-tests comparing proportion of cattle observed in habitats with proportion of habitats in the area. Additional analysis of activities within habitats, distance to shade and water, and environmental effects will be reported in graduate student thesis to be completed later this year.

## RESULTS AND DISCUSSION MIDDLE FORK SEASON OF USE STUDIES

### Utilization

Utilization of the most common available forages in Middle Fork pastures generally increased in successive seasons of use (Table 1). Exceptions to this trend were annual grasses and greasewood. These species declined in use or remained similar over the seasons probably because of poor quality or loss of leaves in the fall. Within the channel habitat some species appeared to be used more than others. Canada wildrye was used more than inland saltgrass in spring and summer possibly because clumped Canada wildrye plants provide easier access to more forage at one location. In terrace areas adjacent to the channel perennial grasses were generally used more than annual grasses, while

TABLE 1. Utilization (%) of current annual growth of major forage species within habitats in spring, summer, and fall grazed pastures of Middle Fork, 15-Mile creek, 1984.

| Habitat<br>Forage class<br>Species | Season<br>Spring | <br>Summer | <br>Fall | Mean |
|---|---|---|---|---|
| Channel | | | | |
| Perennial grasses | | | | |
| Inland saltgrass[1/] | 16.5 | 33.5 | 65.2 | 38.4 |
| Canada wildrye | 34.6 | 45.2 | 57.0 | 45.6 |
| Mean | 25.5 | 39.4 | 61.1 | 42.0 |
| | | | | |
| First Terrace | | | | |
| Perennial grasses | | | | |
| Rhizomatous wheat-grass | 32.5 | 56.0 | 62.9 | 50.5 |
| Sandberg bluegrass | 46.6 | 31.0 | 56.7 | 44.8 |
| Mean | 39.6 | 43.5 | 59.8 | 47.6 |
| | | | | |
| Annual Grasses | | | | |
| Cheatgrass brome | 33.5 | 35.9 | 20.3 | 29.9 |
| Six-weeks fescue | 26.4 | 22.6 | 9.9 | 19.6 |
| Mean | 30.0 | 29.3 | 15.1 | 24.8 |
| | | | | |
| Greasewood | | | | |
| New twigs | 42.6 | 70.3 | 52.5 | 55.1 |
| Old twigs | 16.7 | 15.3 | 34.2 | 22.1 |
| Mean | 29.7 | 42.8 | 43.4 | 38.6 |
| | | | | |
| First Terrace Mean | 33.1 | 38.5 | 39.4 | 37.0 |
| | | | | |
| Upland | | | | |
| Perennial grasses | | | | |
| Blue grama | 4.4 | 18.1 | 37.1 | 19.9 |
| Indian ricegrass | 47.5 | 45.4 | 55.6 | 49.4 |
| Sand dropseed | 32.3 | 33.6 | 46.9 | 37.6 |
| Needleandthread | 36.3 | 44.2 | 65.5 | 48.7 |
| Mean | 30.1 | 35.3 | 51.3 | 38.9 |

[1/]Inland saltgrass (*Distichlis stricta*), Canada wildrye (*Elymus canadensis*), rhizomatous wheatgrass (*Agropyron smithii*, *A. dasystachyum*), Sandberg bluegrass (*Poa secunda*), cheatgrass brome (*Bromus tectorum*), six weeks fescue (*Vulpia octoflora*), blue grama (*Bouteloua gracilis*), Indian ricegrass (*Oryzopsis hymenoides*), Sand dropseed (*Sporobolus cryptandrus*), Needleandthread (*Stipa comata*).

greasewood use was intermediate to the two classes of grass. New twigs of greasewood appeared much preferred over older twigs even though leaves were present in both spring and summer. Warm season grasses, blue grama and sand dropseed, were used less (Table 1) than cool season grasses, Indian ricegrass and needleandthread, in upland areas. The sharp increase in use of blue grama from spring to fall may be a consequence of higher use levels of other species in the fall pasture reducing their availability relative to blue grama.

Comparison of utilization of perennial grasses (Table 1) occurring in all habitats suggests that, except possibly in spring, grazing impact is similar in the three habitats. In spring, perennial grass utilization was 14% lower in the channel than in first terrace. In summer, 8% separated first terrace and upland, while in fall 10% separated channel and upland utilization of perennial grasses. Mean forage use over all forages and seasons in the three habitats was similar.

## Forage Quality

Forage dry matter (DM) content and crude protein (CP) may influence palatability and subsequent utilization. Animal performance is also influenced through DM intake and protein level. Cattle performance during the 10-day seasonal grazing trials was not measured but it appears that except for spring and for greasewood, CP (Table 2) was below levels needed for growth or lacation. An important question is whether sufficient greasewood would be consumed to compensate for low CP in other forages during summer and fall.

In the channel area, higher use of Canada wildrye in spring (Table 1) may be partially explained by its greater succulence (lower DM)

TABLE 2. Crude protein (%) of forage species, pre- and post-spring, summer and fall grazed pastures of Middle Fork, 15-Mile Creek, 1984.

| Habitat<br>Forage class<br>Species | Season | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spring | | Summer | | Fall | | Mean |
| | pre | post | pre | post | pre | post | |
| Channel | | | | | | | |
| Perennial grasses | | | | | | | |
| Inland salt-grass | 12.6 | 12.4 | 6.2 | 6.5 | 6.1 | 2.7 | 7.8 |
| Canada wildrye | 14.4 | 12.2 | 4.6 | 5.6 | 5.9 | 4.9 | 7.9 |
| Mean | 12.9 | | 5.7 | | 4.9 | | 7.9 |
| First Terrace | | | | | | | |
| Perennial grasses | | | | | | | |
| Rhizomatous Wheat-grass | 15.3 | 13.4 | 4.1 | 6.7 | 4.3 | 3.0 | 7.8 |
| Sandberg blue-grass | 19.2 | 10.5 | 4.8 | 4.3 | 5.1 | 4.5 | 8.1 |
| Mean | 14.6 | | 5.0 | | 4.2 | | 8.0 |
| Annual Grasses | | | | | | | |
| Cheatgrass brome | 14.6 | 10.3 | 7.6 | 3.7 | 2.8 | 3.5 | 7.1 |
| Six-weeks fescue | 8.8 | 8.2 | 7.0 | 6.8 | 7.6 | 6.5 | 7.5 |
| Mean | 10.5 | | 6.3 | | 5.1 | | 7.3 |
| Greasewood | | | | | | | |
| New twigs | 25.2 | 21.6 | 12.6 | 18.1 | 12.8 | 17.2 | 17.9 |
| Old twigs | 23.4 | 13.3 | 7.3 | 11.5 | 12.3 | 12.8 | 13.4 |
| Mean | 20.9 | | 12.4 | | 13.8 | | 15.7 |
| First Terrace Mean | 15.3 | | 7.9 | | 7.7 | | 10.3 |
| Upland | | | | | | | |
| Perennial grasses | | | | | | | |
| Blue grama | 17.5 | 15.7 | 5.9 | 7.5 | 7.7 | 4.2 | 9.8 |
| Indian rice-grass | 19.1 | 11.4 | 5.7 | 6.0 | 4.5 | 4.4 | 8.5 |
| Sand dropseed | 19.6 | 11.5 | 8.1 | 5.2 | 6.8 | 10.3 | 10.3 |
| Needleandthread | 14.3 | 13.2 | 7.0 | 8.5 | 5.9 | 6.9 | 9.3 |
| Mean | 15.3 | | 6.7 | | 6.3 | | 9.5 |

compared to inland salt grass (Table 3) in addition to its growth form. In the first terrace, mean DM of annual grasses (Table 3) declined more rapidly than most other forages and may have influenced the decline in utilization of this group from spring to fall. The very high CP (Table 2) and succulence (low DM) (Table 3) of greasewood new growth appeared to strongly influence its high use, particularly in summer. At all seasons the lower use of old greasewood than new greasewood was consistent with the lower CP and succulence (higher DM) of old greasewood. In uplands CP and DM (Tables 2 and 3) were not generally highly variable within seasons nor was utilization except for blue grama. The lower use of blue grama, particularly in spring but in other seasons also, was more likely a function of its low stature compared to the taller bunch grasses.

Although some differences in quality between habitats appeared to exist, particularly in DM of forages (Table 3), they apparently did not compensate for differences in area and total forage in habitats to result in large overall differences in forage utilization between habitats. Higher quality (e.g. new twigs of greasewood) did, however, result in the highest level of use for a kind of forage.

Quality appeared to drop sharply between spring and summer with little change into fall (Table 2). The overall decline was probably to be expected but in normal years might be less sharp between spring and summer. Precipitation was quite low (108 mm) for April through October 1984. Only 5 mm per event of precipitation occurred in 15 events that undoubtedly caused very little effective soil moisture. Crude protein and DM contents indicate forages were largely cured in summer and fall.

TABLE 3. Dry matter (%) of forage species, pre- and post-spring, summer, and fall grazed in pastures of Middle Fork, 15-Mile Creek, 1984.

| Habitat<br>Forage class<br>Species | Season<br>Spring<br>pre | <br><br>post | <br>Summer<br>pre | <br><br>post | <br>Fall<br>pre | <br><br>post | <br>Mean<br> |
|---|---|---|---|---|---|---|---|
| Channel | | | | | | | |
| Perennial grasses | | | | | | | |
| Inland saltgrass | 33.3 | 34.8 | 56.2 | 48.6 | 70.6 | 72.6 | 52.7 |
| Canada wildrye | 23.5 | 29.1 | 49.7 | 48.2 | 69.2 | 74.9 | 49.1 |
| Mean | 30.2 | | 50.7 | | 71.9 | | 50.9 |
| First Terrace | | | | | | | |
| Perennial grasses | | | | | | | |
| Rhizomatous Wheat-grass | 20.9 | 28.6 | 71.8 | 62.5 | 80.5 | 75.1 | 56.6 |
| Sandberg blue-grass | 49.9 | 37.7 | 91.4 | 90.2 | 96.7 | 96.5 | 77.1 |
| Mean | 34.3 | | 79.0 | | 87.2 | | 66.8 |
| Annual Grasses | | | | | | | |
| Cheatgrass brome | 31.7 | 42.7 | 92.8 | 97.9 | 94.1 | 95.0 | 75.7 |
| Six-weeks fescue | 44.9 | 41.1 | 61.8 | 74.3 | 98.1 | 98.6 | 69.8 |
| Mean | 40.1 | | 81.7 | | 96.5 | | 72.8 |
| Greasewood | | | | | | | |
| New twigs | 19.1 | 23.1 | 31.2 | 27.6 | 45.5 | 42.1 | 31.4 |
| Old twigs | 19.8 | 28.8 | 39.7 | 39.5 | 50.2 | 57.1 | 39.2 |
| Mean | 22.7 | | 34.5 | | 48.7 | | 35.3 |
| First Terrace Mean | 32.4 | | 65.1 | | 77.5 | | 58.3 |
| Upland | | | | | | | |
| Perennial grasses | | | | | | | |
| Blue grama | 38.7 | 48.1 | 55.1 | 50.7 | 86.9 | 87.1 | 61.1 |
| Indian rice-grass | 42.1 | 38.7 | 58.0 | 56.0 | 77.5 | 85.7 | 59.7 |
| Sand dropseed | 67.2 | 43.7 | 55.3 | 59.3 | 63.0 | 62.1 | 58.4 |
| Needleandthread | 32.5 | 39.8 | 72.8 | 66.9 | 84.7 | 78.0 | 62.5 |
| Mean | 43.9 | | 59.3 | | 78.1 | | 60.4 |

Quality factors do not explain the general increases in utilization from spring to fall as intake should decline at low forage quality unless availability was limited.

## Distribution

Cattle distribution generally favored habitats nearer the stream (Table 4). Proportion of cattle in the channel area was always greater than would be expected if cattle were randomly distributed while proportions of cattle were greater in the terrace in spring and summer and were lesser in the upland in spring and summer. The channel and first terrace were level and topographically more uniform than adjacent uplands. Water resources were located in the terrace and cottonwood trees in the terrace and adjacent to the channel would have provided shade when needed. Forage production appeared to be greater per unit area in the channel and terrace. Forage succulence (Table 3) was generally greater (lower DM) in the channel in all seasons. The absence of strong habitat selectivity in the fall may be due to the general similarity of forage characteristics over much of the pasture.

While habitat selection suggests habitat preferences by cattle, these preferences were not reflected in higher utilization of forages in preferred habitats except possibly in fall (Table 1) when utilization was generally higher in the most preferred channel habitat. Conversely in spring the channel received lowest use even though it was a preferred habitat. The absence of large differences in utilization between preferred and non-preferred habitats may not be surprising when relative forage amounts available in the habitats are considered along with general similarity of forage quality factors. Additionally, the use of

TABLE 4. Proportion (%) of total numbers of cattle observed in three habitats and proportion of habitats in spring, summer,and fall grazed pastures of Middle Fork, 15-Mile Creek, 1984.

| Pastures | Habitats | | | | | |
|---|---|---|---|---|---|---|
| | Channel | | Terrace | | Upland | |
| | % Pas. | % Cat. | % Pas. | % Cat. | % Pas. | % Cat. |
| Spring[1/] | 2.0 | 7.6 | 12.6 | 39.5[2/] | 85.4 | 54.0 |
| Summer[1/] | 1.3 | 16.5 | 12.6 | 34.5 | 86.1 | 49.0 |
| Fall | 2.3 | 16.0[1/] | 19.3 | 26.3 | 78.4 | 57.7 |
| All pastures[1/] | 1.9 | 14.4 | 14.9 | 34.2 | 83.3 | 51.5 |

[1/] The proportion of cattle observed was different ($p \leq 0.05$) than what would occur with random distribution over habitats.

[2/] The proportion of cattle observed in the habitat was different ($p \leq 0.05$) between seasons.

relatively small pastures and a short 10-day grazing period in each season may remove distortions in distribution patterns caused by non-forage factors, (i.e., distance to water, topography) common to distribution in large pastures and extended grazing periods.

Stocking Rates

In each of the seasonal pastures, 30 cow-calf pairs were maintained for 10 days in each season. Pasture sizes and habitat areas are listed in Table 5. All pastures averaged a stocking rate of 7.5 acres per animal unit month (AC/AUM) (Table 6). Generally the AC/AUM increased from channel to upland as might be expected based on forage production differences. In spring, however, AC/AUM were similar in channel and terrace even though utilization of channel vegetation (Table 1) was lower than in the terrace. This finding might be expected with the higher productivity of the channel over the terrace and the lower percent cattle use of channel in spring compared to other seasons. In summer AC/AUM was lower (Table 6) than other seasons in the channel due to higher percent cattle in the channel and lower acres in the channel. Plant utilization increased from spring to summer in the channel but compared to other seasons, not as much as AC/AUM would indicate. This implies that the high incidence of use in the channel in summer may have a high amount of non-grazing activity such as shading.

In the terrace habitat, use decreased in the fall as indicated by a lower percentage cattle (Table 4) and higher AC/AUM (Table 6) and there was a corresponding increase in use of uplands (lower AC/AUM). This change could be indicative of the lower quality of the apparently palatable greasewood in the terrace and the general similarity of forage

TABLE 5. Areas (ac) of pastures and habitats in spring, summer and fall grazed pastures of Middle Fork, 15-Mile Creek, 1984.

| Pasture | Habitat | | | Total |
|---|---|---|---|---|
| | Channel | Terrace | Upland | |
| Spring | 1.7 | 10.4 | 70.7 | 82.8 |
| Summer | 0.9 | 8.9 | 60.5 | 70.3 |
| Fall | 1.7 | 14.0 | 56.7 | 72.3 |

TABLE 6. Acres per animal unit month provided by pastures and habitats in spring, summer, and fall grazed pastures of Middle Fork, 15-Mile Creek, 1984.

| | | | | |
|---|---|---|---|---|
| Spring | 2.2 | 2.6 | 13.0 | 8.3 |
| Summer | .5 | 2.6 | 12.3 | 7.0 |
| Fall | 1.1 | 5.3 | 9.8 | 7.2 |
| Mean | 1.3 | 3.5 | 11.7 | 7.5 |

quality across habitats of other species in fall (Table 2). The increase in use of uplands in fall is reflected in higher plant utilization in this habitat.

In general it appears the habitat and seasonal use differences can be at least partially explained by forage factors. Differences in apparent productivity of habitats in these small pastures appeared to be the major consideration in selection of a habitat by grazing cattle where other factors were similar such as forage quality or need for shade. Higher use (low AC/AUM) of channel in summer but moderate plant utilization and the shift away from terrace (higher AC/AUM) in fall coinciding with the drop in quality of greasewood were variations in the general trend between habitat use. The similarity of plant utilization by cattle of a forage class occurring in all habitats (perennial grasses) within each season seemed to additionally support the hypothesized effect of productivity on habitat use as forage quality for the class was generally similar across habitats in each season.

## Morphology Responses

Standard channel morphology measurements were taken before and after each season of use grazing trial in the control and treatment pastures. Data was collected on each cross-section by stringing a leveled line between cross-section end points. Vertical measurements of the distance from this reference to the channel were then taken at intervals of one-tenth (.10) of channel top width. The position and depth of the left and right interim banks was also collected at each cross-section. Areas were calculated for each cross-section and changes in area determined to monitor responses in the channel attributable to cattle activities. Results indicate that spring use had no effect on channel cross-sectional area. However, the summer and fall treatments had mean changes in channel area that were significantly different from the control reaches at the $\alpha = .05$ level (Fig. 1). In both cases, the grazing treatment appeared to limit the increase in channel area in comparison to the control reaches.

In order to ascertain whether any of the changes in channel area were a result of channel downcutting, mean channel depths by reach were determined. Comparison of these depths show no significant change in channel depth for any grazing treatment or for the controls in 1983 or 1984 (Tables 7 and 8).

Extended bank survey data was processed using an area approach. The permanent marker farthest from the stream was used as a base height. Using a computer program, the area of the cross-section under an imaginary line extending from the base height was calculated from the data collected before and after grazing. Using these calculations to determine the change in area, means were developed for each reach in the treatment and control pastures. Only one trial--1983 summer grazing--displayed any significant difference between the control and the grazed pasture. All other trials indicated the mean area changes of the grazed pasture and control to not be significantly different at an ($\alpha = .10$) (Table 9 and Fig. 2).

## RESULTS AND DISCUSSION NORTH FORK STOCKING RATE STUDY

### Utilization

Utilization of forages appeared to shift among habitats over the 3-week grazing trial (Table 10). Generally, the weekly changes were

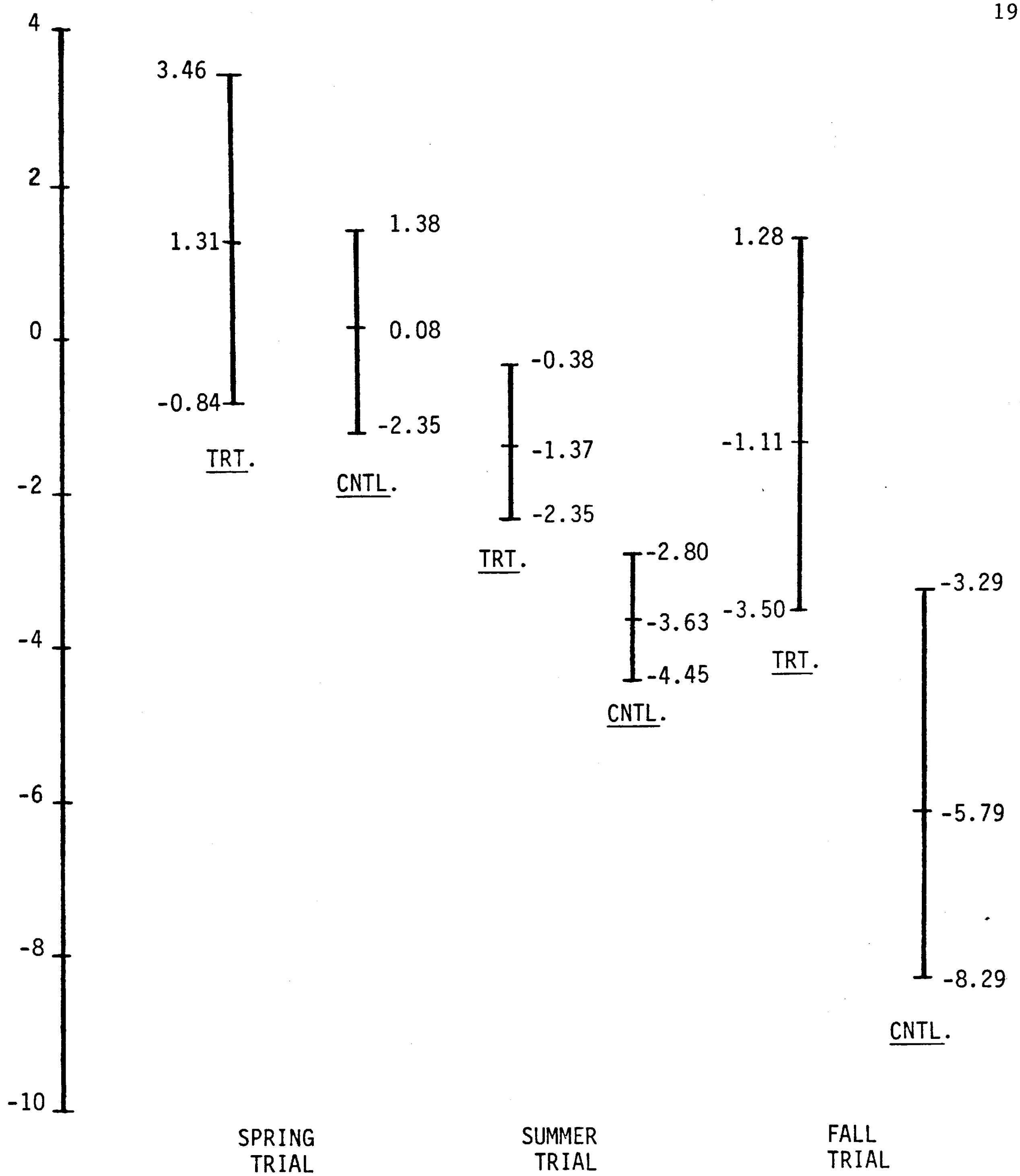


Figure 1. Season of use x-section area changes, means and standard deviations, 1984.

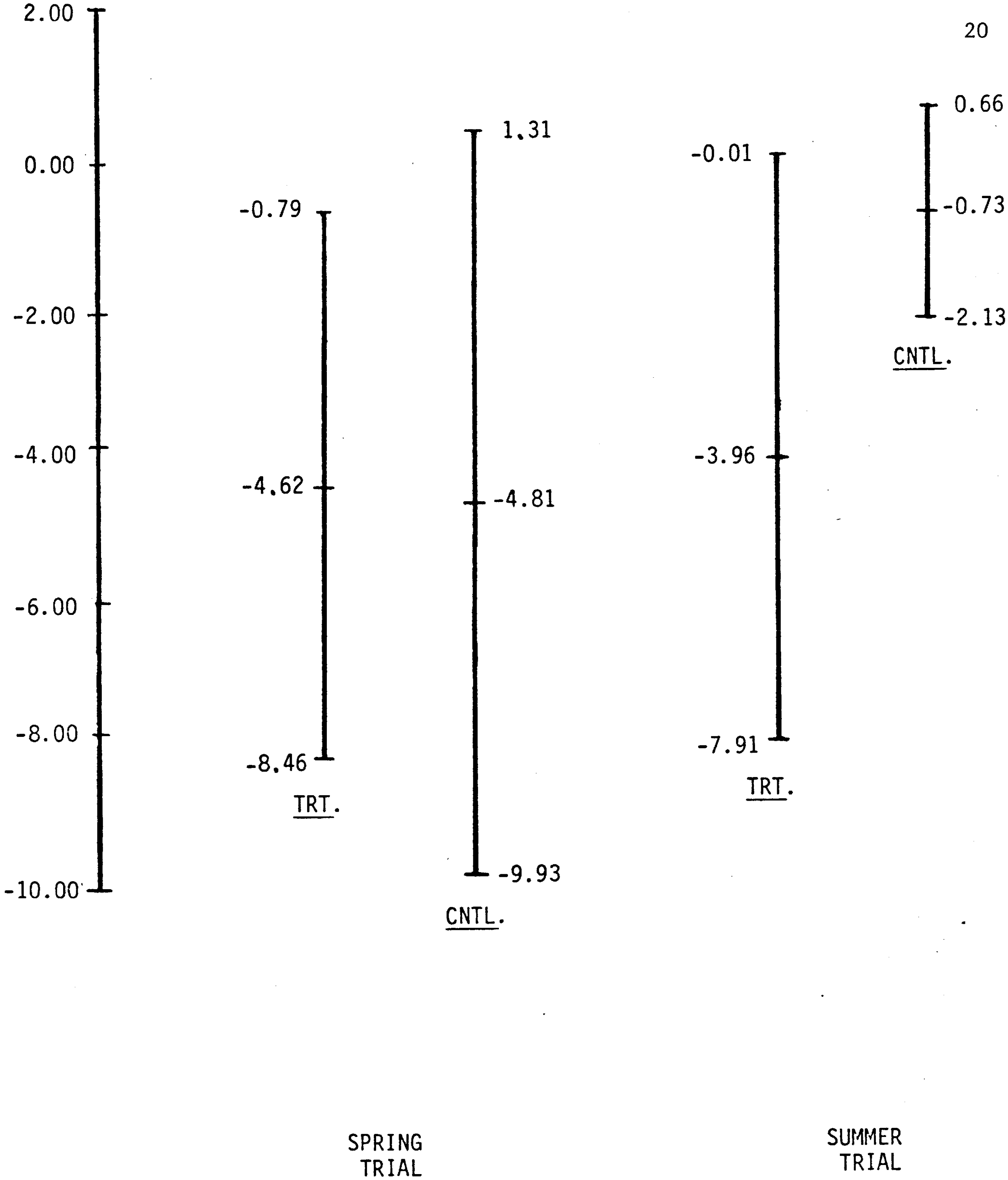


Figure 2. Season of use extended bank survey means and standard deviations of area change, 1984.

TABLE 7. Mean and standard deviations (SD) of channel depths (ft). during 1983 seasonal grazing trials.

| | SPRING | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 3 (Treatment) | 3.04 | 1.95 | 3.15 | 2.00 |
| 4 | 2.73 | 2.01 | 2.67 | 2.08 |
| 9 (Control) | 2.59 | 1.62 | 2.59 | 1.74 |
| 10 | 1.99 | 1.73 | 1.93 | 1.82 |

| | SUMMER | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 5 (Treatment) | 3.11 | 2.10 | 3.07 | 2.08 |
| 6 | 2.74 | 1.81 | 2.66 | 1.85 |
| 9 (Control) | 2.59 | 1.74 | 2.71 | 1.81 |
| 10 | 1.79 | 1.80 | 1.78 | 1.81 |

| | FALL | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 5 (Treatment) | 2.36 | 1.48 | 2.38 | 1.58 |
| 6 | 2.05 | 1.62 | 2.06 | 1.75 |

TABLE 8. Mean and standard deviation (SD) of channel depths (ft). during 1984 seasonal grazing trial.

| | SPRING | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 3 (Treatment) | 3.28 | 2.12 | 31.5 | 2.01 |
| 4 | 2.66 | 2.18 | 2.76 | 2.08 |
| 9 (Control) | 2.75 | 1.94 | 2.65 | 2.05 |
| 10 | 2.02 | 1.82 | 2.08 | 1.78 |

| | SUMMER | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 3 (Treatment) | 3.12 | 2.04 | 3.22 | 2.09 |
| 4 | 2.70 | 1.78 | 2.78 | 1.80 |
| 10 (Control) | 1.89 | 1.75 | 2.06 | 1.78 |

| | FALL | | | |
|---|---|---|---|---|
| | PRE-GRAZING | | POST-GRAZING | |
| Reach | Mean | SD | Mean | SD |
| 7 (Treatment) | 2.16 | 1.89 | 2.17 | 1.87 |
| 8 | 2.01 | 1.56 | 2.66 | 2.05 |
| 9 (Control) | 2.62 | 1.83 | 2.80 | 1.91 |
| 10 | 1.93 | 1.86 | 2.10 | 1.85 |

TABLE 9. Means and standard deviations of area change ($ft^2$) from extended bank surveys.

| | Mean | SD | No Change |
|---|---|---|---|
| | **1984 EBS** | | |
| SPRING | | | |
| Trt | -4.627 | 7.681 | Sig. Dif. $\alpha$ = .10 |
| Cntl | -4.811 | 10.244 | |
| SUMMER | | | |
| Trt | -3.96 | 7.904 | No. Sig. Dif. $\alpha$ = .10 |
| Cntl | -.733 | 2.793 | |
| | **1983 EBS** | | |
| SPRING | | | |
| Trt | -5.367 | 8.843 | No Sig. Dif. $\alpha$ = .10 |
| Cntl | 1.177 | 2.521 | |
| SUMMER | | | |
| Trt | -4.182 | 6.665 | Sig. Dif. $\alpha$ = .10 |
| Cntl | 4.399 | 11.361 | |
| FALL | | | |
| Trt | -3.933 | 9.258 | No. Sig. Dif. $\alpha$ = .10 |
| Cntl | 1.043 | 3.536 | |

TABLE 10. Utilization (%) of current annual growth of forage classes in replicate pastures of North Fork, 15-Mile Creek, stocking rate study by week within habitats, summer 1984.

| Habitat / Forage class / Replication | WEEKS End 1 | End 2 | End 3 | Total |
|---|---|---|---|---|
| Channel | | | | |
| Grasses[1/] | | | | |
| North pasture | 12.4 | 26.8 | 10.0 | 49.2 |
| South pasture | 11.5 | 20.1 | 8.4 | 40.0 |
| Mean | 12.0 | 23.5 | 9.2 | 44.6 |
| Cottonwood[2/] | | | | |
| North pasture | 33.6 | 18.2 | 11.2 | 63.0 |
| South pasture | 8.5 | 34.8 | 16.1 | 59.4 |
| Mean | 21.1 | 26.5 | 13.7 | 61.2 |
| Lemon scurfpea[3/] | | | | |
| North pasture | 12.2 | 2.6 | 2.2 | 17.0 |
| South pasture | 24.9 | 7.5 | 3.3 | 35.3 |
| Mean | 18.6 | 5.1 | 2.8 | 26.2 |
| Terraces | | | | |
| Grasses[4/] | | | | |
| North pasture | 11.9 | 14.9 | 23.3 | 50.1 |
| South pasture | 15.5 | 8.1 | 19.6 | 43.1 |
| Mean | 13.7 | 11.5 | 21.5 | 46.6 |
| Willow[5/] | | | | |
| North pasture | 8.3 | 19.1 | 19.5 | 46.9 |
| South pasture | 11.8 | 22.7 | 15.4 | 49.9 |
| Mean | 10.1 | 20.9 | 17.5 | 48.4 |
| Saline upland | | | | |
| Grasses[6/] | | | | |
| North pasture | 9.6 | 20.1 | 14.5 | 44.2 |
| South pasture | 5.8 | 24.9 | 9.8 | 40.5 |
| Mean | 7.7 | 22.5 | 12.2 | 42.4 |
| Shrubs[7/] | | | | |
| North pasture | 15.2 | 8.0 | 2.2 | 25.4 |
| South pasture | 9.4 | 3.9 | 1.9 | 15.2 |
| Mean | 12.3 | 6.0 | 2.1 | 20.3 |

1/ Inland saltgrass (Distictis stricta), wildryes (Elymus sp.)
2/ Cottonwood (Populus sargentii)
3/ Lemon scurfpea (Psoralea tenuiflora)
4/ Wheatgrasses (Agropyron sp.), Foxtail barley (Hordeum jubatum)
5/ Willow (Salix sp.)
6/ Indian ricegrass (Oryzopsis hymenoides), Bottlebrush squirreltail (Sitanion hystrix), Sand dropseed (Sporobolues cryptandrus)
7/ Budsagewort (Artemisia spinescens), Gardner saltbrush (Atriplex gardnerii)

similar in replicate pastures. In the channel (and reservoir basin) habitat, use was greater during weeks 1 and 2 than 3. Use of grasses peaked in week 2 while cottonwood use appeared similar in week 1 and 2 and forb use was greater in week 1.

In the man-made terraces greatest utilization occurred in weeks 2 and 3. For grasses highest mean use occurred in week 3 (Table 10) but variation between use in replicate pastures was evident. Use of willow in terraces appeared similarly higher in weeks 2 and 3 than 1.

Saline upland habitat was interspersed with terraces and between most terraces and the channel/basin area. A pattern of change in use was evident for each forage class but the pattern for greasewood shrubs was not similar (Table 10). Grasses were used more in week 2 while shrubs were used more in week 1.

Low spring and early summer precipitation had resulted in most herbaceous forages approaching maturity and presumably low palatability at the beginning of the study. Cottonwoods remained succulent and provided shade and thus may have increased cattle selection for them and associated forages in the channel area during weeks 1 and 2. Rains in week 2 caused flow into basins and terraces resulting in wider water availability and possible regreening of some species in terraces. Changes in forages and water in the terraces coupled with less available forage in the channel/basin areas could have shifted utilization toward terrace habitat species in weeks 2 and 3.

The total utilization levels achieved on grasses, forbs or upland shrubs (Table 10) do not appear high enough to cause concern for the stability of individual species or the plant community. Utilization levels affecting resource values provided by cottonwood and willow such as structural diversity for birds are apparently not well established and may be highly dependent on the particular area. Projecting long term effects from one season of use may be open to criticism, however, some comments appear intuitively justified. Willow on this area is largely available to grazing cattle due to its low stature. If only 48% of current annual growth is removed as here, it would appear unlikely that substantial change in stand structure will occur due to grazing at the level of this study. Considering the decadent nature of stands in the North Fork exclosure, grazing may stimulate suckering if water supplied by the terraces remains available.

Cottonwoods may react somewhat differently. Utilization was measured on cottonwood growth considered available to grazing cattle. Much of this was low branches on older trees. Relatively few young plants or suckers were present. Use of 61% of total current available cottonwood may impact the subsequent growth of the small proportion of young plants. Preliminary data on suckering of tagged willows and cottonwoods to partially address the question of grazing effects on regeneration has been taken. Wildlife grazing on cottonwood is at present unquantified but appeared significant before cattle grazing. Water regimes induced by the reservoirs and terraces also is currently unknown but they may have a detrimental effect on cottonwood regeneration. The absence of substantial cottonwood regeneration in the study pastures prior to this study raises a question of whether cottonwood is increasing or declining without cattle grazing. The 25 acres/animal unit month used in this study would appear to be a safe level of use under the conditions experienced in 1984 except for the possible negative effects on cottonwood.

## Forage Quality

Crude protein (CP) and dry matter (DM) contents of species (Tables 11 and 12) comprising the majority of forages available in North Fork pastures indicate that many herbaceous species were near maturity during this study. Most grasses provided only 5 to 6% CP while DM, averaged 50 to 70%. Rain that fell during the grazing trial appeared to cause regreening and an increase in CP in wheatgrasses in the terraces and sand dropseed in saline uplands. Dry matter content however continued to increase during the trial. Woody species maintained a constant DM and CP content during the three weeks of grazing but were generally more succulent (lower DM) and higher in CP than grasses. The only forb of note, lemon scurfpea, was also more succulent and higher in CP than grasses.

Forage quality differences or changes during the trial did not appear to strongly influence utilization levels or shifts during the trial except in cottonwood and in grasses in the terraces. Higher cottonwood utilization appeared to coinside with its greater succulence and CP. The increase in CP in wheatgrasses in terraces during the trial was followed by increased utilization.

Lemon scurfpea received the lightest utilization of all plants measured even though CP and succulence were higher than many other plants. Palatability of lemon scurfpea was probably influenced by other plant factors.

TABLE 11. Crude protein (%) of forage species in replicate pastures of North Fork, 15-Mile Creek, stocking rate study by week within habitats, summer 1984.

| Habitat<br>Forage class<br>Species | Weeks<br>Pre-grazing | <br>End 1 | <br>End 2 | <br>End 3 | <br>Mean |
|---|---|---|---|---|---|
| Channel | | | | | |
| Grasses | | | | | |
| Inland salt-grass | 5.6 | 5.2 | 5.2 | 5.1 | 5.3 |
| Wildryes | 6.3 | 6.1 | 5.2 | 5.4 | 5.8 |
| Mean | 6.0 | 5.7 | 5.2 | 5.3 | 5.6 |
| Cottonwood | 9.1 | 14.2 | 11.7 | 12.6 | 11.9 |
| Lemon scurfpea | 12.7 | 11.8 | 9.8 | 10.3 | 11.2 |
| Mean | 9.3 | 10.6 | 8.9 | 9.4 | 9.6 |
| Terraces | | | | | |
| Grasses | | | | | |
| Wheatgrasses | 6.2 | 7.6 | 9.3 | 9.1 | 8.1 |
| Foxtail barley | 5.5 | 5.2 | 5.7 | 5.5 | 5.5 |
| Mean | 5.9 | 6.4 | 7.5 | 7.3 | 6.8 |
| Willow | 8.8 | 7.7 | 6.9 | 6.9 | 7.6 |
| Mean | 7.4 | 7.1 | 7.2 | 7.1 | 7.2 |
| Saline upland | | | | | |
| Grasses | | | | | |
| Indian ricegrass | 5.1 | 5.1 | 6.1 | 5.9 | 5.6 |
| Bottlebrush squirreltail | 8.3 | 7.0 | 6.9 | 6.9 | 7.3 |
| Sand dropseed | 6.1 | 7.9 | 14.7 | 10.5 | 9.8 |
| Mean | 6.5 | 6.7 | 9.2 | 7.8 | 7.6 |
| Shrubs | | | | | |
| Bud sagewort | 7.1 | 7.0 | 8.1 | 7.9 | 7.5 |
| Gardner saltbush | 11.2 | 10.1 | 14.6 | 12.9 | 12.2 |
| Mean | 9.2 | 8.6 | 11.4 | 10.4 | 9.9 |
| Mean | 7.9 | 7.7 | 10.3 | 9.1 | 8.8 |

TABLE 12. Dry matter (%) of forage species in replicate pastures of North Fork, 15-Mile Creek, stocking rate study by week within habitats, summer 1984.

| Habitat<br>Forage class<br>Species | Weeks<br>Pre-grazing | <br>End 1 | <br>End 2 | <br>End 3 | <br>Mean |
|---|---|---|---|---|---|
| Channel | | | | | |
| Grasses | | | | | |
| Inland saltgrass | 44.2 | 48.1 | 49.1 | 59.7 | 50.3 |
| Wildryes | 50.7 | 56.9 | 52.3 | 60.3 | 55.0 |
| Mean | 47.5 | 52.5 | 51.2 | 60.0 | 52.7 |
| Cottonwood | 32.3 | 44.4 | 45.2 | 43.7 | 41.4 |
| Lemon scurfpea | 30.4 | 33.0 | 36.7 | 55.2 | 38.8 |
| Mean | 36.7 | 43.3 | 44.4 | 53.0 | 44.3 |
| Terraces | | | | | |
| Grasses | | | | | |
| Wheatgrasses | 48.8 | 58.3 | 62.7 | 60.5 | 57.6 |
| Foxtail barley | 48.9 | 57.4 | 63.9 | 62.7 | 58.2 |
| Mean | 48.9 | 57.9 | 63.3 | 61.6 | 57.9 |
| Willow | 34.8 | 51.4 | 54.6 | 55.0 | 49.0 |
| Mean | 41.9 | 54.7 | 59.0 | 58.3 | 53.4 |
| Saline upland | | | | | |
| Grasses | | | | | |
| Indian rice-grass | 64.2 | 76.1 | 78.0 | 76.7 | 73.8 |
| Bottlebrush squirreltail | 79.6 | 84.5 | 86.3 | 89.5 | 85.0 |
| Sand dropseed | 3.19 | 5.17 | 53.5 | 57.4 | 48.6 |
| Mean | 58.6 | 70.8 | 72.6 | 74.5 | 69.1 |
| Shrubs | | | | | |
| Bud sagewort | 74.6 | 75.2 | 74.8 | 78.6 | 76.8 |
| Gardner salt-bush | 54.9 | 47.5 | 43.2 | 59.4 | 51.3 |
| Mean | 64.8 | 61.4 | 59.0 | 69.0 | 64.0 |
| Mean | 61.7 | 66.1 | 65.8 | 71.8 | 66.6 |

Distribution

Cattle exhibited preferences for the channel, flood plain and seeded terrace habitats over the more abundant saline upland (Table 13) as indicated by the higher proportion of cattle observations than proportion of habitats in pastures and lesser proportion of cattle in saline upland than proportion of habitat in pastures. Preferred habitats generally had more or better quality forages than the saline upland.

Channel and flood plain had cottonwood shade trees and a water source that would attract cattle. The seeded terraces appeared to be the most preferred habitat as their actual contribution to area was much smaller compared to cattle use than in other habitats (Table 13). The apparently rapid improvement in quality (CP), Table 13) in the second and third week of grazing after precipitation runoff into terraces appeared to greatly enhance preference for this habitat (Table 13). Use was very low in week 1 (1.7% of cattle) compared to high use (35% of cattle) in week 3. Other habitats except saline upland showed changes in use over weeks. Peak use of the channel occurred in week 2 while the flood plain use steadily declined over the three weeks. Changes in use did not appear to be related to forage quality (CP or DM) changes except in seeded terraces. Channel and flood plain contained essentially the same kind of forage resource and were adjacent. Combined use (% cattle) of these habitats over weeks (1-75.2%, 2-72%, 3-40.6%) seems to follow an inverse pattern to use in seeded terraces. This suggests that declining forage availability due to forage utilization and slight decline in quality in channel and flood plain combined with the

TABLE 13. Proportion (%) of cattle and of habitats in pastures by week in replicate pastures of North Fork, 15-Mile Creek, stocking rate study, summer 1984.

| Week / Pasture | Habitats: Channel %Hab. | Channel %Cat. | Flood Plain %Hab. | Flood Plain %Cat. | Seeded Terrace %Hab. | Seeded Terrace %Cat. | Saline Upland %Hab. | Saline Upland %Cat. |
|---|---|---|---|---|---|---|---|---|
| Week 1 | | [2] | | [2] | | [2] | | |
| North | 1.3 | 6.1 | 11.6 | 64.0[1] | 0.8 | 3.1 | 86.2 | 28.2[1] |
| South | 3.0 | 5.1 | 18.8 | 72.3[1] | 0.4 | 1.1 | 77.8 | 21.6[1] |
| Combined | 2.1 | 6.9 | 15.2 | 68.3[1] | 0.6 | 1.7 | 82.0 | 23.1[1] |
| Week 2 | | | | | | | | |
| North | 1.3 | 20.4[1] | 11.6 | 50.5[1] | 0.8 | 13.1 | 86.2 | 16.1[1] |
| South | 3.0 | 29.7[1] | 18.8 | 48.5[1] | 0.4 | 10.2 | 77.8 | 11.5[1] |
| Combined | 2.1 | 26.2[1] | 15.2 | 47.8[1] | 0.6 | 12.4 | 82.0 | 13.7[1] |
| Week 3 | | | | | | | | |
| North | 1.3 | 17.1 | 11.6 | 20.0 | 0.8 | 32.3[1] | 86.2 | 30.6[1] |
| South | 3.0 | 6.3 | 18.8 | 37.1 | 0.4 | 38.2[1] | 77.8 | 18.5[1] |
| Combined | 2.1 | 11.8 | 15.2 | 28.8 | 0.6 | 35.0[1] | 82.0 | 24.4[1] |
| All weeks | | | | | | | | |
| North[1] | 1.3 | 14.3 | 11.6 | 47.1 | 0.8 | 14.7 | 86.2 | 24.5 |
| South[1] | 3.0 | 14.8 | 18.8 | 53.2 | 0.4 | 15.1 | 77.8 | 16.9 |
| Combined[1] | 2.1 | 15.3 | 15.2 | 50.1 | 0.6 | 14.6 | 82.0 | 20.5 |

1/In rows proportion of cattle observed in habitats were significantly different (p < .05 from that expected if distribtuion were random in the pasture(s).

2/In columns significant difference ( p < .05) between weeks in pastures and pastures combined.

increased CP of forages in seeded terraces causing the shift in areas used over the three week period.

Even though cattle exhibited preferences for habitats the similar levels of utilization achieved in habitats (Table 10) suggests that in these relatively small pastures, animals were responding to forage factors in their use patterns. Cottonwood plants in channel and flood plain received somewhat higher utilization (Table 10) than other species but they also maintained higher CP and succulence (Tables 11, 12). Wheatgrasses in seeded terraces apparently became more attractive (higher CP) later and may have caused the shift in distribution. Water locations and other intrinsic pasture characteristics did not change during the study.

Stocking Rates

In each of the replicate pastures 10 cow-calf pairs were maintained for 21 days of grazing time resulting in 14 animal unit months (AUM) use in 355.2 ac (Table 14) or 25 AC/AUM. Of more interest were values for each habitat (Table 15). In both pastures seeded terraces appeared to be the most productive for grazing followed by channels, flood plains and saline uplands as might be expected from water flow patterns in the pastures. Seeded terraces in the south pasture were probably more productive because the terraces were in better repair. North pasture channels would appear to be more productive because water passes through the reservoir upsteam but rarely fills the next reservoir sufficiently to permit flow in the main channel in the south pasture. Flood plains and saline uplands were similar in both pastures.

TABLE 14. Areas (ac) of pastures and habitats used in North Fork, 15-Mile Creek, stocking rate study, summer 1984.

| Pasture | Habitats | | | | Total |
|---|---|---|---|---|---|
| | Channel | Flood Plain | Seeded Terrace | Saline Upland | |
| North | 2.6 | 23.3 | 1.7 | 173.4 | 201.1 |
| South | 4.6 | 29.0 | .6 | 119.9 | 154.1 |
| Combined | 7.2 | 52.3 | 2.3 | 293.3 | 355.2 |

TABLE 15. Acres per animal unit month provided by pastures and habitats in North Fork, 15-Mile Creek, stocking rate study, summer 1984.

| Pasture | Habitats | | | | |
|---|---|---|---|---|---|
| | Channel | Flood Plain | Seeded Terrace | Saline Upland | All |
| North | 2.6 | 7.0 | 1.7 | 101.1 | 28.7 |
| South | 4.4 | 7.8 | 0.6 | 101.3 | 22.0 |
| Combined | 3.4 | 7.5 | 1.1 | 101.2 | 25.4 |

Based on utilization levels achieved in a low precipitation year, the AUMs of use would probably allow perpetuation of plant communities in North Fork pastures with the caution that cottonwood regeneration needs closer study before final recommendations are made. Conclusive recommendations could only be made after observing change in plant species composition.

Future Plans North Fork

Considerations:

A. Objectives
   1. Stocking rate to sustain ephemeral stream riparian vegetation
   2. Forage characteristics and distribution relationships

B. Question relative to meeting objectives
   1. Suitability of area, representative of ephemeral riparian zones
   2. Years needed
   3. Other data: shrub resprouting, utilization by size and class of cottonwood

RESULTS AND DISCUSSION - FREE RANGING CATTLE HABITAT SELECTION

In all study areas, cattle preferred the channel regardless of season (Table 16). This effect was more obvious on Main Channel where the stream channel was a source of water in all seasons and upland reservoirs were dry in 1984. The terrace was selected in greater proportion than available only on Main Channel (Table 16) while uplands were selected less than available on Main Channel only. Absence of water in uplands along Main Channel appeared to be the major factor causing the majority of cattle to be in channel and terrace habitats.

In contrast to Main Channel, cattle on the Middle Fork selected terrace and upland habits in proportions similar to availability of the habitats (Table 16). On Middle Fork the reservoir in upland areas had water only during a short flow event in mid-summer. On Middle Fork a

TABLE 16. Proportions of cattle (%) observed and proportions of habitats (%) in observed areas for free ranging cattle in Middle Fork and Main Channel areas of 15-Mile Creek in spring, summer, and fall, 1984.

| | | | | | | |
|---|---|---|---|---|---|---|
| Middle Fork | | | | | | |
| Spring | 3.9 | 13.2 | 26.1 | 30.5 | 70.0 | 56.3 |
| Summer | 3.9 | 13.7 | 26.1 | 6.0[1/] | 70.0 | 80.2 |
| Fall | 3.9 | 11.1 | 26.1 | 43.7 | 70.0 | 45.2 |
| All Seasons | 3.9 | 12.7[1/] | 26.1 | 26.8 | 70.0 | 60.6 |
| Main Channel | | | | | | |
| Spring | 5.0 | 29.1[1/] | 25.0 | 68.5[1/] | 70.0 | 2.4[1/] |
| Summer | 5.0 | 24.7 | 25.0 | 75.3[1/] | 70.0 | 0.0 |
| Fall | 5.0 | 0.0[1/] | 25.0 | 100.0[1/] | 70.0 | 0.0[1/] |
| All Seasons | 5.0 | 21.2[1/] | 25.0 | 77.8[1/] | 70.0 | 1.1[1/] |
| Combined | | | | | | |
| Spring | 4.5 | 20.3[1/] | 25.5 | 48.1 | 70.0 | 31.6[1/] |
| Summer | 4.5 | 16.5 | 25.5 | 14.7 | 70.0 | 68.9 |
| Fall | 4.5 | 6.5 | 25.5 | 51.9 | 70.0 | 41.6 |
| All Seasons | 4.5 | 14.4[1/] | 25.5 | 38.2 | 70.0 | 47.4[1/] |

[1/] The proportion of cattle in habitat(s) were different. $p = < .05$ than that assumed with random distribution.

majority of cattle needs were supplied by uplands in contrast to the low amounts supplied by uplands along Main Channel. Availability of livestock water in the uplands appeared to be the key difference between areas.

Differences in cattle use of habitats between season were not significant, probably because of high variation and low numbers of animals sighted, especially in the Main Channel area. Drought conditions and low availability of livestock water were likely influential in limiting cattle distribution to areas nearer water. Selection of areas near water seems particularly evident on Middle Fork in summer and Main Channel in each season (Table 16).

Habitat selection by cattle in the small pasture studies (season of use, stocking rate) was similar to habitat selection of free ranging cattle. Preference for the channel was consistent over all study areas. The first terrace (flood plain) areas were selected similar to availability, or in greater proportion depending on availability of water and season. Uplands were selected in lesser proportion than available except by free ranging cattle on the Middle Fork area where water was available in a reservoir. Where distance from water did not limit distribution the greater forage available seemed to satisfy cattle demand without excessive utilization of forage species. Utilization of important woody species in selected habitats (i.e., cottonwood) may be high. However, more consideration of natural regeneration and wildlife use needs to be made before the effects of cattle use can be assessed.

## MORPHOLOGIC/HYDROLOGIC STUDIES

### Morphology

Standard cross-section measurements were performed in the fall of 1984 for all study areas. Again, some difficulty was experienced in re-establishing cross sections. Additional markers were put in to help alleviate these problems and reduce the variance in future measurements.

Cross-section data was analyzed in three manners. The PLOTV graphics program was used to obtain visual representations of each cross-section. Mean reach depths and cross-sectional areas were calculated for each reach to determine channel changes.

Current mean reach depths and standard deviations (SD) were calculated for all four study areas. The two areas associated with higher order streams, (Main Channel and Below Exclosure) showed no strong overall trend though each had multiple reaches which changed in character (e.g., becoming (a) deeper than the range of the area mean ± one SD, (b) shallower than the range of the area mean ± one SD, or (c) staying within the range of the area mean ± one SD) (Tables 17, 18 ). However, the two areas of the Middle Fork displayed strong trends. The area above the exclosure had a majority of the reaches that were changing; trending to greater mean depths indicating a general degradation in the area (Table 19). The exclosure data indicated an opposite trend, as all reaches changing in character became relatively shallower (Table 20).

Cross-sectional area was calculated for each transect for 1983 and 1984. The 1984 values were then subtracted from the 1983 values to determine the change in area. By this method a negative value indicates

TABLE 17. Main Channel - mean depths (ft) and trends by reach.

| REACH | 1982 | 1983 | 1984 | TREND 1983 vs 1984 |
|---|---|---|---|---|
| 1-1 | 3.98* | 4.17* | 3.28@ | shallowing |
| 1-2 | 3.56@ | 3.41@ | 3.54@ | - |
| 1-3 | 3.28@ | 3.80* | 2.76@ | shallowing |
| 1-4 | 4.16* | 4.78* | 4.78* | - |
| 1-5 | 2.32** | 2.51** | 2.40** | deepening |
| 1-6 | 2.58** | 2.61** | 1.87** | - |
| 1-7 | 3.08@ | 3.17@ | 2.60@ | - |
| 1-8 | 3.14@ | 3.34@ | 3.55@ | - |
| 1-9 | 3.29@ | 3.64* | 3.36@ | shallowing |
| 1-10 | 3.66* | 3.69* | 3.22@ | shallowing |
| 1-11 | 3.71* | 3.73* | 3.47* | - |
| 1-13 | 3.79* | 2.83** | 2.87@ | deepening |
| 1-14 | 2.77** | 3.08@ | 2.54@ | - |
| 1-15 | 1.79** | 2.57** | 2.11** | - |
| 1-16 | 2.49** | 3.04@ | 2.47@ | - |
| 1-17 | 3.21@ | 3.65* | 2.90@ | shallowing |
| 1-18 | 3.93@ | 2.40** | 2.34@ | deepening |
| Mean | 3.27 | 3.24 | 2.94 | |
| Std. Dev. | 0.64 | 0.65 | 0.70 | |

* - Deeper than treatment mean ± 1 Standard Deviation.
** - Shallower than treatment mean ± 1 Standard Deviation.
@ - Within range of treatment mean ± 1 Standard Deviation.

TABLE 18. Below Exclosure - mean depths (ft) and trends by reach.

| REACH | 1982 | 1983 | 1984 | TREND 1983 vs 1984 |
|---|---|---|---|---|
| 2-1 | 2.54* | 2.98* | 1.74@ | shallower |
| 2-2 | 3.95* | 3.82* | 3.11* | - |
| 2-3 | 2.20@ | 2.20@ | 1.53@ | - |
| 2-4 | 1.78** | 1.94** | 1.81@ | deeper |
| 2-5 | 2.22@ | 2.34@ | 1.97@ | - |
| 2-6 | 2.23@ | 2.33@ | 2.32@ | - |
| 2-7 | 1.90** | 1.82** | 0.92** | - |
| 2-8 | 2.28@ | 2.41@ | 2.15@ | - |
| 2-9 | 2.73* | 2.69* | 2.36@ | shallower |
| 2-11 | 2.26@ | 2.18@ | 2.20@ | - |
| 2-13 | 2.44@ | 2.75* | 2.44@ | shallower |
| 2-15 | 1.82** | 1.76** | 0.88** | - |
| 2-17 | 2.08@ | 1.89** | 2.03@ | deeper |
| 2-19 | 1.85** | 1.84** | 1.75@ | deeper |
| 2-21 | 1.50** | 1.97** | 1.04** | deeper |
| Mean | 2.25 | 2.33 | 1.94 | |
| Std. Dev. | .59 | .55 | .59 | |

* - Deeper than treatment mean ± 1 Standard Deviation.
** - Shallower than treatment mean ± 1 Standard Deviation.
@ - Within range of treatment mean ± 1 Standard Deviation.

TABLE 19. Above Exclosure - mean depths (ft) and trends by reaches.

| REACH | 1982 | 1983 | 1984 | TREND 1983 to 1984 |
|---|---|---|---|---|
| 3-1 | 3.31* | 3.47* | 3.38* | - |
| 3-2 | 3.33* | 3.63* | 3.54* | - |
| 3-3 | 3.51* | 3.61* | 3.04@ | shallower |
| 3-4 | 4.15* | 4.07* | 3.99* | - |
| 3-5 | 3.36* | 3.05@ | 2.80@ | - |
| 3-7 | 2.78@ | 2.79@ | 2.36@ | - |
| 3-8 | 2.39@ | 1.73** | .92** | - |
| 3-11 | 2.07** | 1.37** | 1.39@ | deeper |
| 3-13 | 2.38@ | 2.43@ | 2.24@ | - |
| 3-15 | 1.41** | 1.57** | 1.30** | - |
| 3-17 | 1.76** | 1.33** | 1.49@ | deeper |
| 3-19 | 2.50@ | 2.10** | 1.93@ | deeper |
| Mean | 2.75 | 2.60 | 2.37 | |
| Std. Dev. | .80 | .98 | .99 | |

* - Deeper than treatment mean ± 1 Standard Deviation.
** - Shallower than treatment mean ± 1 Standard Deviation.
@ - Within range of treatment mean ± 1 Standard Deviation.

TABLE 20. Exclosure - mean depth (ft) and trend by reaches.

| REACH | 1982 | 1983 | 1984 | TREND 1983 to 1984 |
|---|---|---|---|---|
| 4-1 | 2.94@ | 3.03@ | 2.91@ | - |
| 4-2 | 3.09@ | 2.86@ | 2.60@ | - |
| 4-3 | 3.29* | 3.08* | 2.92@ | shallower |
| 4-4 | 3.40* | 3.13 | 2.85@ | shallower |
| 4-5 | 3.40* | 3.23* | 3.10* | - |
| 4-6 | 3.09@ | 2.83 | 2.76@ | - |
| 4-7 | 2.29** | 2.55** | 2.16** | - |
| 4-8 | 3.24@ | 2.81@ | 2.01** | shallower |
| Mean | 3.09 | 2.94 | 2.59 | |
| Std. Dev. | .36 | .22 | .41 | |

* - Deeper than treatment mean ± 1 Standard Dev.
** - Shallower than treatment mean ± 1 Standard Dev.
@ - Within range of treatment mean ± 1 Standard Dev.

the 1984 cross-section is larger in area than the 1983 while a positive difference represents a decrease in area for the measurement period. These differences were then summarized to determine a mean and SD for each treatment area.

The main channel and below exclosure study areas both display means indicating an overall decrease in channel cross-section area in 1984 as compared to 1983. The means of the two study areas on the Middle Fork indicate that they are experiencing an increase in cross-sectional area (Table 21). An interesting phenomena is noted, however, when the exclosure is broken down by treatments (control, spring grazing, summer grazing, fall grazing). The reaches in the control display an increased cross-sectional area similar to the study area above the exclosure. In contrast, the channel in each grazing treatment experienced a decrease in cross-sectional area. Although previous data (1983) does not show a turnabout, the absolute values of the differences between the control reaches and the various grazing treatments are quite similar (Table 22).

## Precipitation

1983 precipitation records indicate that the seven month period April through October was well above average. Comparisons with long term (30 year) records for Worland, a wetter location, indicates the area received amounts which were comparable to or exceeding the long term average. In contrast, 1984 proved to be relatively dry, especially in early spring and late summer (Table 23).

TABLE 21. Means and standard deviations ($ft^2$) of differences in channel area by treatment from 1983-1984.

| Treatment Area | Mean of Area Change | Std. Deviation of Area Change |
|---|---|---|
| Main Channel | .60 | 43.55 |
| Below Exclosure | 6.38 | 36.99 |
| Exclosure | -.31 | 15.53 |
| Above exclosure | -3.94 | 15.32 |

TABLE 22. Means and standard deviations ($ft^2$) of changes in channel area in the exclosure by treatment and analysis period.

| Analysis Period | Control | | Spring Grazing | | Summer Grazing | | Fall Grazing | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}$ | SD | $\bar{X}$ | SD | $\bar{X}$ | S |
| 83 to 84 | -2.81 | 5.62 | +.22 | 7.18 | +.15 | 1.47 | +2.77 | 6.27 |
| 82 to 83 | -3.04 | 3.02 | -.38 | 5.93 | -.38 | 15.50 | -.71 | 14.40 |

TABLE 23. Precipitation summary for 15-Mile Creek watershed area.

| YEAR | MONTH | WORLAND 30 YR. AVG. | SQUAW TEATS | MIDDLE | EXCLOSURE | N. FORK |
|---|---|---|---|---|---|---|
| 1983 | Apr | .99 | .75 | .85 | .60 | .69 |
| | May | 1.35 | 1.70 | 1.25 | 1.40 | 1.38 |
| | June | 1.45 | 3.20 | 1.75 | 1.40 | 1.55 |
| | July | .74 | .50 | .75 | .65 | .84 |
| | Aug | .42 | 1.50 | 1.05 | 1.30 | .63 |
| | Sept | .71 | .70 | .30 | .55 | .50 |
| | Oct | .63 | .75 | .60 | .20 | .31 |
| | Total | 6.29" | 9.30" | 6.55" | 6.10" | 5.90" |
| 1984 | Apr | | *** | *** | *** | |
| | May | 1.35 | .65 | .40 | .20 | .50 |
| | June | 1.45 | 1.17 | 1.36 | 1.25 | 1.42 |
| | July | .74 | .38 | .70 | 1.10 | .78 |
| | Aug | .42 | .72 | .16 | .10 | .27 |
| | Sept | .71 | 1.09 | 1.62 | 1.65 | 1.66 |
| | Oct | .63 | .14 | *** | 0.0 | |
| | Total | 5.30 | 4.15" | 4.24" | 4.30" | 4.63" |

*BLM recording gage on North Fork-15 Mile Creek.
**Est. by regression.
***Missing data - gage removed.

## Soil Moisture

Soil moisture readings for 1983 and 1984, reported by the neutron probe as $kg/m^3$, were translated to linear (cm) readings. Tubes were paired on the basis of their position relative to the stream channel and the floodplain-upland boundary. Each pasture was taken as a separate treatment with replications of measurements--one associated with a channel meander, the other with a straight stream reach. With this design, the analysis framework becomes five treatments, each with two replications of three samples and two observations per sample (Fig. 3).

Comparison of profile totals (summation of linear water to the 8 ft depth) showed little change from month to month. This was not unexpected as the lag time for any excess water to percolate into a profile and evaporation/transpiration losses should tend to smooth any changes detectable on a monthly basis. Subsectioning the profile into top, middle, and lower layers improved our capacity to detect changes in soil water content but provided no information indicating a systematic response of soil moisture to grazing treatments.

Soil moisture readings do appear to correlate to precipitation and flow events in a manner that is not yet fully analyzed. The correlation is strongest for tubes on meanders and, predictably, those closest to the stream. It appears that the soil water in the upper layer (0-3 ft) has a stronger relationship to the flow events than the lower layers. At this time, a more rigorous and complete analysis is being undertaken.

Additional tubes were installed in 1984 to expand and solidify the soil moisture monitoring network. These tubes are scheduled for inclusion in the monitoring sequence in 1985.

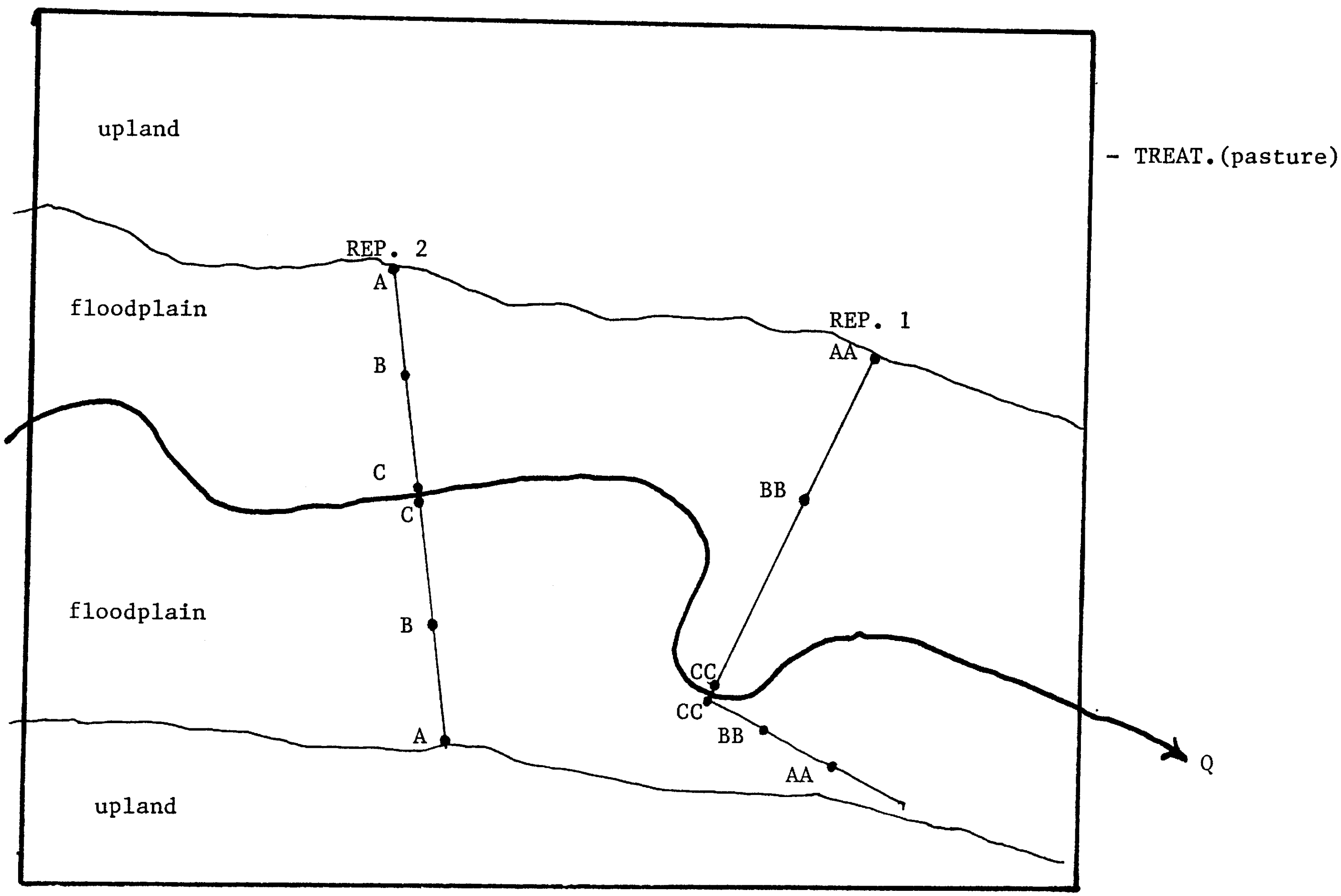


Figure 3. Soil moisture analysis schematic -- tubes with the same designation are paired observations.

# VEGETATION STUDIES

## ABOVEGROUND BIOMASS

Aboveground biomass was sampled in 1984 in a manner similar to the previous years (1982 and 1983 annual reports). Permanent vegetation transects were established in 1983 in the Middle fork and North Fork exclosures. Vegetation data collected in 1983 and 1984 has been summarized for this report. Sampling in 1982 was not as extensive as the following years, therefore results have been omitted in this report. All results are presented in grams per square meter ($gr/m^2$) unless otherwise noted. Results are based on clipped plot results, rather than clipped and estimated plots. Analysis of the combination of clipped and estimated quadrats has not been completed, but preliminary results are similar to clipped plot results in most instances. Common names have been used instead of scientific names. A complete list of scientific names can be found in Appendix 1. Common and scientific names follow those recommended by Beetle (Recommended Plant Names. Univ. of Wyo. Agric, Exp. R.I. 31. 1970) Our precipitation records indicate spring and summer 1983 rainfall was well above the long-term average for Worland. In contrast, the spring and summer 1984 precipitation was below average. On most sites, aboveground biomass was greater in 1983 than in 1984. Many plant species sampled in 1984. had half of the production recorded in 1983.

### Middle Fork Exclosure

The Middle Fork exclosure has been divided into three very broad landform types and five pastures. On the average, each pasture contains 83% uplands, 15% terrace, and 2% channel area. Aboveground biomass of perennial grasses and forbs in 1984 on each of these landforms and pastures is listed in Table 24. Production of perennial grasses was highest in the channel followed by the uplands and then the terrace. Forb production was greater in the manipulation and spring grazed cells than in the other pastures.

The upland land form is generally characterized by blue grama, prickly pear and some needleandthread. Production figures based on ten clipped plots for the upland vegetation type are presented in Table . Blue grama production in 1984 was half as much as it was in 1983. Perennial grass species usually accounted for less than half of the total annual production for any given pasture. Large fluctuations in cactus biomass were observed, and has been noted on other studies within the state. Production figures for blue grama were similar for all pastures within the same years (Table 25).

Results taken from two long and short transects were combined to estimate the production in the terrace. Long transects (200 ft.) were located the farthest from the channel, but still within the first terrace (1983 annual report). Measurements from two long transects on ten clipped plots were taken within each pasture. Production of perennial grasses was usually less than 5% of the total production in all pastures except the control (Table 26). Cactus biomass accounted for the greatest percentage of production in all pastures. Cheatgrass production in 1983 was almost twice as much as it was in 1984. Short transects were established in the terrace as well (1983 annual report). Prickly pear was the dominant plant species in all pastures except the 1984 control (Table 27) based upon 12 clipped plots. Perennial grass

TABLE 24. Aboveground biomass ($gr/m^2$) of perennial grasses and forbs within the Middle Fork exclosure by land form in 1984.

| | Manipulation | | Spring | | Summer | | Fall | | Control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grass | Forbs | Grass | Forbs | Grass | Forbs | Grass | Forbs | Grass | Forbs |
| UPLANDS | 11 | | 11 | | 14 | | 13 | 7 | 10 | |
| TERRACE | 10 | 2 | 3 | 4 | 7 | 2 | 4 | | 5 | 2 |
| CHANNEL | 25 | 17 | 15 | 17 | 46 | | 29 | 2 | 38 | 1 |

TABLE 25. Aboveground biomass ($gr/m^2$) of upland communities in all pastures of the Middle Fork exclosure in 1983 and 1984.

| FORAGE CLASSES Plant Species (Common name) | Manipulation | | Spring | | Summer | | Fall | | Control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| GRASSES & GRASSLIKES | | | | | | | | | | |
| Blue grama | 16 | 11 | 26 | 11 | 19 | 12 | 22 | 12 | 21 | 10 |
| Needleandthread | | | | t | 4 | 1 | 2 | 1 | 1 | t |
| Sixweek fescue | | | 1 | | | | t | | | |
| Bottlebrush squirrel-tail | | t[a] | | | | | | | | |
| Threadleaf sedge | | | | | | 1 | | | | |
| FORBS | | | | | | | | | | |
| Wolly plantain | 1 | | 1 | | | | | | | |
| Bluebur stickweed | | | | t | 1 | | | | | |
| Slimflower scurfpea | | | | | | | | 7 | | |
| Rush skeleton plant | | | | | | | t | | | |
| SHRUBS | | | | | | | | | | |
| Plains pricklypea | 36 | 72 | 24 | 32 | 35 | 71 | 32 | 22 | 17 | 12 |
| Louisiana sagewort | | | | | | | | 1 | | |
| TOTAL ± S.E.[b] | 53±31 | 84±35 | 52±19 | 44±14 | 59±23 | 85±43 | 56±13 | 43±13 | 39±11 | 22±13 |

a/ t = trace < .50 $gr/m^2$

b/ Standard Error = $\frac{S}{n}$

TABLE 26. Aboveground biomass (gr/$m^2$) of first terrace communities (short transects) in all pastures of the Middle Fork exclosure in 1983 and 1984.

| FORAGE CLASS<br>Plant species<br>(Common name) | Manipulation | | Spring | | Summer | | Fall | | Control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| GRASSES & GRASSLIKES | | | | | | | | | | |
| Needleandthread | 4 | 2 | | 1 | 1 | 2 | | | t | |
| Blue grama | | 2 | | t | t | 2 | | | 1 | 1 |
| Wheat grasses | t[a] | t | 1 | t | 2 | | | 1 | | 1 |
| Cheatgrass | 4 | 2 | 1 | | 10 | 5 | 9 | 4 | 7 | 3 |
| Indian ricegrass | t | t | | t | 2 | t | | 1 | 2 | 1 |
| FORBS | | | | | | | | | | |
| Slimflower scurfpea | 1 | 2 | | 2 | 1 | 1 | | | 1 | 2 |
| Pinnate tansymustard | | | | | | 1 | | | 1 | 2 |
| Wolly plantain | t | | | | | | | | | |
| Russian thistle | | | 1 | | | | | | | |
| Miners candle | | | | | 3 | | t | | | |
| Other | t | | 1 | | 1 | | | | | t |
| SHRUBS | | | | | | | | | | |
| Plains pricklypear | 33 | 38 | 9 | 14 | 55 | 44 | 23 | 19 | 26 | t |
| TOTAL ± S.E.[b] | 44±20 | 46±31 | 15±9 | 18±9 | 78±42 | 57±40 | 35±15 | 26±18 | 42±26 | 9±2 |

a/ t = trace < .50 gr/$m^2$
b/ Standard Error = $\frac{S}{n}$

TABLE 27. Aboveground biomass (gr/m$^2$) of first terrace communities (long transects) in all pastures within the Middle Fork exclosure in 1983 and 1984.

| FORAGE CLASS<br>Plant Species<br>(Common name) | Manipulation | | Spring | | Summer | | Fall | | Control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| GRASSES & GRASSLIKES | | | | | | | | | | |
| Blue grama | 1 | 2 | t | t | 1 | t | t | 1 | 1 | |
| Sandbergs bluegrass | 3 | 1 | t | | t | t | t | | t | |
| Sand dropseed | 1 | | t | t | t | | | | 1 | t |
| Cheatgrass | 1 | | 2 | | 8 | 1 | 21 | 10 | 6 | 3 |
| Bottlebrush squirrel-tail | t[a] | 1 | t | | 1 | 1 | | | | |
| Sixweeks fescue | t | | t | | 1 | | | | 6 | |
| Indian ricegrass | | t | | t | 2 | t | | | | t |
| Needleandthread | | t | | | | t | 2 | | 6 | 1 |
| FORBS | | | | | | | | | | |
| Wolly plantain | t | | t | | t | | | | t | |
| Halogeton | | | | 2 | t | | | | 2 | |
| Other | t | t | t | | t | | t | | t | |
| SHRUBS | | | | | | | | | | |
| Plains pricklypear | 71 | 58 | 66 | 17 | 75 | 33 | 17 | 55 | 17 | 6 |
| Saltsage | 1 | | | | t | 1 | | | | 1 |
| TOTAL ± S.E.[b] | 78±50 | 62±16 | 71±32 | 20±11 | 90±67 | 37±23 | 41±17 | 66±22 | 38±16 | 12±6 |

a/ t = trace < .50 gr/m$^2$

b/ Standard Error = $\frac{S}{n}$

production was greater on these transects than found on the long transects. Cheatgrass production was higher in 1983 than in 1984. This was true for most other grass species.

A more extensive survey of the vegetation biomass associated with the channel was initiated in the summer of 1984. Three transects of the lower, middle and top edge of the channel were established on each straight reach within a grazing cell. The length of each transect was the same as the length of the associated reach. Three transects were established on each side of the channel. Each reach contained a total of 18 clipped plots. Clipped plot results from six transects per reach were combined to estimate biomass production by species for each cell. The summer and control pastures contained more wildrye ($gr/m^2$) than the other three pastures (Table 28). The fall grazed pasture had more wheatgrasses and crested wheatgrass than the other pastures. Forb production (Slimflower scurfpea) in the manipulation and spring grazed pastures was substantially higher than the other pastures.

North Fork Exclosure

The vegetation in the North Fork exclosure has been divided into four broad categories. The uplands are dominated by saltsage, prickly pear, and Indian ricegrass. Uplands account for 82% of the area in the North Fork exclosure. Seeded lowlands or lowland grass areas comprise less than 1% of the area and are dominated by several wheatgrass species and forbs. Lowland shrub communities account for 15% of the exclosure and are dominated by prickly pear, halogeton, and a small number of grass species. The channel vegetation type covers 2% of the exclosure. This type was not intensively sampled in 1983 or 1984

TABLE 28. Aboveground biomass ($gr/m^2$) of channel vegetation in all pastures within the Middle Fork exclosure in 1984.

| FORAGE CLASS<br>Plant Species<br>(Common name) | Manipulation | Spring | Summer | Fall | Control |
|---|---|---|---|---|---|
| GRASSES | | | | | |
| Wildrye grasses | 10 | 7 | 40 | 7 | 19 |
| Inland saltgrass | 10 | 4 | 2 | 2 | 16 |
| Wheatgrasses | 5 | 2 | 2 | 12 | 2 |
| Blue grama | | 2 | t | | |
| Crested wheat-grass | | | | 8 | |
| Indian rice-grass | | | | | t |
| FORBS | | | | | |
| Slimflower scurf-pea | 17 | 17 | | 2 | |
| Annual sun-flower | | t[a] | | t | 1 |
| Other | | | t | | |
| SHRUBS | | | | | |
| Total ± S.E.[b] | $\overline{42}$±8 | $\overline{32}$±9 | $\overline{47}$±12 | $\overline{31}$±14 | $\overline{39}$±16 |

t = trace < .5 $gr/m^2$

$S.E. = \frac{S}{n}$

although some utilization measurements of willow were taken. Overall production from each type in 1983 and 1984 is included in Table 29.

Five transects were established in the upland sites in 1983. Production figures, based on 50 clipped quadrats, are presented in Table 30. Saltsage, prickly pear and Indian ricegrass comprised the majority of the biomass on the type. Grass production declined in 1984. Large fluxuations in prickly pear production were present between years. Although total production in 1984 was higher than 1983, this difference is due to the increase in prickly pear production.

Seeded lowland production, taken from 31 clipped plots, in 1984 was about half the 1983 figures (Table 31). This was due to almost entirely to the decline in seeded wheatgrass species production in 1984. Forb production was the same in both years.

Lowland shrub community production, based upon 35 clipped plots, showed little change between years except for one transect (Table 32). Transect three increased in production from 8 gr/$m^2$ in 1983 to 62 gr/$m^2$ in 1984. This was probably due to differences in sampling methods, and not an actual change. Grass production on the site was very low in both years.

## Plantings

Trial plantings of *Elymus cinerus* and *Agropyron smithii* in the Middle Fork exclosure, in 1983 were not successful. Rooted willow slips were planted in May 1983 and May 1984. Willows were planted at three depths, half were irrigated in May 1984 and the other half were not irrigated. Slips were planted on eight sites, both sides of the stream in the manipulation cell. When twigs were observed in the fall, less

TABLE 29. Aboveground biomass ($gr/m^2$) by site, year, and forage class on the North Fork exclosure.

| | AREA % | GRASSES | | FORBS | | SHRUBS | |
|---|---|---|---|---|---|---|---|
| | | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| UPLANDS | 83 | 4 | 2 | t[a] | t | 27 | 38 |
| LOWLAND GRASS | 2 | 91 | 37 | 8 | 9 | | |
| LOWLAND SHRUB | 15 | 1 | t | 3 | 2 | 23 | 47 |

a/ t = trace < .50 $gr/m^2$.

TABLE 30. Aboveground biomass (gr/$m^2$) of upland sites in the pastures of the North Fork exclosure in 1983 and 1984.

| FORAGE CLASS<br>Plant species<br>(Common name) | Transect 1 | | Transect 2 | | Transect 3 | | Transect 4 | | Transect 5 | | $\bar{X}$ ± S.E.[b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| GRASSES & GRASSLIKES | | | | | | | | | | | | |
| Indian ricegrass | t[a] | | 7 | 1 | 4 | t | 2 | t | 2 | | 3±2 | t |
| Bottlebrush squirrel-tail | t | | 3 | 1 | | | t | | 2 | | 1±1 | t |
| Wildrye | 2 | | | | | | | | | | t | 1±1 |
| Sandberg bluegrass | 1 | | | | | | | | | | | |
| Alkali sacaton | | | | | | | 1 | | 1 | | t | |
| Other | | | | | | | 1 | | | | t | |
| FORBS | | | | | | | | | | | | |
| Halogeton | | | | t | | | | | | | | t |
| Wooly plantain | 1 | | | | | | | | | | 1 | |
| Other | 1 | | t | | | | | | | | t | |
| SHRUBS | | | | | | | | | | | | |
| Saltsage | 18 | 11 | 10 | 11 | 17 | 4 | 12 | 16 | 13 | 13 | 14±2 | 11±2 |
| Plains pricklypear | 21 | 76 | 15 | 46 | | | 17 | | 4 | 21 | 12±4 | 27±15 |
| Other | | | | | 3 | | | | | | 1±1 | |
| TOTAL | 46 | 87 | 35 | 59 | 24 | 4 | 33 | 17 | 22 | 34 | 32±5 | 40±15 |

a/ t = trace < .50 gr/$m^2$
b/ Standard Error = $\frac{S}{n}$

TABLE 31. Aboveground biomass (gr/$m^2$) of lowland grass sites in the North Fork exclosure in 1983 and 1984.

| FORAGE CLASS<br>Plant species<br>(Common name) | Transect 1<br>1983 | <br>1984 | Transect 2<br>1983 | <br>1984 | Transect 3<br>1983 | <br>1984 | $\bar{X}$ ± S.E.[b]<br>1983 | <br>1984 |
|---|---|---|---|---|---|---|---|---|
| GRASSES & GRASSLIKES | | | | | | | | |
| Wheatgrasses | 154 | 77 | 18 | 9 | 9 | 4 | 60±6 | 30±4 |
| Crested wheatgrass | | | | | 72 | 21 | 24±6 | 7±2 |
| Foxtail barley | 1 | 1 | t | | 10 | t | 4±2 | 7±2 |
| Others | 2 | | 2 | | 3 | | 3±2 | |
| FORBS | | | | | | | | |
| Slimflower scurfpea | | | 25 | 26 | | | 8±2 | 9±2 |
| Cocklebur | 4 | | t | | | | 1±1 | |
| Hoary aster | | | t | | | | t | |
| Others | | | | | | | t | |
| SHRUBS | | | | | | | | |
| TOTAL | 161 | 78 | 45 | 34 | 94 | 25 | 100±9 | 46±5 |

a/ t = trace < .50 gr/$m^2$
b/ Standard Error = $\frac{S}{n}$

TABLE 32. Aboveground biomass ($gr/m^2$) of lowland shrub sites in the North Fork exclosure in 1983 and 1984.

| FORAGE CLASS<br>Plant species<br>(Common name) | Transect 1 | | Transect 2 | | Transect 3 | | $\bar{X}$ ± S.E.[b] | |
|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| GRASSES & GRASSLIKES | | | | | | | | |
| Alkali sacaton | 2 | | | | | | 1±.5 | |
| Indian ricegrass | t[a] | t | t | t | | | t | t |
| Red threeawn | t | | | | | | t | |
| Blue grama | t | | | | | | t | |
| Needleandthread | | | 1 | | | | t | |
| Other | t | | t | | | | t | |
| FORBS | | | | | | | | |
| Halogeton | | 1 | | 1 | 8 | 5 | 3±1 | 2±1 |
| SHRUBS | | | | | | | | |
| Plains pricklypear | | 1 | 68 | 81 | | 57 | 23±22 | 47±18 |
| Douglas rabbitbrush | | | | | t | | | |
| TOTAL | 4 | 2 | 69 | 82 | 8 | 62 | 27±22 | 49±18 |

a/ t = trace < .50 $gr/m^2$

b/ Standard Error = $\frac{S}{n}$

than half appeared to be alive. Irrigation did not appear to improve the survival of willows. Evaluating willow success in the fall may be misleading by overestimating failures due to lack of moisture, therefore we will return this spring to monitor our plantings.

## Other Studies

Measurements were taken in 1984 to monitor plant encroachment into the channel area. These measurements were taken in the same manner as the previous year (1983 annual report). Analysis of these measurements has not been completed.

Shrub density counts were conducted in 1984. Five foot belt transects were used on the channel edge in the Middle Fork exclosure to characterize the shrub densities of each species within each grazing cell. Results from this investigation have not been summarized.

## BELOWGROUND BIOMASS

Results from preliminary belowground biomass quadrats in 1983 was reported in the last annual report (1983 annual report). Data taken in 1984 has not been analyzed.

The sampling scheme used in 1984 was modified from the 1983 (1983 annual report) method. In 1984, 2.5 inch diameter root cores were driven to 12 inch depths in the Middle Fork exclosure. Three samples were taken at fixed intervals along three transects which paralleled the stream on both banks. Thus there were theoretically nine samples per bank, two banks, therefore 18 samples associated with each cross section. There are five cross sections per reach and two reaches per grazing cell, therefore 90 samples per reach, 180 samples per cell, times five cells equals 900 possible samples taken from the Middle Fork exclosure. Due to physical limitations of the terrain, we collected about 850 samples from the exclosure.

# APPENDIX 1: SPECIES LIST

15 Mile Creek Species List

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| Ag os | Agoseris spp. | Agoseris |
| Ag cr | Agropyron cristatum | Crested wheatgrass |
| Ag ri | Agropyron riparium | Streambank wheatgrass |
| Ag sm | Agropyron smithii | Western wheatgrass |
| Ag sp | Agropyron spicatum | Bluebunch wheatgrass |
| Ag tr | Agropyron trachycaulum | Slender wheatgrass |
| Al te | Allium textile | Prairie onion |
| Ar lo | Aristida longiseta | Red threeawn |
| Ar so | Arnica sororia | ---- |
| Ar ca | Artemisia cana | Silver sagebrush |
| Ar pe | Artemisia pedatifida | Birdfoot sagewort |
| Ar sp | Artemisia spinescens | Bud sagewort |
| Ar tr | Artemisia tridentata | Big sagebrush |
| Ar tr tr | Artemisia tridentata tridentata | Basin big sagebrush |
| Ar tr wy | Artemisia tridentata wyomingensis | Wyoming sagebrush |
| As sp | Asclepias speciosa | Milkweed |
| As tr | Astragalus spp. | Milkvetch |
| At ar | Atriplex argentea | Tumbling saltbrush |
| At ga | Atriplex gardneri | Saltsage |
| Bo uk | Boraginaceae unknown | ---- |
| Bo gr | Bouteloua gracilis | Blue grama |
| Br ja | Bromus japonicus | Japanese brome |
| Br te | Bromus tectorum | Cheatgrass |
| Ca mi | Calochortus minimus | Mariposalily |
| Ce cy | Centaurea cyanus | Cornflower knapweed |
| Ch al | Chenopodium album | Lambsquarters goosefoot |
| Ch na | Chrysothamnus nauseosus | Rubber rabbitbrush |
| Ch vi | Chrysothamnus viscidiflorus | Douglas rabbitbrush |
| Ci sp | Cirsium spp. | Thistle |
| Cr gl | Cryptantha glomerata | Minerscandle |
| De pi | Descurania pinnata | Pinnate tansymustard |
| Di st | Distichlis stricta | Inland saltgrass |
| El ca | Elymus canadensis | Canada wildrye |
| El ci | Elymus cinereus | Basin wildrye |
| El ma | Elymus macounii | Macoun wildrye |
| Er ov | Erioginum ovifolium | Cushion wildbuckwheat |
| Er sp | Erioginum spp. | Wild buckwheat |
| Gr sq | Grindelia squarrosa | Curlycup gumweed |
| Ha gl | Halogeton glomeratus | Halogeton |
| Ho ju | Hordeum jubatum | Foxtail barley |
| La re | Lappula redowskii | Bluebur stickseed |
| La sc | Lactuca scariola | Prickly lettuce |
| Le de | Lepidium densiflorum | Prairie pepperweed |
| Lo sp | Lomatium spp. | Lomatium |
| Ly ju | Lygodesmia juncea | Rush skeletonplant |
| Ma ca | Machaeranthera canescens | Hoary aster |

| | | |
|---|---|---|
| Ma gr | Machaeranthera grindelioides | |
| Ma ta | Machaeranthera tanacetifolia | Tansyleaf aster |
| Mo nu | Monolepis nuttaliana | Nuttall monolepis |
| Op po | Opuntia polycantha | Plains pricklypear |
| Or hy | Oryzopsis hymenoides | Indian ricegrass |
| Ph ho | Phlox hoodii | Hoods phlox |
| Pl pa | Plantago patagonica | Woolly plantain |
| Po sa | Poa sandbergii | Sandbergs bluegrass |
| Po av | Polygonum aviculare | Prostrate knotweed |
| Ps te | Psoralea tenuiflora | Slimflower or lemon scurfpea |
| Ru sp | Rumex spp. | Dock |
| Sa ka | Salsola kali | Russian thistle |
| Sa ve | Sarcobatus vermiculatus | Greasewood |
| Sc pa | Schedonardus paniculatus | Common tumblegrass |
| Si al | Sisymbryium altissimum | Tumbling hedgemustard |
| Si hy | Sitanion hystrix | Bottlebrush squirreltail |
| Sp co | Sphaeralcea coccinea | Scarlet globemallow |
| Sp ai | Sporobolus airoides | Alkali sacaton |
| Sp cr | Sporobolus cryptandrus | Sand dropseed |
| St co | Stipa comata | Needle and thread |
| Su fr | Sueda fructicosa | Alkali seepweed |
| St vi | Stipa viridula | Green needlegrass |
| Tr du | Tragopogon dubius | Yellow salsify |
| Un an | Unknown annual forb | ---- |
| Uk pf | Unknown perennial forb | ---- |
| Vi am | Vicia americana | American vetch |
| Vu oc | Vulpia octoflora | Sixweeks fescue |
| Xa st | Xanthium strumarium | Cocklebur |

# APPENDIX 2: BUDGET SUMMARY

A corrected statement from the U.W. financial records system is included in this appendix. Note that corrections which are pencilled in arise from item code corrections. Factoring out indirect costs which are obligated but not yet paid out of account, the remaining operating budget as of February is $25,818.10.

DATE RUN 03/05/85
TIME RUN 20:11:36
FBM090 - A1

UNIVERSITY OF WYOMING
FINANCIAL RECORDS SYSTEM
STATEMENT OF ACCOUNT FOR 02/28/85
REPORT DESTINATION = 10008

REPORT PAGE 911
PROGRAM ID FBM092
ACCOUNT PAGE 1

ACCT: 5-38689
DEPT: 00008 RANGE MANAGEMENT

WY DEQ EFFECT OF SELECTED GRAZING TREAT SKINNER

TO: SKINNER
AG BLDG

| START | END-DT | IC RATE1 | IC BASE1 | IC RATE2 | IC BASE2 | TECH-DT | FISC-DT | INVT-DT | RNWL-DT |
|---|---|---|---|---|---|---|---|---|---|
| 080182 | 063085 | 20.0 | 2 | | | 000000 | 000000 | 000000 | 000000 |

| SUB CODE | DESCRIPTION | BUDGETS ORIGINAL | BUDGETS REVISED | ACTUAL CURRENT MONTH | ACTUAL FISCAL YEAR 7/84-2/85 | ACTUAL PROJECT YEAR | OPEN COMMITMENTS | BALANCE AVAILABLE | PERC USED |
|---|---|---|---|---|---|---|---|---|---|
| 0999 | ABR BUDGET POOL 2 | 64,361.17 | 28,507.44 | | | | | 28,507.44 | 0 |
| 1230 | PT STAFF-GENERAL | | 2,488.58 | | 2,488.58 | 2,488.58 | | | 100 |
| 1240 | PT-STUDENTS | | 1,720.00 | | 1,720.00 | 1,720.00 | | | 100 |
| 1401 | GRADUATE ASSISTANTS | | 5,535.00 | 615.00 | 3,690.00 | 3,690.00 | 1,845.00 | | 100 |
| 1902 | BENEFITS-SOC SEC | | 174.20 | | 174.20 | 174.20 | | | 100 |
| 1906 | BENEFITS-HEALTH INS | | 73.46 | | 73.46 | 73.46 | | | 100 |
| 1909 | BENEFITS-LIFE INS | | 6.54 | | 6.54 | 6.54 | | | 100 |
| | PERSONAL SERVICES | | 9,997.78 | 615.00 | 8,152.78 | 8,152.78 ✓ | 1,845.00 | | 100 |
| 2021 | OTHER EQUIP REPAIRS | | 363.75 | | 363.75 | 363.75 | | | 100 |
| 2204 | PHOTO/MICROFILM SUP | | 197.80 | | 197.80 | 197.80 | | | 100 |
| 2270 | EDUC & INSTR SUPPL | | 4,508.21 | | 4,508.21 | 4,508.21 | | | 100 |
| 2277 | BOOKS | | 4.50 | | 4.50 | 4.50 | | | 100 |
| | SUPPORTIVE SERVICES | | 5,074.26 | | 5,074.26 | 5,074.26 ✓ | | | 100 |
| 3001 | TIS-COM CARR-STAFF | | 400.00 | | | | ~~400.00~~ | | 100 |
| 3003 | TIS-PER DIEM-STAFF | | 982.48 | | 982.48 | 982.48 | | | 100 |
| 3011 | TIS-PER DIEM-GUEST | | 9,431.70 | | 9,289.39 | 9,289.39 | ~~142.31~~ | | 100 |
| 3012 | TIS-OTHER FEES-GUEST | | 3,440.60 | | 1,040.60 | 1,040.60 | 2,~~400.00~~ | | 100 |
| 3112 | TOS-MLG PD-GUEST | | 179.00 | | | | 179.00 | | 100 |
| | TRAVEL | | 14,433.78 | | 11,312.47 | 11,312.47 ✓ | 3,121.31 | | 100 |
| 9212 | OTH CONTRACTED SVCS | | 1,200.00 | | 1,200.00 | 1,200.00 ✓ | | | 100 |
| 9535 | INDIRECT COST-FED-UW | | 5,147.91 | 123.00 | 5,147.91 | ~~5,147.91~~ | | | 100 |
| | NET ACCOUNT TOTAL | 64,361.17 | 64,361.17 | 738.00 | 30,887.42 | ~~30,887.42~~ | ( 2024.00 ~~4,966.31~~ + | 28,507.44 ) | 55 |

THIS IS A SUMMARY REPORT, TRANSACTION DETAIL IS ON FBM091. IF YOU HAVE QUESTIONS PLEASE CALL THE ACCOUNTING OFFICE, X3310; GRANTS X3131

31449.75
- 5631.65 Indirect Cost N[illegible]
25,818.10 Balance Available