Cows and Fish Report

A Survey to Determine Forage Production of Riparian Areas in the Central Parkland Natural Subregion of Alberta.

Submitted by:

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Cows and Fish
Alberta Riparian Habitat Management Program Report No. 021

Acknowledgments

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About Cows and Fish

Riparian areas are those areas along rivers, streams, lakes, wetlands, springs, and ponds that are strongly influenced by water and are recognized by water-loving vegetation. Cows and Fish is striving to foster a better understanding of how riparian areas function and how improvements in management strategies in riparian areas can enhance landscape health and productivity for the benefit of livestock producers, their communities and others who value these landscapes.

Cows and Fish Partners: Producers and community groups, Alberta Beef Producers, Trout Unlimited Canada, Canadian Cattlemen's Association, Alberta Agriculture, Food and Rural Development, Alberta Sustainable Resource Development, Alberta Environment, Fisheries and Oceans Canada, Agriculture and Agri-Food Canada, Alberta Conservation Association

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Executive Summary

A survey to determine forage production in riparian areas in the Central Parkland Natural Subregion of Alberta was completed in the 2003 growing season. The purpose of the survey is to gather data in a variety of riparian zones beside different water body types. Twenty-five riparian sites mostly in the Central Parkland were established and were successfully clipped. Forage production in the riparian zones average 4126 Kg/ha (3684 lb/acre). These values range from 1273 to 6268 Kg/ha (1136 to 5596 lb/acre) showing high variability between the sites. Plant species composition analysis also shows differences between sites. These ranged from saltgrass (*Distichlis stricta*) communities to tall willow (*Salix spp.*), to riparian communities mainly composed of tame species.

Six upland areas composed of native rangeland or tame species were surveyed to compare upland production with their associated riparian zones. Average forage production is 3652 Kg/ha (3260 lb/acre) in the tame uplands and 859 Kg/ha (767 lb/acre) in the native rangelands. In both upland types associated riparian production is greater in almost all cases, especially in the native rangeland comparisons.

Three small exclosures within the riparian were constructed for long term vegetation data. These 5 m^2 areas will be monitored for changes in riparian health and recovery.

A significant amount of production data was made available for comparison from the University of Alberta Kinsella Research Farm. These data were derived from clipping wetland riparian areas in large pastures not grazed this year. When grouped into two vegetation types the forage yields are 5145 Kg/ha (4594 lb/acre) for bluegrass and 5997 Kg/ha (5355 lb/acre) for sedge sites. These sites again denote variability between different types of riparian.

These values indicate riparian areas as an important forage resource and also the potential for problems in areas where this forage is a substantial component of the total production. For proper management, riparian areas should be included in the forage capacity of an area and managed to ensure their health as well as the uplands. This information will be provided to producers and other land managers in Alberta to aid in making appropriate decisions regarding forage production and utilization in riparian areas. It will also provide more information to better understand the resilience of riparian to grazing and other disturbances. The high variability of production and plant communities surveyed in this report warrants the importance of current and specific knowledge on these areas.

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1.0 Introduction

Alberta agriculture has relied on the production of healthy rangeland pastures since the turn of the century. When used in a sustainable fashion, these areas provide an abundant forage supply for agriculture and many other values such as recreation, soil conservation, wildlife habitat, and water quality. Riparian areas in these pastures provide only 2-5% of the landscape but maintaining a healthy riparian has been well documented as an important component to ensuring healthy range and pasturelands. (Adams and Fitch 1998)

Current and specific information is required to ensure good riparian management. Grazing management information specific to riparian areas is a relatively new focus, and as such there are knowledge gaps in certain areas. One area that has been identified is the lack of forage production information specifically in the Central Parkland Natural Subregion of Alberta. Quantifying the productive capabilities of riparian areas is a critical component to better understand how they tolerate and recover from grazing and other disturbances.

In the 2003 growing season, a production survey was completed mostly in the Central Parkland Natural Subregion of Alberta. Riparian areas from a variety of water body types were sampled for plant species composition, forage and litter production, and utilization. The purpose of this report is to summarize the data gathered and suggest recommendations to further increase understanding riparian production in these areas.

2.0 Methods

Methodology used for this survey was derived from a combination of referring to the Range Survey Manual (Alberta Government 2002), and consultation with staff from Cows and Fish and Public Lands Division, Alberta Sustainable Resource Development. The field portion of the survey consisted of three parts; site establishment, plant species composition sampling, and forage clipping.

2.1 Site Establishment

Twenty four sites were established between June 1 and 15, 2003 mostly throughout the Central Parkland Natural Subregion. Seven more sites were established by Cows and Fish staff. These were for other projects but the data were included in this survey.

Site establishment was coordinated through Cows and Fish Staff contacting landowners and Sustainable Resource Development staff regarding suitable locations. The acceptable riparian areas were then stratified by vegetation bands and in most cases the site was located within a single riparian band. Usually ten forage production cages were installed at roughly 20 meter spacing if the area permitted. Refer to figure 1 for site layout. Plant community selection was based on proximity to water and how conducive the area was to the cage specifications of a 1.25 m^2 area at the base by 1.25 m tall. In six pastures that were available and suitable, upland cages were established as sites for

comparison to the riparian communities. In all cases the riparian area and associated uplands were stratified and measurements of water type, riparian band types and riparian widths were recorded.

Small exclosure sites were also constructed at some locations for analysis of longer term trends of selected riparian areas. Exclosure design was either composed of 10 small panels enclosing a 5 m^2 area, or a group of 5 evenly spaced cages. Both designs were left in place at the riparian site after the season.

2.2 Plant Species Composition

Plant species composition sampling occurred from July 8 to July 13, 2003. The vegetation community was well developed during this period and species identification and composition measurements were optimized. All sites were sampled on 30 meter transects located within the area of established forage cages. The transects were located on the low side of the cages and situated so sampling occurred toward the wetter area. All transects were permanently located with a global positioning system geographic location (latitude / longitude) and marked with a painted 6 inch spike and washer driven to ground level at the beginning and end of each transect. A spike and washer also marked mid-point locations where the transect could not stay straight for the complete 30 meters. The distance from start the midpoint occurred and the new angle the transect was oriented towards was also recorded.

Data collection methodology followed the Range Survey Manual. Percent cover of graminoids, forbs, and shrubs were estimated in 15 nested frames along the transect. Graminoids and forbs were measured in a 0.1 m^2 frame (20 cm x 50 cm), shrubs in a larger 1 m^2 frame. At sites where trees or shrubs greater than 2.5 m existed, canopy cover of these were measured in one large 20 m^2 (4 m x 5 m) plot at the center of the transect (15 m).

2.3 Forage Production

Forage production cages were clipped from August 20 to September 5, 2003 to coincide with peak forage production as closely as possible. All forage within the cages was clipped by a 0.5 m^2 sample. This was accomplished by clipping two 0.25 m^2 (50 cm x 50 cm) frames side by side. Graminoids and forbs were clipped to ground level and sorted into separate bags. Current annual growth was clipped on all shrubs rooted within the frames. Litter was collected from the first 0.25 m^2 frame.

Utilization clipping occurred at all sites where grazing by cattle occurred before production clipping. Five 0.5 m^2 samples were clipped outside the cages and separated to graminoid, forb, and shrub components. These were usually located between the first five cages within the site (Figure 1).

2.4 Soils

One soil sample was collected at each site for a simple measure of texture. These were collected from below the organic layer, just into the mineral component of the soil horizons. This was to provide information in addition to that collected from the Agricultural Region of Alberta Soil Inventory Database[1] database.

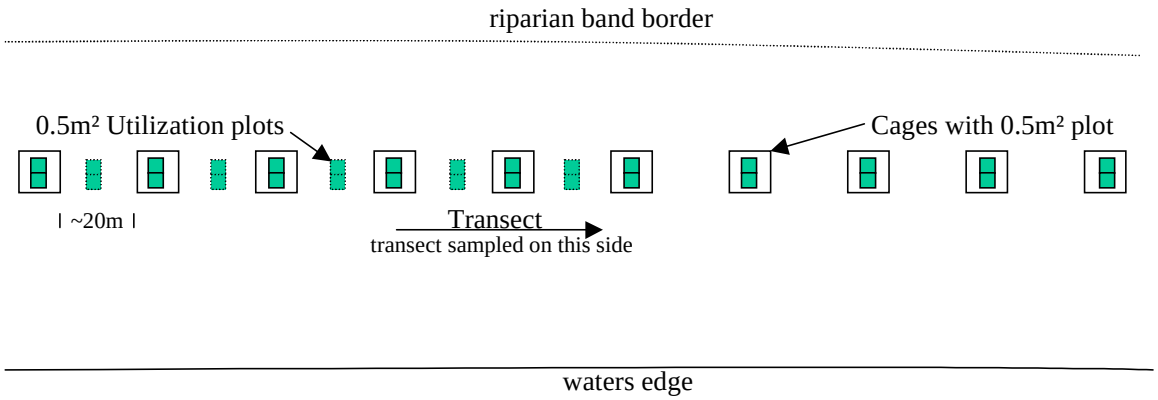


Figure 1. Schematic layout of cage and transect locations. Configuration changed slightly at each location due to site limitations.

2.5 Post-Field

After the field component all forage cages were recovered from the sites. Data collected were summarized by the following:

- Plant species composition was summarized by site for description and also formatted to standards outlined in the Range Survey Manual.

- Forage production samples were dried and weighed by Alberta Sustainable Resource Development methodology. The data were summarized per site.

- Soil samples were analyzed for texture and course fragment composition. Each site was also located within the Agricultural Region of Alberta Soil Inventory Database[1] (AGRASID 3.0) for further information on soil landscape model and classification.

- Each landowner or land manager was interviewed for information regarding the pasture the site was located in. This information included pasture size, riparian size, present use, and historic management.

[1] Agricultural Region of Alberta Soil Inventory Database (AGRASID 3.0) is a soils database maintained by the Alberta Provincial Government, Agriculture, Food and Rural Development.

3.0 Results

3.1 Site Characteristics

Twenty five riparian sites are established in total (Figure 2). Nineteen are established by the main project, which includes a site at Sunken Lake managed by Alberta Sustainable Resource Development staff for their benchmark data program. Most occur mainly in the Central Parkland Natural Subregion, the more southerly occur in the Northern Fescue and

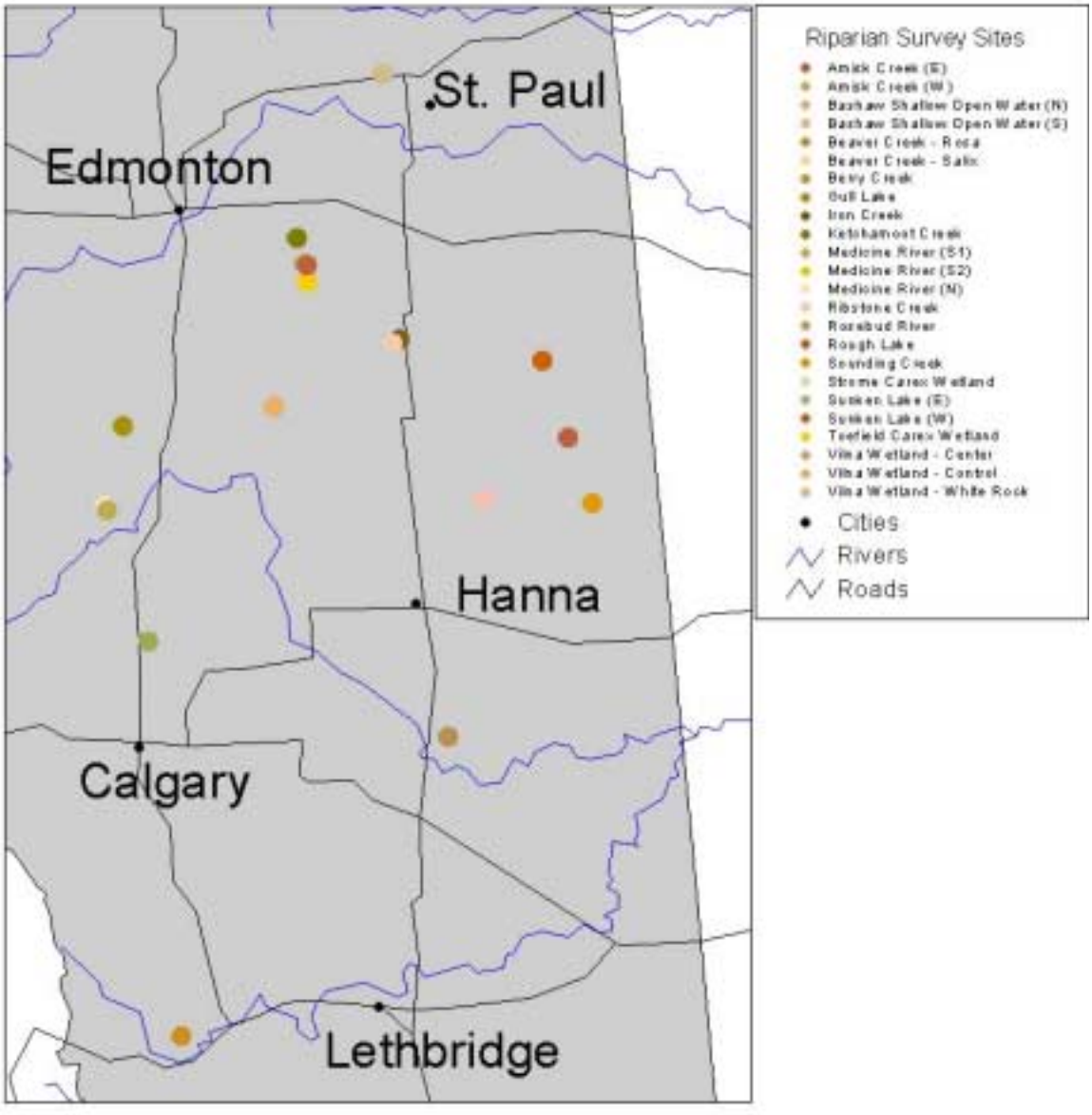


Figure 2. Locations of sites for the riparian forage production survey.

Dry Mixedgrass Natural Subregions. The other sites established by Cows and Fish staff are three stream-side riparian sites at Beaver Creek by Pincher Creek, and three wetland riparian sites near Vilna. The Beaver Creek sites occur in the Foothills Fescue Natural Subregion and Vilna sites occur in the northern portion of the Central Parkland Natural Subregion. Appendix 1 contains detailed information on each site.

Riparian sites are established on a number of different water body and riparian types. Table 1 lists some site differences throughout the survey. The most common site type is a riparian band closest to a small or ephemeral creek. Most riparian sites are in a pasture with an adjacent upland. The upland varies significantly on size and type of vegetation. Most are dominated by native plant species, but several have components of tame species.

Table 1. Some differences between types of sites within the riparian production survey.

Water Body Type		Riparian Band**		Location	Upland Association**	
Lake	4	Next to water*		10	Tame Species	9
River	4	Middle Band		5	Native Species	12
Creek	10	Next to Upland		7	Excluded from Upland	1
Shallow Open Water	7					
Total	25			22		22

* Also includes areas with only 1 riparian band
** Does not include Vilna sites.

Six upland sites are established to coincide with six of the sampled riparian areas. Five are established within the main project at Amisk Creek (East), Berry Creek, Gull Lake, Strome Carex Wetland, and Medicine River (South). One other upland is established at the southern Beaver Creek site by Cows and Fish staff. Berry Creek and Beaver Creek uplands represent native range areas while the other four are in pastures primarily composed of tame species.

Three exclosures are constructed at Gull Lake, Amisk Creek (East), and Iron Creek, all in different types of riparian areas. Panel design exclosures are used at Gull Lake and Amisk Creek, and five forage cages at Iron Creek were left after clipping. Gull Lake is a lakeside riparian with many small willows, Amisk Creek (East) is next to a small creek with some tall shrubs, and Iron Creek is a primarily graminoid community also beside a creek. As these exclosures are constructed close to the sampled areas at these sites, the sampled information of the main project for this year is considered the baseline data for each. Minimal data was collected specifically from the exclosures in 2003.

Soil information was collected from small samples at each site, and from the Agricultural Region of Alberta Soil Inventory Database (AGRASID 3.0). The sites are in Soil Correlation Areas (SCA) 1,4,7,9, and 10. According to the AGRASID 3.0, most sites have a Gleysolic component. The smaller polygons following the stream or wetland have Dominant or Codominant soils primarily ZGW (Miscellaneous Gleysol), or ZUN (Orthic Regosol). The larger polygon's Dominant soils are typically upland type soils, but most have Significant soils labeled as either ZGW or ZUN. These may indicate smaller areas influenced by the wetter conditions. Soil textures from samples collected vary from sandy clays on the east sites, to more silty clays on the westerly sites. Appendix 1 has soil information at each site.

3.2 Plant Species Composition

There are a total of twenty five transects sampled for plant species composition, including nineteen riparian, and six upland sites. Detailed plant species composition data was not collected at the sites at Beaver Creek riparian sites and the wetlands near Vilna as part of the main project as these were established and sampled by Cows and Fish staff. However, the upland at Beaver Creek was sampled for plant species composition this year by Cows and Fish staff. Refer to Appendix 2 for detailed vegetation cover summaries per site.

The purpose of this project is to sample many types of riparian areas in the Central Parkland Natural Subregion. Geographic site location, water body type, and soils differ between sites and all influence the vegetation composition. Riparian sites range in community type from a low growing saltgrass (*Distichlis stricta*), to tall willow (*Salix spp.*) communities, to communities mainly comprised of tame species. Table 2 lists sites by the three species of highest cover.

None of the riparian sites in the project have the same dominant vegetation but some similarities can be made at different levels. 79% of the riparian areas are dominated by species common to wetter environments. The other 21% have either a weed component or are encroached by upland tame species. Only two sites are dominated by tall shrubs, mainly due to site suitability for this project. The sampling design in 2003 only incorporates forage below these tall shrubs so these communities were not usually included in site selection.

Upland sites are again quite diverse. Site differences can be attributed to distance between, and the amount and type of agronomic inputs. The upland beside the Strome Carex Wetland is actually a cultivated, seeded pasture. Three others are also primarily composed of non-native species. Berry Creek and Beaver Creek uplands are both primarily native range, located in more arid, southern locations than the other sites.

Table 2. Sites organized by the three species with highest cover rankings.

Riparian

Site	Common Name	% Cover	Common Name	% Cover	Common Name	% Cover
Amisk Creek (E)	creeping spike-rush*	12.7	Fowl bluegrass	11.0	small-fruited bulrush	8.7
Amisk Creek (W)	buckbrush	23.7	Kentucky bluegrass	21.0	narrow-leaved meadowsweet	15.7
Bashaw Shallow Open Water (N)	perennial sow thistle	26.3	awned sedge	8.8	sea milkwort	7.3
Bashaw Shallow Open Water (S)	Nuttall's alkaligrass	42.3	foxtail barley	8.0	marsh aster	7.3
Berry Creek	slender sedge	23.7	Small-fruited bulrush	13.7	water sedge	4.7
Gull Lake	Baltic rush	34.7	wild mint	4.5	perennial sow thistle	4.0
Iron Creek	beaked sedge	55.7	Small-fruited bulrush	5.0	water sedge	4.0
Ketchamoot Creek	quack grass	19.3	Small-fruited bulrush	10.7	silverweed	9.3
Medicine River (S1)	small-fruited bulrush	19.7	Macoun's buttercup	19.3	redtop	11.2
Medicine River (S2)	reed canary grass	33.3	smooth brome	26.0	meadow horsetail	11.3
Medicine River (N)	slender wheatgrass	46.3	Kentucky bluegrass	27.3	common dandelion	12.9
Ribstone Creek	Baltic rush	35.3	Three-square rush	8.0	creeping spike-rush	6.7
Rosebud river	three-square rush	17.7	creeping spike-rush	15.0	redtop	7.5
Rough Lake	creeping spike-rush	23.3	creeping buttercup	12.9	slender rush	9.9
Sounding Creek	sea milkwort	15.7	seaside arrow-grass	15.2	three-square rush	13.7
Strome Carex Wetland	quack grass	33.7	common wild rose	6.6	Wheeler’s bluegrass	2.7
Sunken Lake (E)	small-leaved pussytoes	61.3	Dewey's sedge	19.0	salt grass	14.5
Sunken Lake (W)	salt grass	30.7	Long-styled rush	14.3	Nuttall's alkaligrass	8.4
Toefield Carex Wetland	awned sedge	38.3	tall manna grass	10.2	narrow reed grass	4.2

Upland

Site	Common Name	% Cover	Common Name	% Cover	Common Name	% Cover
Amisk Creek (E)	Kentucky bluegrass	36.0	smooth brome	15.3	quack grass	12.1
Beaver Creek	northern wheatgrass	47.3	pasture sage	10.9	june grass	10.5
Berry Creek	Porcupine grass	35.7	june grass	7.7	sand grass	6.7
Gull Lake	red clover	40.0	Kentucky bluegrass	33.7	slender wheatgrass	16.3
Medicine River (S)	red fescue	17.9	common dandelion	15.3	slender wheatgrass	15.0
Strome Carex Wetland	Siberian wheatgrass	13.7	fringed brome	11.3	crested wheatgrass	8.3

*Refer to Appendix 3 for complete species list.

3.3 Forage Production

Forage production of riparian areas is the main focus of this survey. All sites were successfully clipped with enough samples to achieve an average production. 2 cages at Berry Creek and 1 cage at the Rosebud river sites were compromised, but still left 8 and 9 samples per site. The Medicine River (South) sites have 5 cages apiece as there was not enough sample space for the full numbers in each area. Sample numbers at the locations established by Cows and Fish staff are slightly different as well. The cage numbers at Beaver Creek are 3, 9, and 9 at the Riparian sites, and 10 cages upland. The Vilna sites are comprised of 9 cages per site and were clipped by Cows and Fish staff. These cages actually spanned 3 neighboring bands at each site, but the management and understory composition was deemed similar enough for grouping the 9 together. 10 cages at Sunken Lake East were clipped and weighed by Sustainable Resource Development staff as part of their benchmark program. Both the Vilna and Sunken Lake East sites were clipped with a 0.25 m^2 frame rather than the 0.5 m^2 frame used in the main survey. Appendix 2 lists forage production per site.

Average total forage production for all the sites is 4126 Kg/ha (SE ±292 Kg/ha) (3684 lb/acre SE± 260 lb/acre), although the differences between sites is quite high (Figure 3). Total forage production ranges from 1272 to 6268 Kg/ha (1136 to 5596 lb/acre). This range is attributed to site conditions and species sampled at each site. The site with the smallest production total is dominated by salt grass (*Distichlis stricta*); a low growing grass associated with saline soils (Moss 1983). The mass of this grass at maturity is much less than a larger plant such as reed canary grass (*Phalaris arundinacea*) which dominates the vegetation at the most productive site. With these differences, it is most useful to look at each site individually and note the variety of production in riparian areas.

There were seasonal conditions this year that may have affected production values at some sites. The southeast sites; Berry Creek, Sounding Creek, and Ribstone Creek, suffered from degrees of grasshopper damage this year as they were in the severe to very severe grasshopper infestations projected by Agriculture Canada (Figure 4). The riparian damage was not visibly significant but the upland at Berry Creek suffered notable damage inside the cages.

Landowners indicated drought conditions at most sites in the previous three years. This year's precipitation was also drier than average. Figure 5 lists rainfall records from three weather stations in the project sample area. All areas had lower than normal rainfall, especially at the southern sites. These drought conditions may have affected the production values.

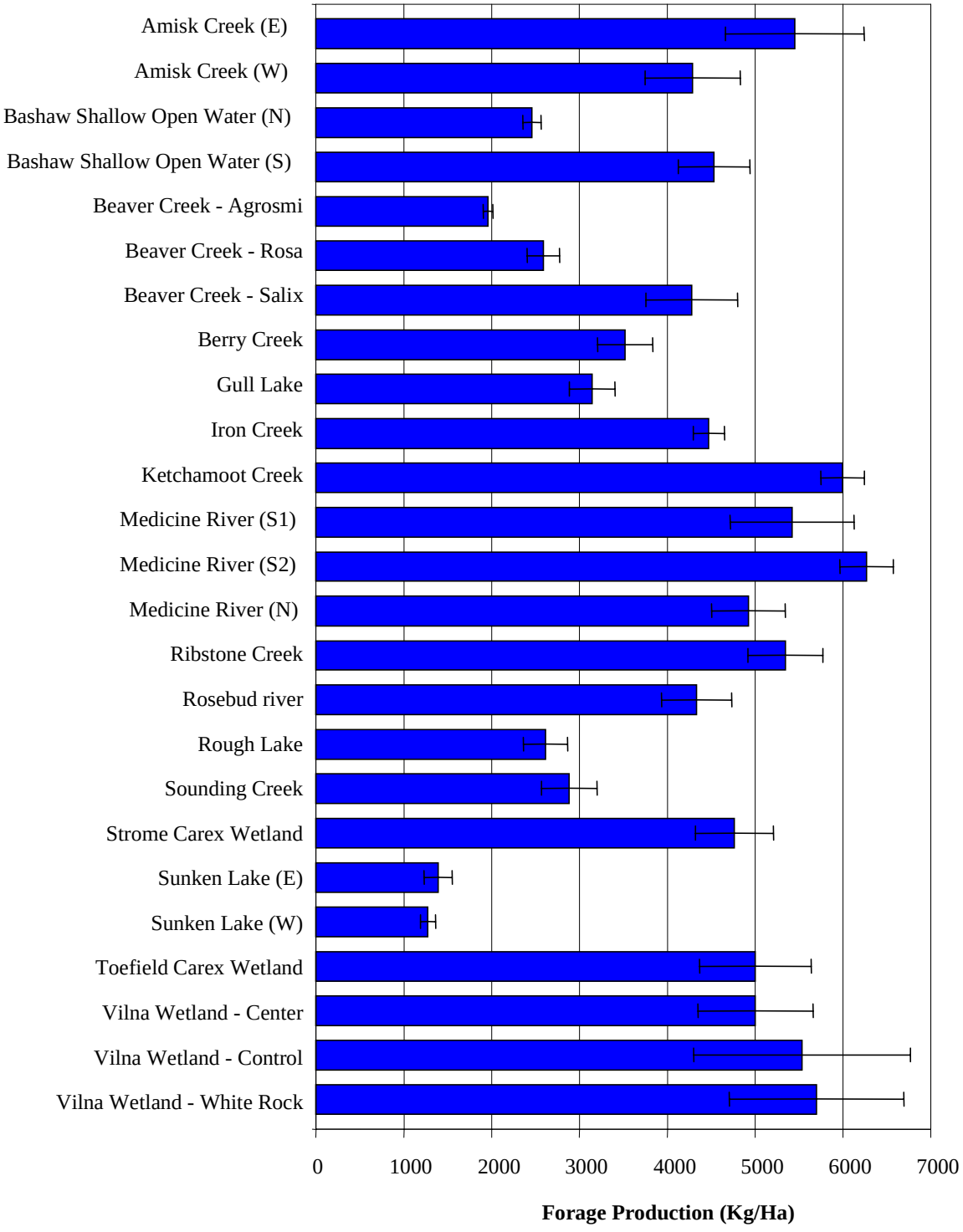


Figure 3. Total forage production at all riparian sites. Error bars indicate standard error at each site.

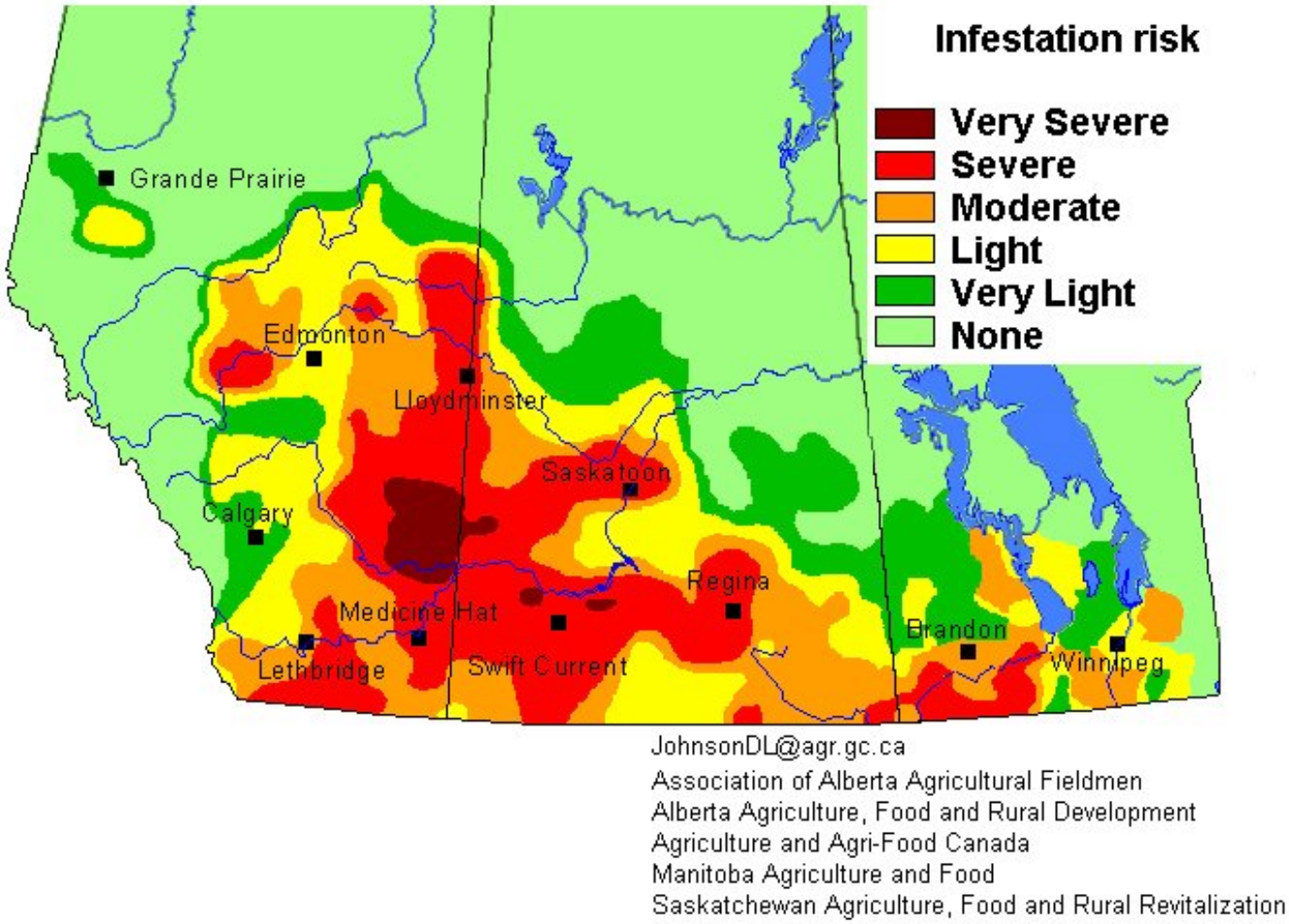


Figure 4. Grasshopper forecast for the Prairie Provinces for June 2003. From Agriculture Canada, Lethbridge Research Station.

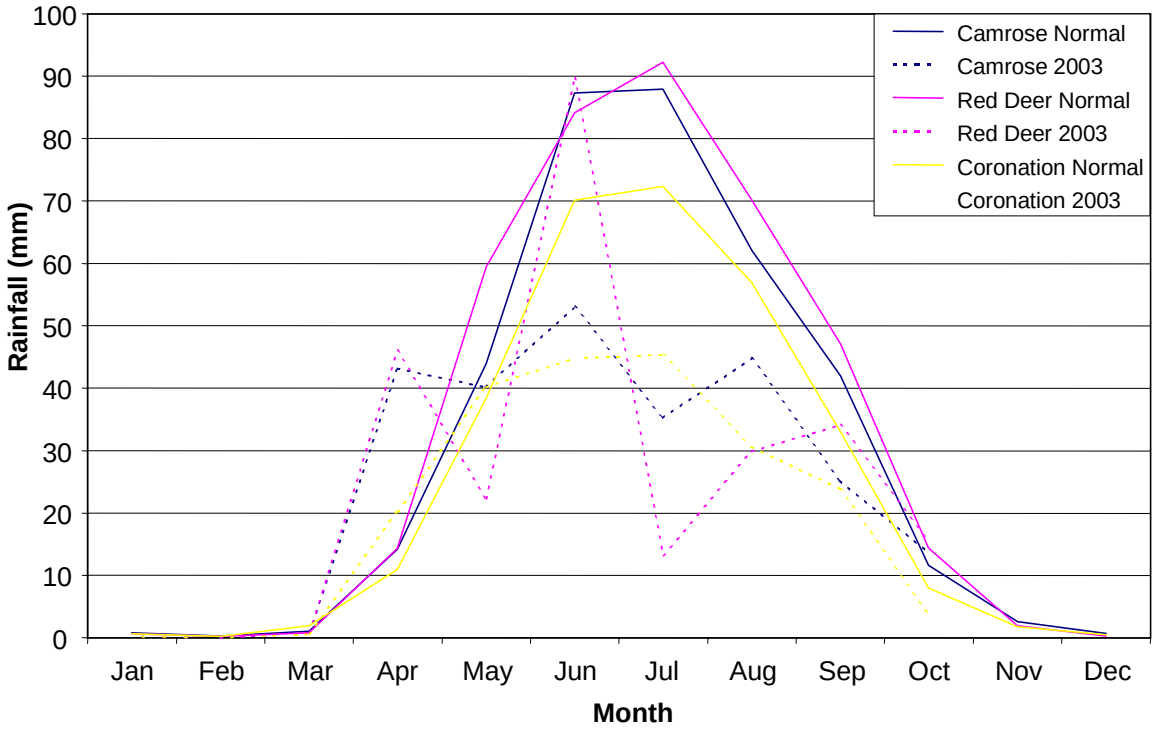
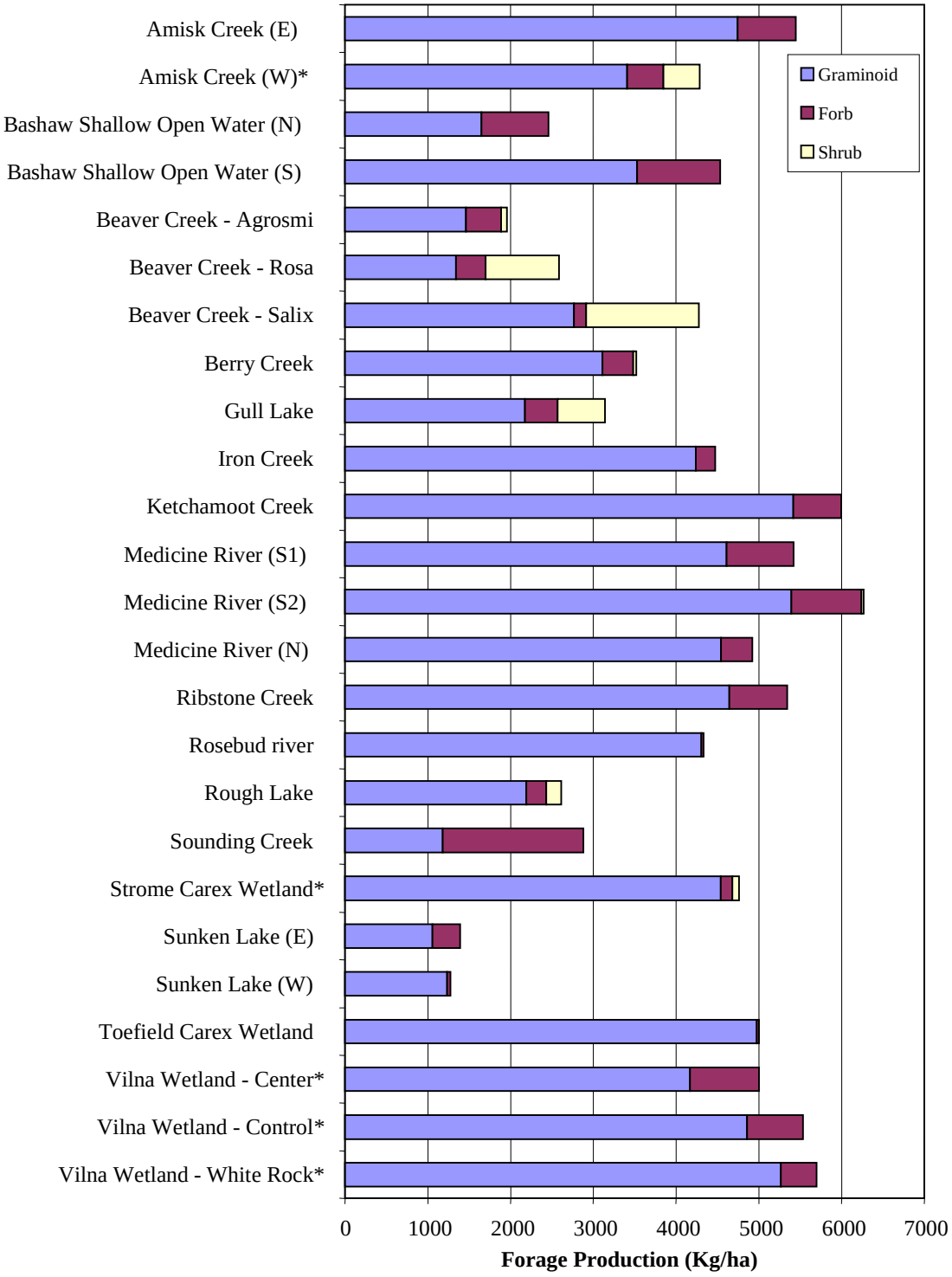


Figure 5. Rainfall records from Camrose, Coronation and Red Deer Weather Monitoring Stations comparing 2003 records with normals from 1971 to 2000. Information gathered from Environment Canada, National Climate Archive.

To further describe the production per site, the forage can be separated into graminoid, forb, and shrub components (Figure 6). Graminoid species contribute greater than 50 % of the total production in all cases except at the Sounding Creek site where forb production is greater. A note should be made about the shrub portion. In two locations tall shrubs are present and a very significant portion of the vegetation. However, the sampling design does not include them as only shrubs small enough to fit in the dimensions of the forage cage are completely protected from grazing and present in the analysis.

Litter in riparian areas varies even more than production values with a range from 132 to 5193 Kg/ha (119 to 4637 lb/acre) (Figure 7). This may be explained by the past utilization of the area, but also by fluctuations of a changing water level. It was observed at a few sites especially beside moving water that spring flooding may have swept litter away. Other sites beside marshes such as the Toefield Carex Wetland have years of litter collected. The drought conditions at most sites in the previous three years may have affected litter levels as well.



*Site contains tall shrubs not measured in the forage production survey

Figure 6. Forage production of riparian sites separated into graminoid, forb, and shrub components.

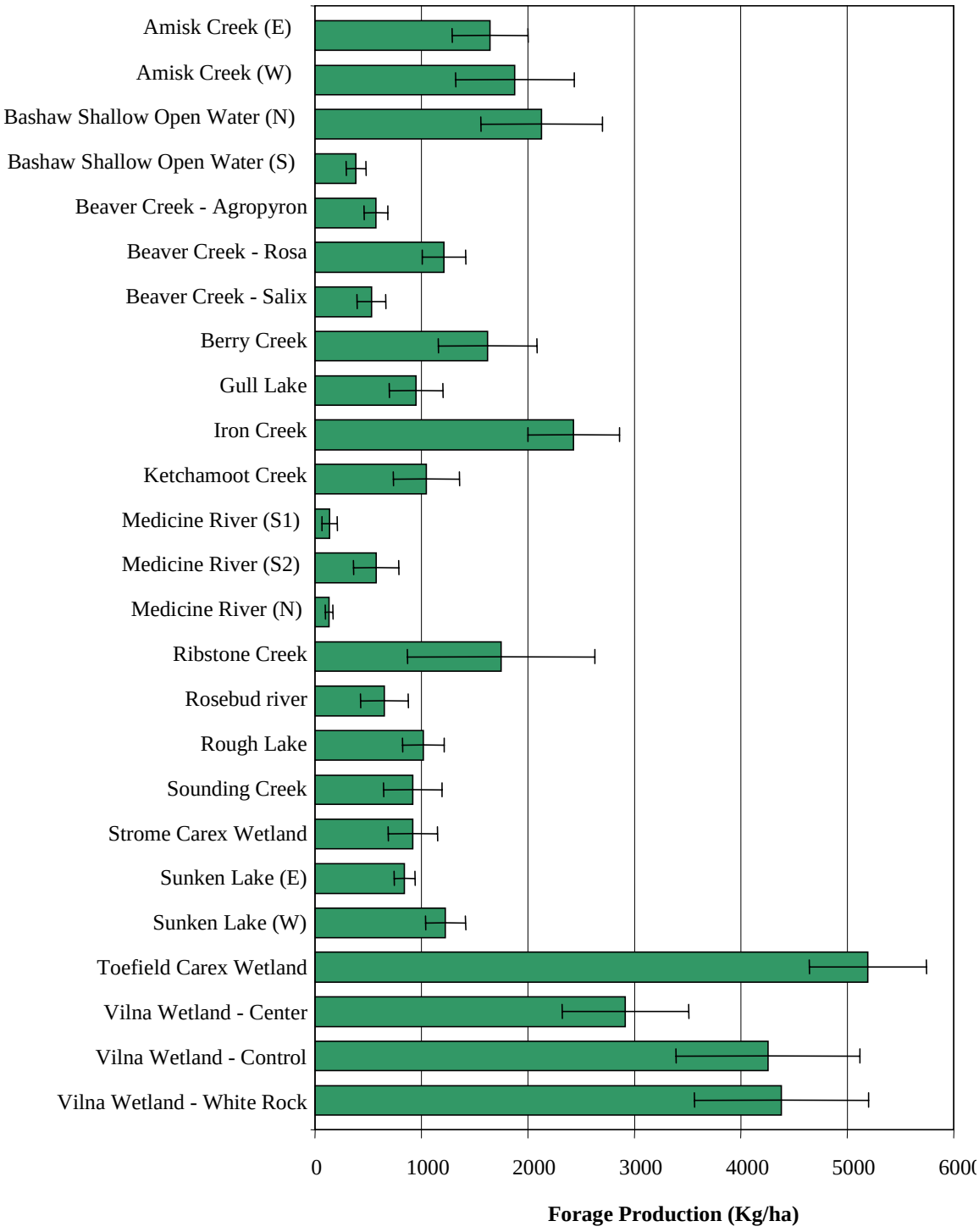


Figure 7. Litter production at all riparian sites. Error bars indicate standard error at each site.

Along with the riparian sites, six upland sites are established (Figure 8). Upland production averages 859 Kg/ha (767 lb/acre) in the native rangeland and 3652 Kg/ha (3260 lb/acre) in tame pastures. The native rangelands are both mainly composed of bunchgrasses; northern wheatgrass (*Agropyron dasystachyum*) or porcupinegrass (*Stipa curtiseta*). The tame uplands all occur further north than the native rangelands and are dominated by rhizomatous species. Bluegrasses (*Poa spp.*), wheatgrasses (*Agropyron spp.*), bromes (*Bromus spp.*), red fescue (*Festuca rubra*), and clover (*Trifolium spp.*) are all common. As mentioned previously, precipitation and / or grasshopper damage may have affected forage production values this year, especially in the south where the two native rangelands occur. These effects would be particularity evident in the uplands.

Comparing these upland values with their associated riparian areas indicate riparian production as much as 77% greater than native rangelands. Upland sites composed mainly of tame species produce more forage than the native areas, but still not as much as the riparian in most cases. The differences of riparian and tame pasture upland production range from –3% (tame pasture has greater production) to 45% more production in the riparian areas.

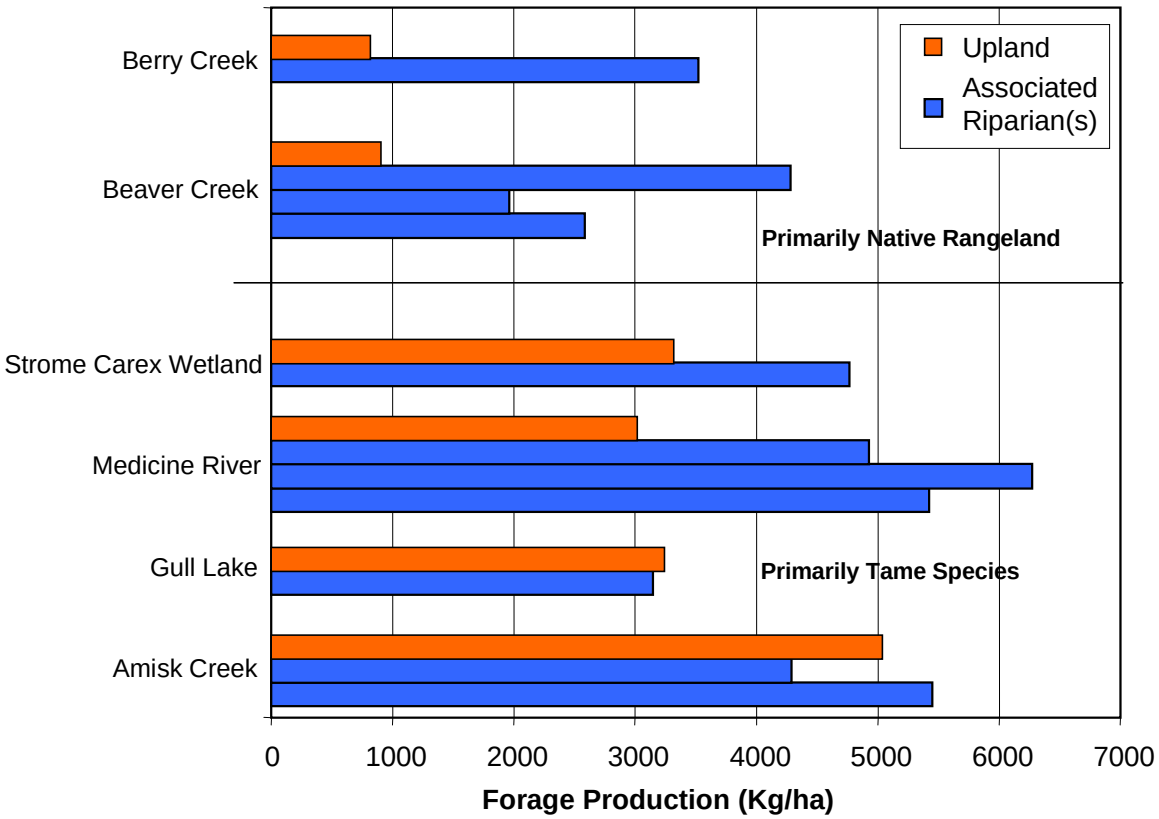
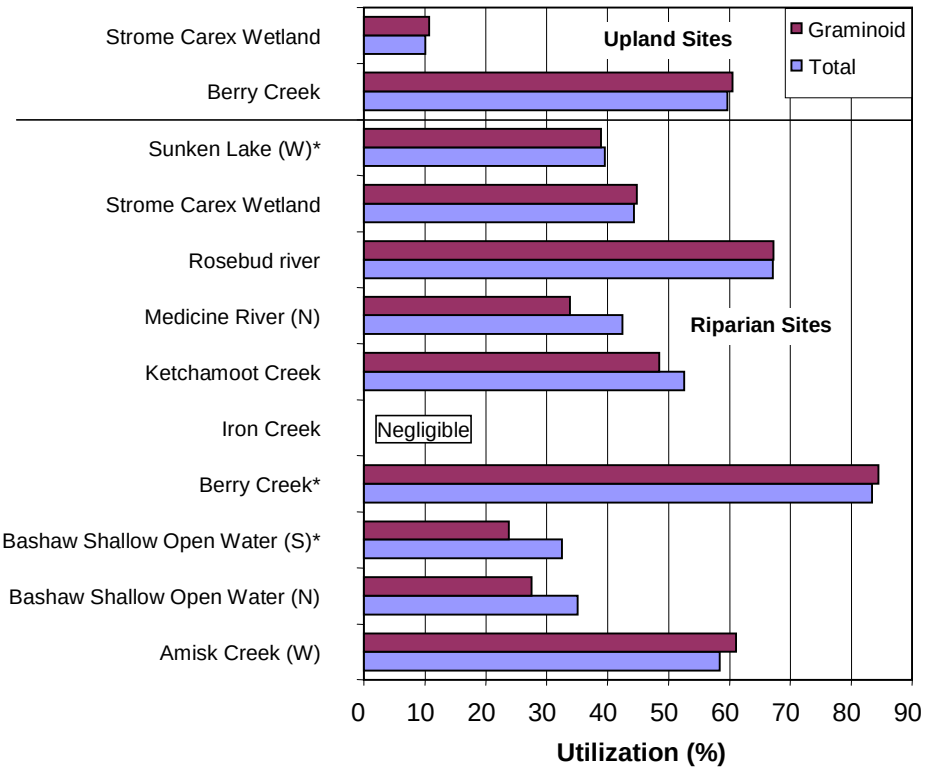


Figure 8. Upland and riparian production comparisons at six locations.

3.4 Forage Utilization

The survey design incorporates uncaged plots at each site to describe this year's livestock use. Not all sites were grazed by time of clipping and only sites with livestock grazing indicated were sampled for forage utilization. In total, twelve sites have utilization values, including ten riparian and two upland sites. Three pastures that were measured still had cattle grazing at clipping time. In these cases it was determined that cattle had been in the pasture long enough that the utilization values could still be used as an approximation.

Total percent utilization ranges from negligible to 83% use (Figure 9). These extremes may both have explanations. The site with high use was affected by drought and grasshoppers that may have increased the grazing focus on the riparian area. It was also observed that this site is located close to a main livestock watering location again causing focused use on the riparian particularly where it was sampled. The riparian area with negligible use is in a pasture only grazed occasionally by horses. There was no sign of grazing in the sampled location at time of clipping. Most other site's utilization levels are closer to the average of 45% in the riparian depending on timing and length of grazing.



*****Cattle still in pasture at time of forage clipping.

Figure 9. Graminoid and total utilization at sites where livestock grazing occurred.

4.0 Discussion

Forage production averages 4126 Kg/ha (3684 lb/acre) throughout all sites. Some trends do occur by grouping riparian sites by type (Table 1). When grouped by water body type production values indicate that riparian areas beside rivers produce the most, while lake-shore riparian areas produce substantially less (Figure 10). Another difference occurs when comparing riparian sites by their proximity to water (Figure 11). Production of riparian bands directly beside water is 4991 Kg/ha (4456 lb/acre) compared to 3083 Kg/ha (2753 lb/acre) produced by bands further up the bank. This is a significant difference but also a logical one as soil moisture would increase closer to the water source increasing the availability of water to plants (Adams and Fitch 1998).

The production of the riparian areas is substantial in the pastures sampled in the project. Comparing the average riparian production of 4126 Kg/ha (n=25), to the 3652 Kg/ha (n=4) the uplands containing tame species produced, and the native rangeland upland average of 859 Kg/ha (n=2) show substantial differences. How significantly riparian vegetation contributes is based on the area the riparian zone incorporates into the entire pasture. The area of riparian is small in most pastures sampled, unless the pasture is specifically designed to contain only these wetter areas. Most pastures sampled have riparian areas that contribute roughly 5-20% of the area (refer to appendix 1 for individual pasture stratification). This production difference along with the limited size of these areas further establishes the importance of the riparian as an important source of forage and habitat (Adams and Fitch 1998).

Utilization levels also show forage dynamics between upland and riparian. In all areas with light to moderate grazing this year the riparian areas were grazed usually to at least a moderate level (average of 45% use). A notable trend occurs at the two locations where utilization sampling occurred on both the upland and riparian sites in the same pasture. These sites had substantially more use in the riparian areas although the upland site was less than 100 meters away. The 640 acre pasture containing the Strome Carex wetland site had light use (10%) in the upland composed of tame species but moderate use (44%) in the riparian that is less than 10% of the total area. The other location with both upland and riparian utilization is 243 acres of native rangeland notably affected this year by grasshopper damage and later season drought conditions. The utilization measured 60% in the upland compared to 83% in the riparian. The riparian zone is estimated at 5% of the total area. As mentioned previously this sample site was located at a main cattle watering location which may have caused an increased focus on that particular area. Both sites however indicate a preference by livestock for riparian vegetation over the neighboring uplands.

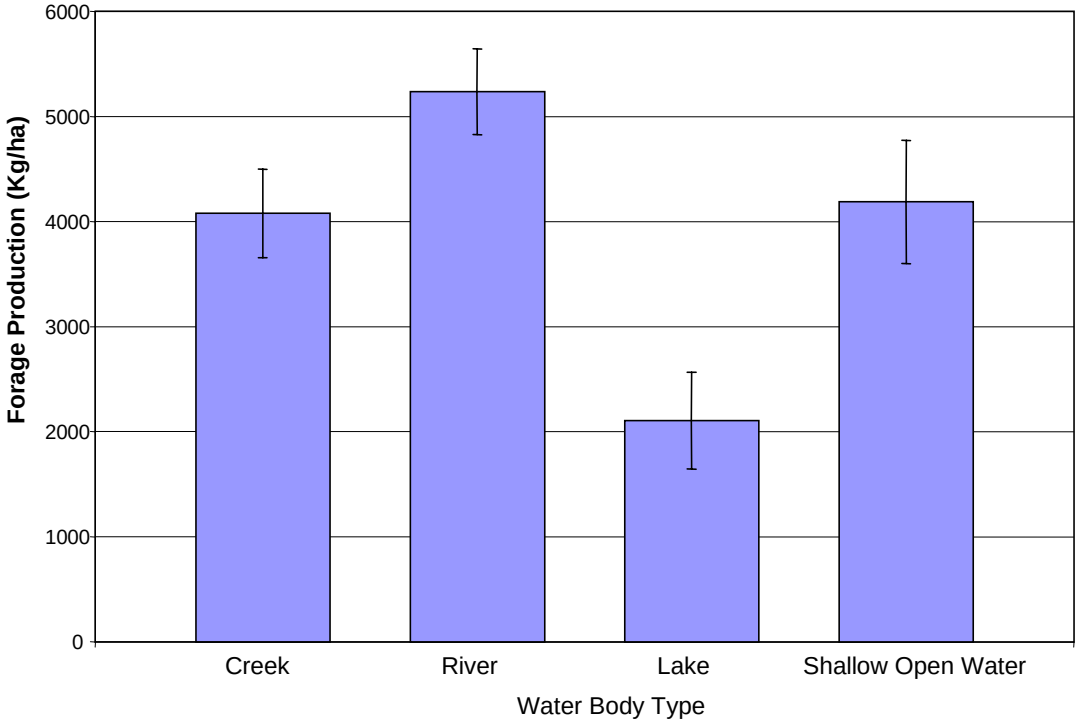


Figure 10. Forage production of riparian areas grouped by water body type.

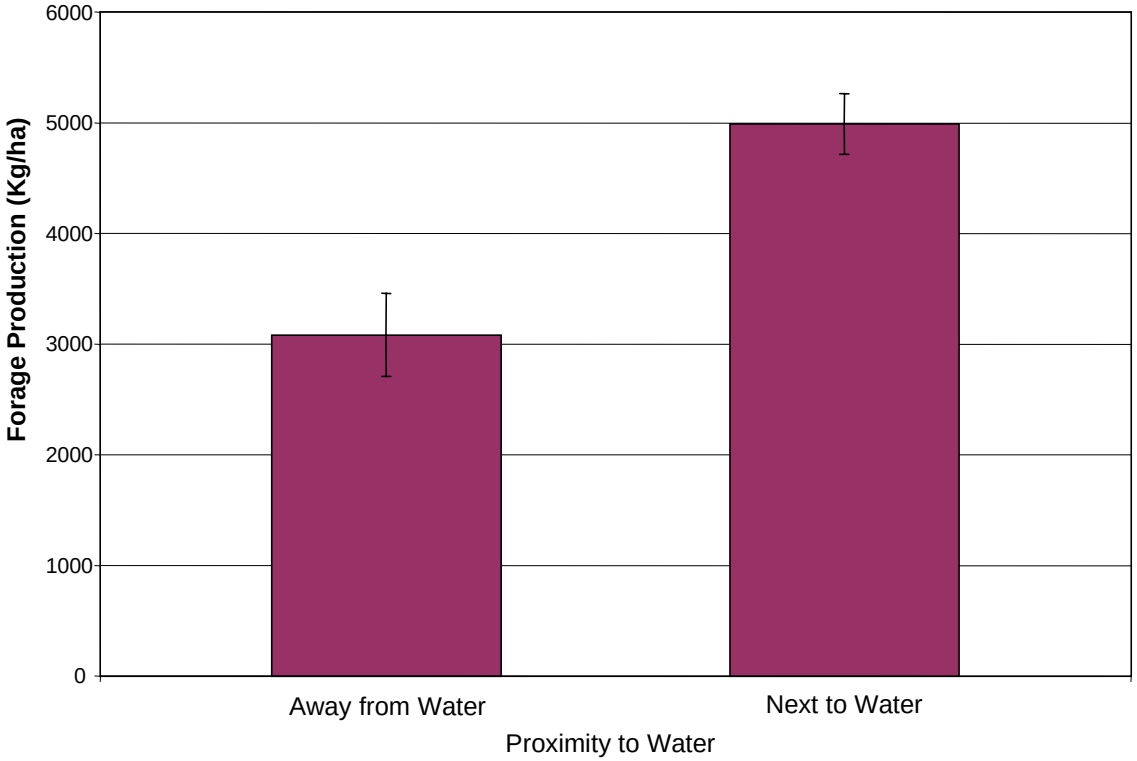


Figure 11. Forage production of riparian areas grouped by proximity to water.

4.1 Kinsella Riparian Production

For comparison of production values produced by this survey, data from another project has been made available. A study was conducted at the Kinsella Research Farm by the University of Alberta. Eighteen riparian sites were established beside pothole wetlands and clipped in twelve pastures ungrazed by cattle this year. Production was completed by clipping three 0.1 m^2 (20cm x 50cm) frames per site. Graminoid and forbs were collected and separately weighed.

Production values from this study average 5618 Kg/ha SE ±408 Kg/ha) (5017 lb/acre SE ±364 lb/acre) and range from 2847 Kg/ha (2542 lb/acre) to 8735 Kg/ha (7799 lb/acre) (Figure 12). This average is above the values of the main project but many values fall within the same range. The composition of forbs and graminoids is similar to most of the main project's production numbers. Graminoid species make up over 50% of the total production in all cases. The production values within this project suggest variability within riparian production as the main project does. As the project is located on one ranch, all sites in this study are close together geographically and have similar soil and climate conditions to one another. The range of riparian forage production still has the largest value 3 times that of the least productive riparian site.

Six of the sites in the Kinsella project are above the maximum production values of the main project and the largest values is almost 2500 Kg/ha (2232 lb/acre) above the largest in the main project. This suggests that some of the Kinsella sites are different vegetation associations than the main project.

For further comparison the Kinsella data can be grouped into two vegetation types. Eight sites have bluegrass (*Poa spp.*) and ten have sedges (*Carex spp.*) among their highest ranking cover values. The average productions of each are 5145 Kg/ha (4594 lb/acre) and 5997 Kg/ha (5355 lb/acre) for bluegrass and sedge sites respectively. The bluegrass sites can be most compared to three sites within the main project. Amisk Creek (West), Amisk Creek (East), and Medicine River (North) have high components of bluegrass. These produce 4289 Kg/ha (3829 lb/acre), 5451 Kg/ha (4867 lb/acre), 4924 Kg/ha (4397 lb/acre) of forage respectively. The Amisk Creek (W) site has an 80% tall shrub coverage that may affect the understory production values but the others range around the bluegrass sites at the Kinsella Research Farm.

Unlike the Kinsella data, the sites within the main project that are dominated by sedges have equal to or lower production than the bluegrass sites. Berry Creek, Iron Creek, and Toefield Carex Wetlands all have high components of sedges and produce 3520 Kg/ha (3143 lb/acre), 4474 Kg/ha (3995 lb acre), and 5003 Kg/ha (4467 lb/acre). These are substantially less than the Kinsella project's sedge sites, and suggest again that these have different vegetation associations than those in the main project.

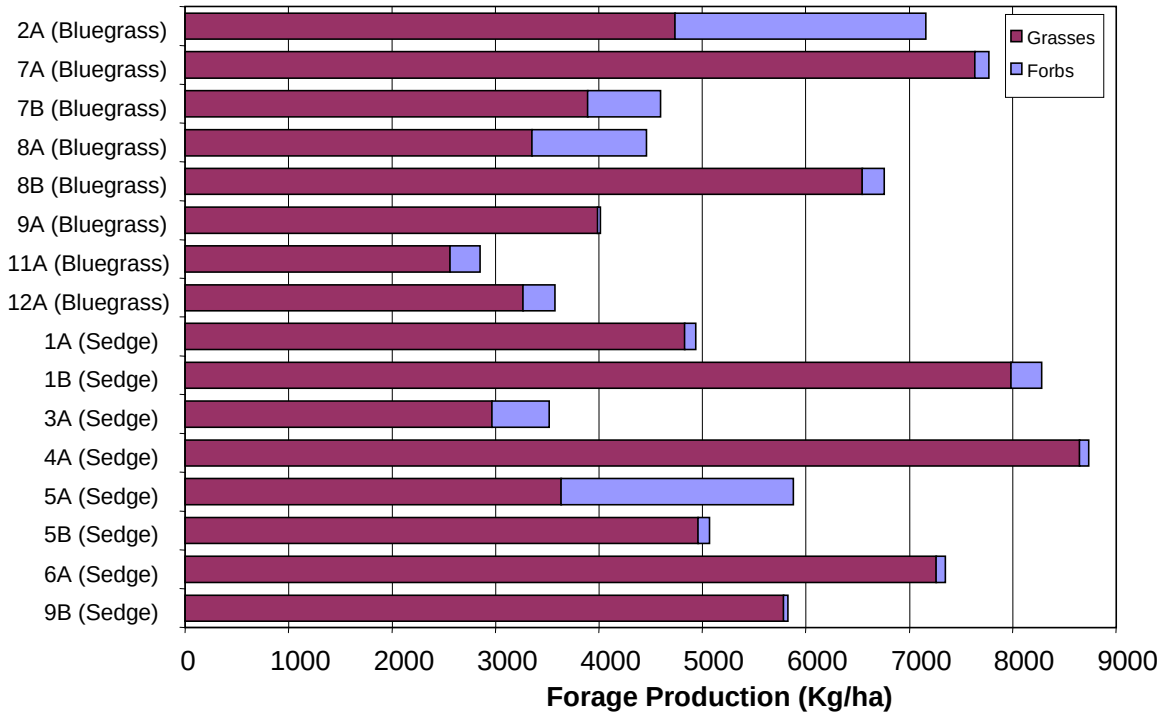


Figure 12. Forage production in riparian areas from the research project at the University of Alberta's Kinsella Research Farm.

5.0 Conclusion and Recommendations

Site variability has a heavy influence on the range of forage production values in the thirty-one riparian and upland sites surveyed. The largest production in the riparian is almost 5 times greater than the smallest. Grouping by site types such as proximity to water, water body types, and upland types did account for some variability but there are other physical and biological factors that may affect production numbers. Soil texture ranges from Sandy Clay to Silty Clay Loam throughout the sites and varies water availability to the plants. Climate differences may also affect values as the sites spanned four Natural Subregions. There are also differences between sites in historic and present grazing practices. Some have very little grazing, others are used regularly in the landowners grazing practices, and some are recovering from historic overgrazing. (Appendix 1).

Variability within sites also influences forage production values. A sample size calculation for simple random sampling (Freese 1962) was completed with this years data to test the variability within a site and determine if the number of plots clipped are adequate for this and future surveys. This calculation also shows what confidence to the mean the number clipped allows. In this analysis each site is considered individually as to how many samples are required to detect percent differences of that site's mean (Figure 13,14). In both upland and riparian sites, the sample numbers show that in most cases, 10 samples per site are sufficient to detect a 20% to 25% change of the mean. This value should be used in future considerations of analysis and further surveys.

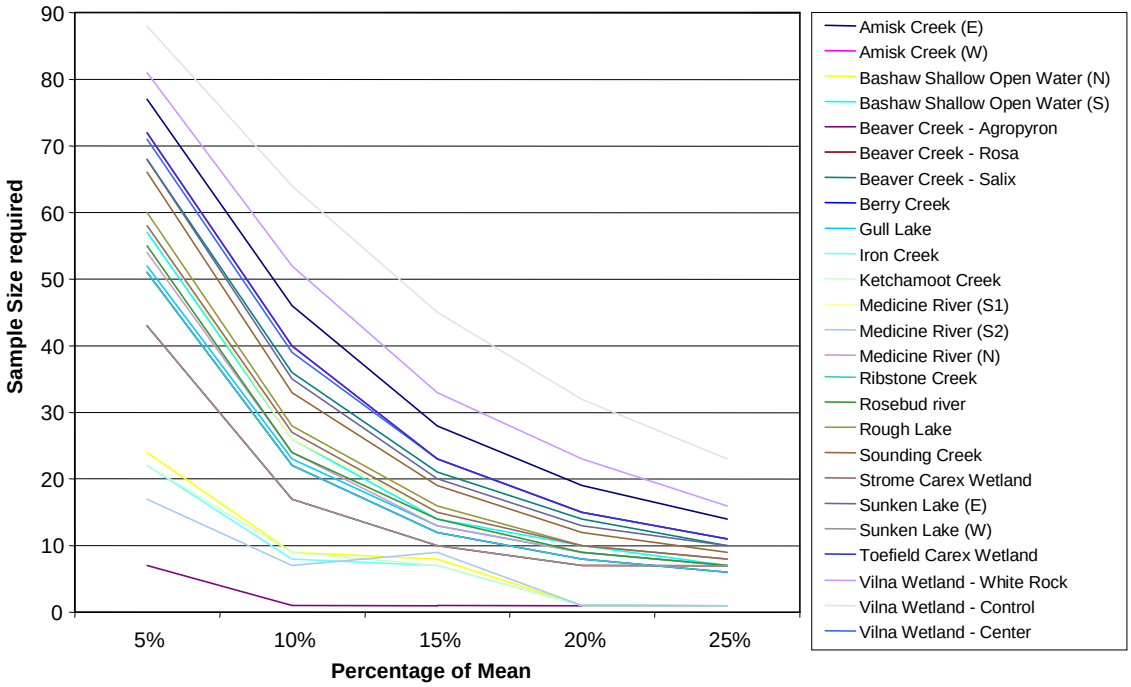


Figure 13. Sample size required to detect percent differences of means at each riparian site (Freese 1962).

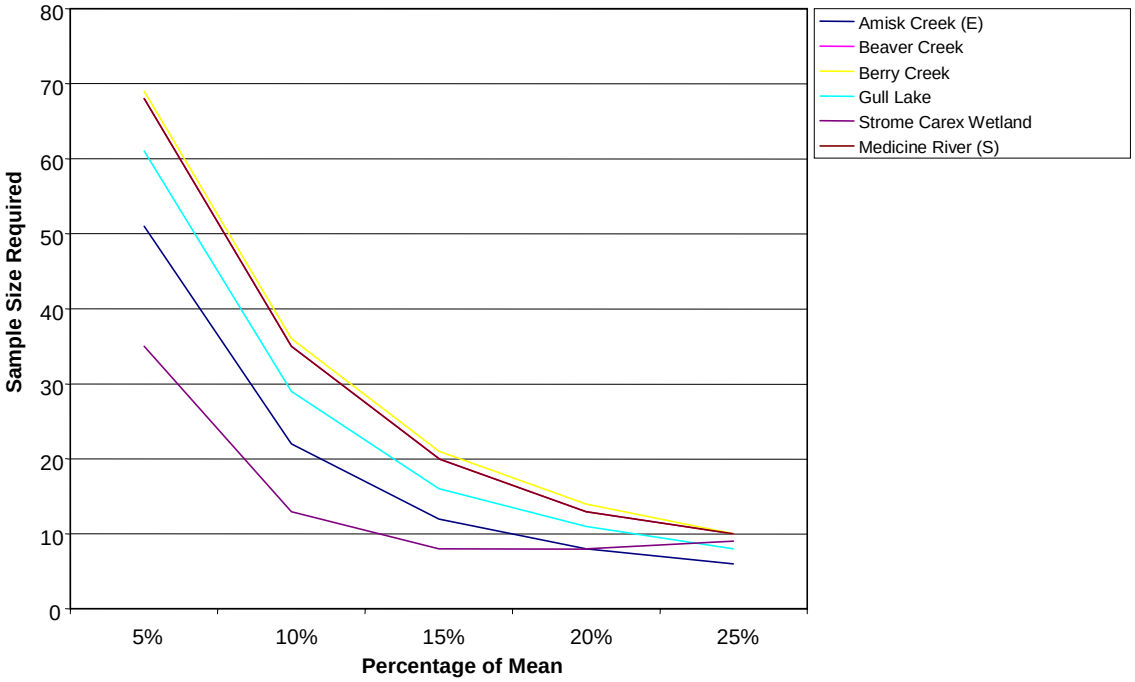


Figure 14. Sample size required to detect percent differences of means at each upland site (Freese 1962).

Within a single riparian site, there are visible differences in plant species compositions between individual riparian bands. These bands vary in number and width. Some narrow streams with high banks sampled within the project have only a 1 meter riparian band, while more level wetlands have several bands all varying in vegetation composition and size. In most cases, only one riparian band was sampled per site, although the others contribute significantly to the total riparian forage production.

Shrub production is another key component that this year's sampling design did not fully incorporate. It was noted that in the Central Parkland Subregion many of the riparian areas have shrubs as a vegetation component. These are not represented in this years sampling. Assessing how much browse these tall shrubs produce and their amount of use would provide a more complete understanding of total riparian production and utilization.

Seasonal conditions are another factor that affected the 2003 forage production. As mentioned, up to this year many areas in the Central Parkland Subregion had been going through a period of drought. This year, the spring was considered close to normal by many of the landowners, but many of the areas sampled did not receive much rainfall in the latter part of the summer (Figure 5). These two factors and grasshopper damage in some areas may all affect forage production to varying degrees. This is the first year of sampling for these sites, and there are not any other numbers available to directly compare the production values of this year to.

Recommendations for further sampling are based on either knowledge gaps that still may be present in the Central Parkland or to further the data-set completed with the 2003 survey. One recommendation is to collect literature of other studies such as the University of Alberta's Kinsella Project. A classification manual for riparian vegetation that includes the Central Parkland will soon be published. Riparian data could be sorted by vegetation type, and production data from this survey could be compared to other similar riparian areas.

Other recommendations are based on enhancing the sampling design of this year's data:

- Repeat the project over more than one year. Seasonal conditions may have affected 2003 production data as climate conditions and pest problems suggest. These affects cannot be assessed without further production values in the same areas with climate data added as a covariate.

- Incorporate tall shrubs in the sampling design. Examine methodology to best clip these shrubs under protection from grazing and to survey their use by livestock.

- Incorporate all the bands around a riparian in the forage production analysis. Usually only one stratified vegetation band was sampled per riparian zone, and represents only a portion of what that area produces.

- Sample upland in all pasture situations. This year's data indicates some interesting trends comparing uplands and riparian. Further enhancing the data by incorporating

upland production and more accurate measurements of upland and riparian areas in each pasture would be beneficial in describing associations between the two.

- Sample utilization after cattle are removed. Utilization values help further assess riparian and upland interactions. More accurate utilization levels could be incorporated at all sites by sampling all areas grazed by cattle after the grazing season ends. On sites grazed in the fall it may requires revisiting the site after the production survey.

- Sample the riparian exclosures periodically to compare changes of the protected area to the management outside.

This information is much needed in the Central Parkland area of Alberta. The high variability between many of the riparian sites indicate the importance of establishing production guidelines for different riparian types to better understand the specific area the land manager is dealing with. Landowners and land managers can use these numbers to better manage their riparian areas and incorporate them into the entire pasture management plan.

6.0 References

Adams, Barry and Lorne Fitch. 1998. Caring for the green zone. Riparian areas and grazing management. Alberta Riparian Habitat Management Program – Cows and Fish, Lethbridge Alberta. Pub. No. I-581. 2nd Edition.

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Government of Alberta. 2002. Range Survey Manual. Alberta Sustainable Resource Development, Public Lands Division, Rangeland Management Branch. (Draft).

Moss, E.H. 1983. Flora of Alberta. University of Toronto Press. ISBN 0-8020-2508-0. 2nd Edition.

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Amisk Creek (East)

Sites: 1 Riparian; 1 Upland; 1 Exclosure (5m² panels)

Water Body Type: Creek (~2 m wide channel)

Riparian Band Descriptions (including sampled): Sampled band (1-2m wide) is directly next to creek with 0-5% slope and aspects of either N or S depending on which side cages are on. Site area is a large U-shape meander, there are many shrubs (willow / poplar) inside of meander, outside has thin band of shrubs and then directly uphill to upland. Some shrubs hang over sampled riparian band. Upland site is flat and mainly domestic / introduced species.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZGW20/FP1	Orthic Humic Gleysol	0%	Silty Clay
Upland	ZGW20/FP1	Orthic Humic Gleysol	0%	Silty Clay Loam

Pasture Information:

Pasture Size: 20 acres Upland: 5% Riparian/Water: 95%

Upland Type: Mainly tame species, especially where upland cages were installed. This area was previously used as a winter feeding location. Some other areas in the pasture have small amounts of native species.

Water Sources: Creek is the main water source.

Current Year Grazing Time / Stocking Rate: 105 cows/calf pairs were allowed access to the area along with larger pasture in late fall / winter. Purpose is to graze down some of the riparian production. They have access later into the season but are fed in a neighboring pasture.

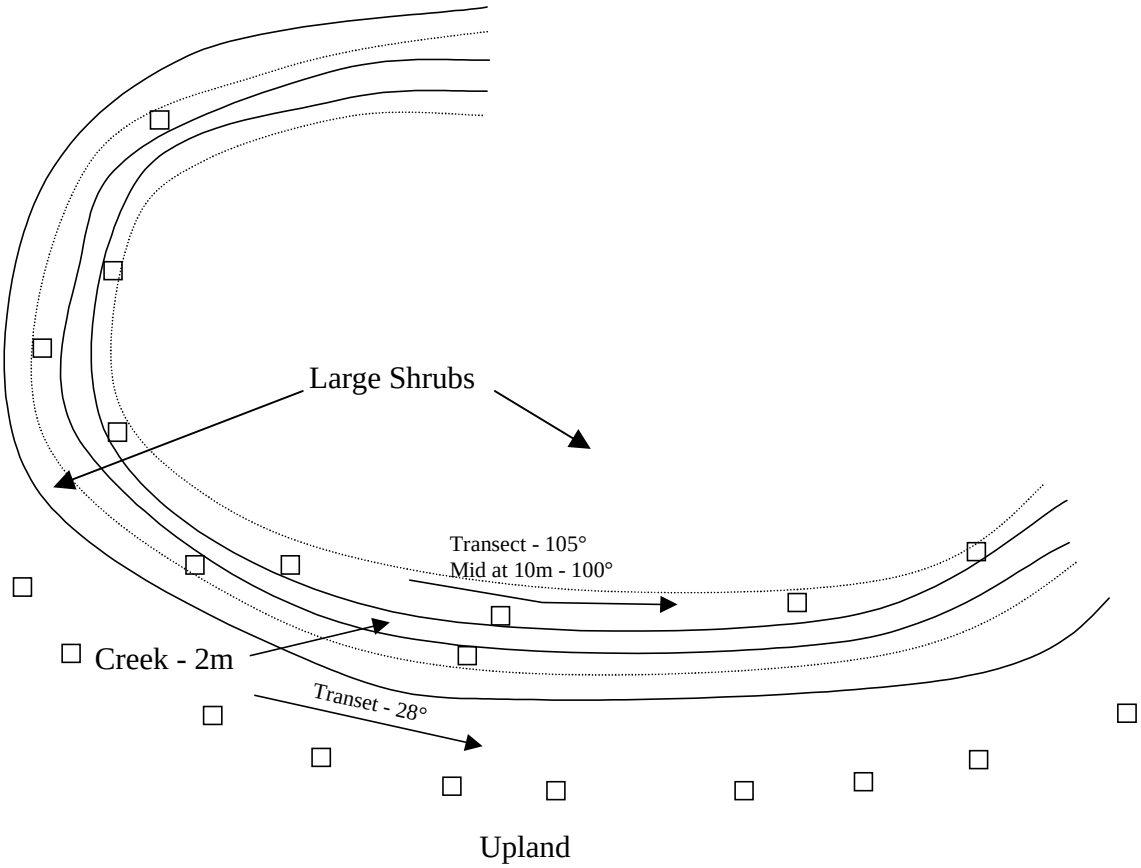
Current Grazing strategy: Primarily used like the current year. Varies slightly if the forage is required (i.e. drought conditions).

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Historic Grazing strategy: Prior to the late 1970's the area was part of a larger pasture and continuously grazed. Since that time the pasture was divided into two and controlled grazing of the riparian pasture has occurred.

2003 Stocking Rate: Winter use and feeding ground

Schematic of Amisk Creek (E):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Amisk Creek (West)

Sites: 1 Riparian

Water Body Type: Creek (15m wide - slow moving water)

Riparian Band Descriptions (including sampled): Sampled band is a large willow riparian with little slope.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZGW20/FP1	Orthic Humic Gleysol	0%	Silty Clay

Pasture Information:

Pasture Size: 120 Acres Upland: 66% Riparian: 30% Water: 3%

Upland Type: Mainly native species.

Water Sources: Creek is the main water source.

Current Year Grazing Time / Stocking Rate: 50 cow/calf pairs / months; in after June, out early September.

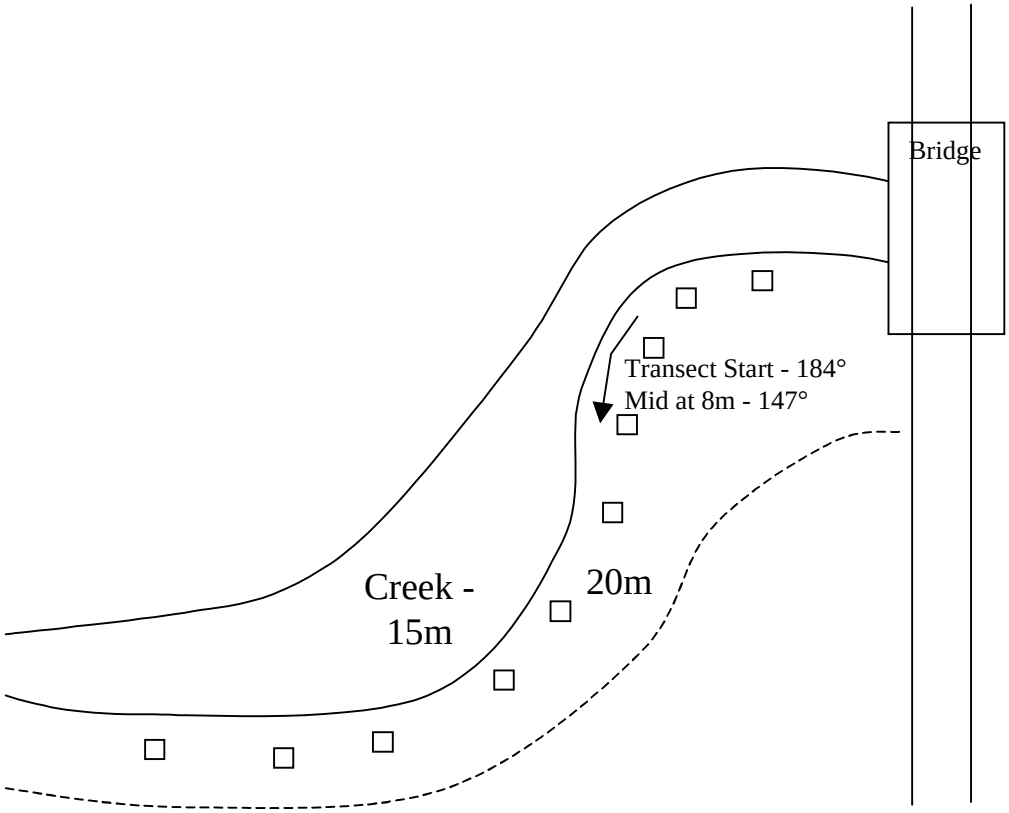
Current Grazing strategy: Strategy is same as this year.

Historic Grazing strategy: The pasture has been leased since 1985. The above grazing strategy has been close to the same as current, although used less than originally thought. Prior to current it was leased a few times by different managers without much of a grazing system.

2003 Stocking Rate: 1.0 pair months / ha (June – September)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Amisk Creek (W):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Bashaw Shallow Open Water (North)

Sites: 1 Riparian

Water Body Type: Wetland Marsh (~0.5 ha)

Riparian Band Descriptions (including sampled): Sample riparian band is the upper riparian band (18m wide) with very little slope. Other riparian bands starting closest to the water are: emergent *Scirpus spp.* (3-5m), *Typha spp.* (~5m), *Carex spp. / Poa spp.* (~4m), followed by the sampled band.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	AGS10/H1h	Orthic Humic Gleysol*	0%	Silty Loam

* Soil is labeled in AGRASID as a Significant Soil. Dominant soil is Eluviated Black Chernozem.

Pasture Information:

Pasture Size: 80 acres Upland: 70% Riparian: 15% Water: 15%

Upland Type: Half native rangeland, half tame species.

Water Source: Several sloughs occurring throughout.

Current Year Grazing Time / Stocking Rate: 25 yearling heifers from July to October 15.

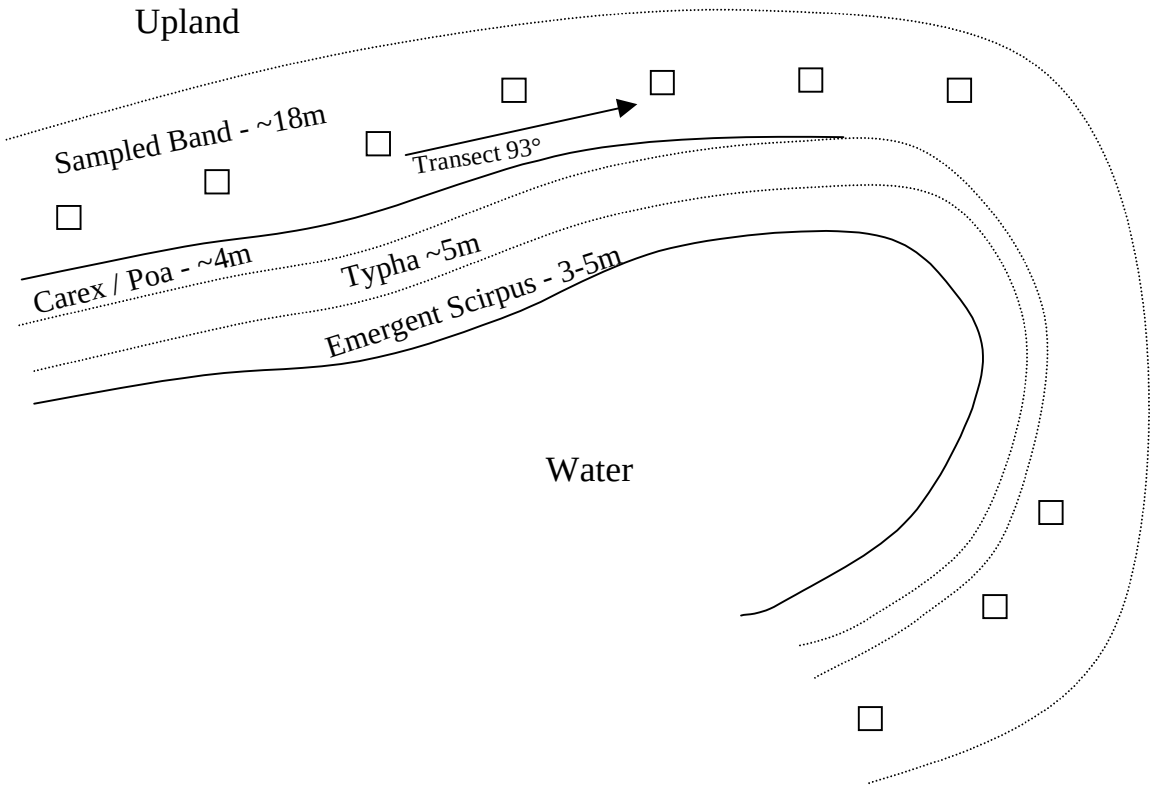
Current Grazing strategy: This years grazing times / stocking rates are typical of the grazing strategy.

Historic Grazing strategy: Same as current grazing.

2003 Stocking Rate: 2.7 heifer months / ha (July – October)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Bashaw Shallow Open Water (N):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Bashaw Shallow Open Water (South)

Sites: 1 Riparian

Water Body Type: Wetland Marsh (~5 ha)

Riparian Band Descriptions (including sampled): Sampled riparian is the second band (9-10m wide) from waters edge. Other riparian bands are *Senecio / Rumex spp.* (2-3m) next to water, *Scirpus spp.* (3-4m) after sampled band, *Carex / Juncus spp.* (10-12m). Site is level.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	AGS10/H1h	Orthic Humic Gleysol	0%	Sandy Loam

***** Soil is labeled in AGRASID as a Significant Soil. Dominant soil is Eluviated Black Chernozem.

Pasture Information:

Pasture Size: 60 acres Upland: 50% Riparian: 20% Water: 30%

Upland Type: Half native rangeland, half tame species

Water Sources: Sampled slough is the only water source.

Current Year Grazing Time / Stocking Rate: 25 heifers and 4 cow / calf pairs from August to October 15.

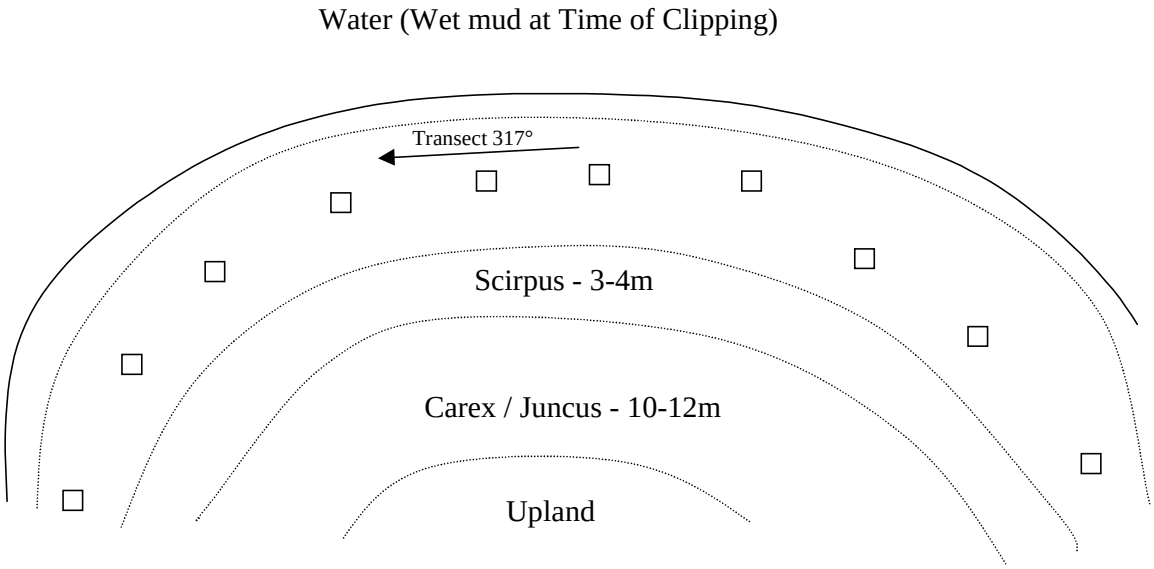
Current Grazing strategy: This years grazing is the typical strategy used in this pasture.

Historic Grazing strategy: Close to same, sometimes the pasture was used earlier in the season.

2003 Stocking Rate: 2.6 heifer months + 0.4 pair months / ha (August - October)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Bashaw Shallow Open Water (S):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Beaver Creek

Sites: 3 Riparian; 1 Upland

Water Body Type: Creek (5-8m wide)

Riparian Band Descriptions (including sampled): Sampled riparian bands are three different bands close to one another. A *Salix exigua* community is sampled in patches that are large enough for the cages closest to the creek. A small sampling (3 cages) of an *Agropyron smithii* community type occurs next. Further away from the creek is a larger fully sampled *Rosa woodsii* community. Upland is about ½ mile east of riparian on an upper bench. All sites have very little slope.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparians	ZUN1/SC1I2	Orthic Regosol	?	?
Upland	PS01/H5l	Rego Black Chernozem	?	?

Pasture Information:

Pasture Size: 160 acres Upland: 70% Riparian: 25% Water: 5%

Upland Type: Mainly native rangeland.

Water Sources: Creek is the main water source.

Current Year Grazing Time / Stocking Rate: Gate was opened to the 1/4 to the south and grazed 100 cow / calf pairs for the last 2 weeks of July (on the 320 acres).

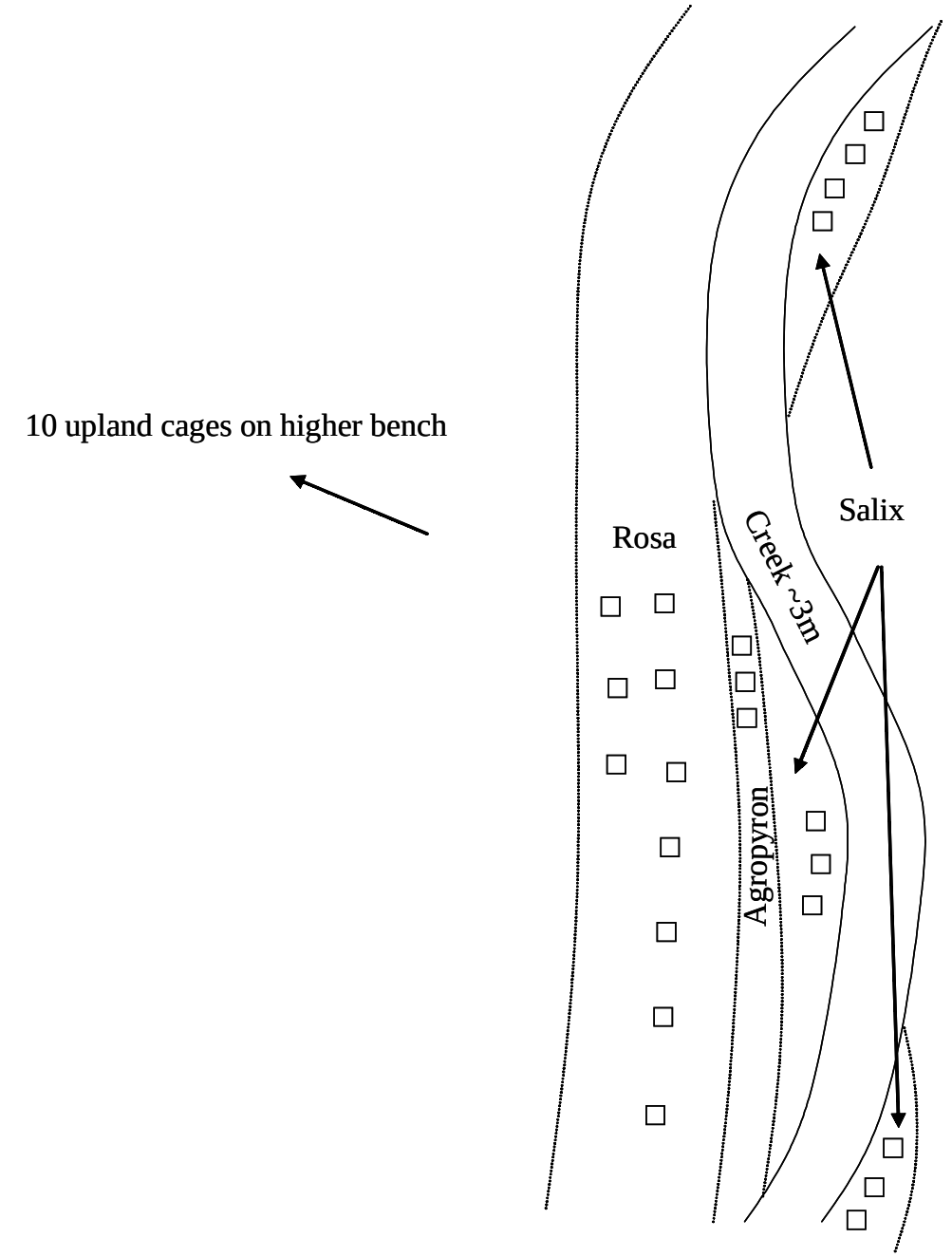
Current Grazing strategy: Typically this pasture (the 160 acres) would hold 30 cow / calf pairs and a bull from June 15 to the end of September. Relatively new ranch plan; higher stocking rate, shorter duration to maximize growing season rest.

Historic Grazing strategy: No information on historic strategy.

2003 Stocking Rate: 0.36 pair months / ha (July)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Beaver Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Berry Creek

Sites: 1 Riparian; 1 Upland

Water Body Type: Creek (5-8m wide)

Riparian Band Descriptions (including sampled): Sampled riparian band (1-3m wide) is nearest creek on bar side. Site bends around meanders with slopes varying 0-5% and 200° - 300° aspects. Upper riparian is *Symphoricarpos / Rosa spp.* (5-9m). Upland is flat native rangeland close to the creek.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	VGR19/SC2	Cumulic Regosol	0%	Sandy Clay
Upland	VGR19/SC2	Orthic Brown Chernozem*	0%	Sandy Loam

***** Soil is labeled in AGRASID as a Significant Soil.

Pasture Information:

Pasture Size: 243 acres Upland: 93% Riparian: 5% Water: 2%

Upland Type: Mainly native rangeland.

Water Sources: Creek is the main water source.

Current Year Grazing Time / Stocking Rate: Not known

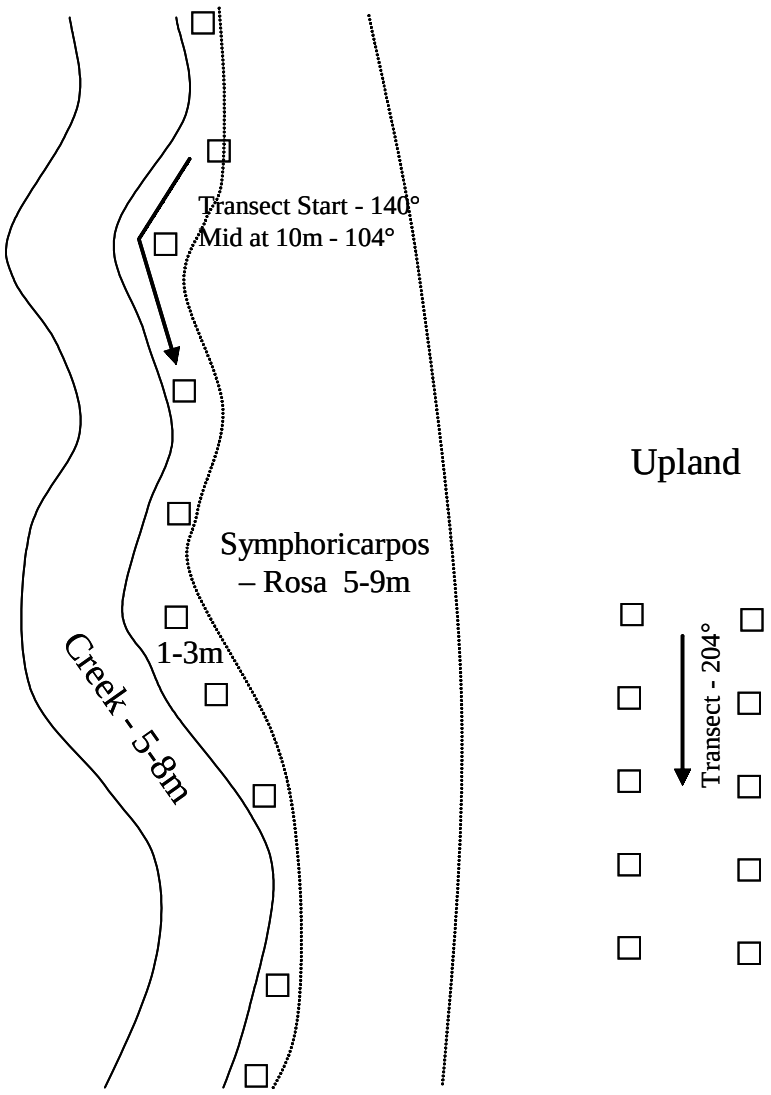
Current Grazing strategy: Plan is to use pasture lightly; put heifers in for a short while. In 1998/99 a fence was put in on the uplands to separate 1280 acres of native pasture from this pasture and a water pipeline was installed for water to those areas. Also a cross-fence was installed to divide the two upland pastures into 640 acre pastures. In 1998 a grazing plan was completed, the carrying capacity for the north riparian pasture (sampled) was set to 49 AUM

Historic Grazing strategy: Historically there were no real controls on cattle movements, there were approximately 2000 acres of pasture in one field that included the sampled riparian pasture and 1280 acres of native upland to the east with the creek as the only water source.

2003 Stocking Rate: Unknown

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Berry Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Gull Lake

Sites: 1 Riparian; 1 Upland; 1 Exclosure (5m² panels)

Water Body Type: Lake (>100 ha)

Riparian Band Descriptions (including sampled): Sampling occurs on the upper riparian band by a large lake. Other bands closer to the water are an emergent *Scirpus spp.* band (0-10m wide) next to water, followed by a *Carex / Calamagrostis spp.* band (~14m). The upland is directly next to riparian consisting mainly of domestic / introduced species. Very little slope on either site.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZGW21/U1l	Orthic Humic Gleysol	25% Gravel	Sandy Clay
Upland	ZGW21/U1l	Orthic Humic Gleysol	0%	Silty Clay

Pasture Information:

Pasture Size: ~80acres Upland: 70% Riparian: 30% Water: None

Upland Type: Mixture of native and tame species. Some native species occur on the upper benches although most of the area has been seeded to tame.

Water Sources: The lake is the main water source.

Current Year Grazing Time / Stocking Rate: 100 cow / calf pairs for one month in September – October.

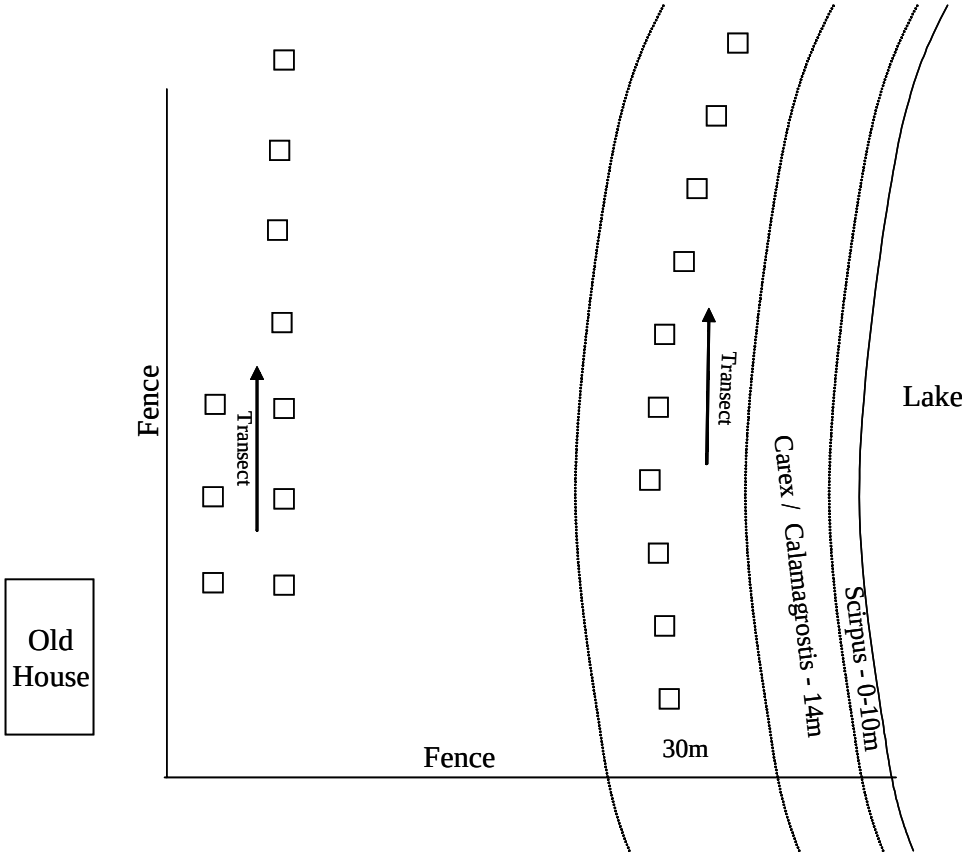
Current Grazing strategy: Pasture is being cross-fenced from 3 large pastures each bordering the lake to 6 smaller paddocks. There will be 3 'shore' and 3 upland paddocks. Grazing system will be used to coordinate use between riparian and upland pastures. Upland pastures will have water systems installed.

Historic Grazing strategy: 3 large pastures, all with access to lake. Cattle left in these larger pastures for longer times; no control on riparian grazing.

2003 Stocking Rate: 3.1 pair months / ha (September – October)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Gull Lake:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Iron Creek

Sites: 1 Riparian; 1 Exclosure (group of five cages)

Water Body Type: Creek (3-5m wide)

Riparian Band Descriptions (including sampled): Single Riparian band (~3m wide) next to creek. The sampled area has 0-5% slope and mainly 102° aspects throughout.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	BLKP9/SC1h	Orthic Humic Gleysol*	0%	Silty Clay

* Soil is labeled in AGRASID as a Significant Soil. Codominant soils are Orthic Black Chernozem and Black Solod.

Pasture Information:

Pasture Size: ~100acres Upland: 80% Riparian: 15% Water: 5%

Upland Type: Primarily native.

Water Sources: The creek is the main water source.

Current Year Grazing Time / Stocking Rate: No grazing past 2 years, horses used area some over winter and into spring.

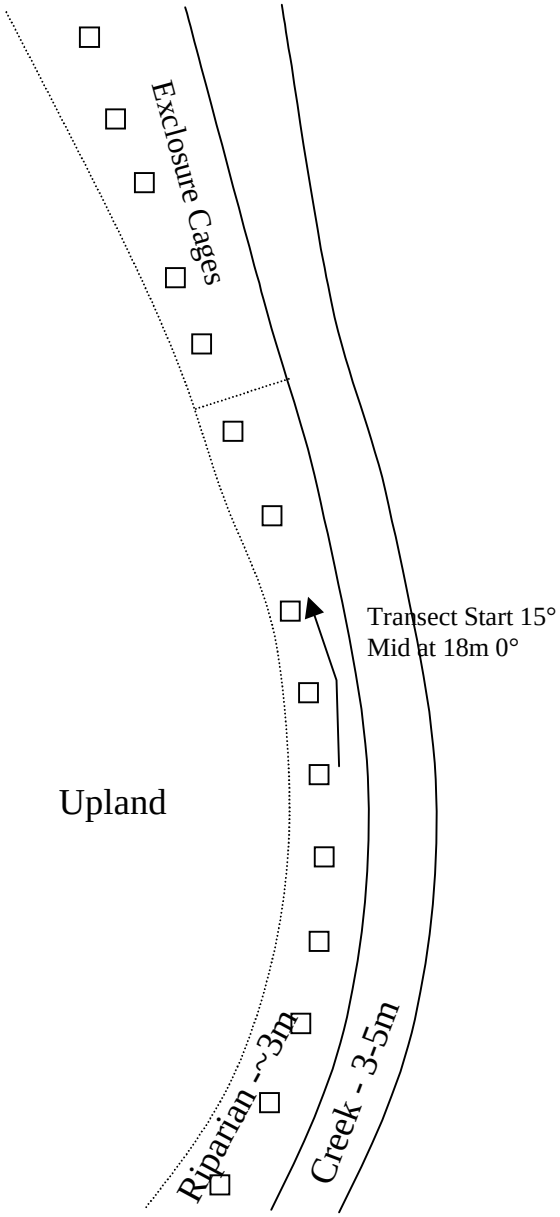
Current Grazing strategy: Horse pasture.

Historic Grazing strategy: Prior to purchase pasture was severely overgrazed.

2003 Stocking Rate: Unknown (light horse use in winter / spring)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Iron Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Ketchamoot Creek

Sites: 1 Riparian

Water Body Type: Creek (1-2m wide)

Riparian Band Descriptions (including sampled): Riparian edge (1-2m wide) sampled in large *Bromus spp. / Agropyron spp.* pasture. Riparian is larger on bar side of creek. Most cages located on bar side. Very little slope.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	MDZG5/L2	Orthic Humic Gleysol*	0%	Sandy Clay Loam

* Soil is labeled in AGRASID as a Codominant soil along with Orthic Black Chernozem.

Pasture Information:

Pasture Size: 200acres Upland: 80% Riparian: 10% Water: 10%

Upland Type: Tame

Water Sources: Stock tank from dugout and creek are main water sources.

Current Year Grazing Time / Stocking Rate: 150 cow / calf pairs from July 20 to August 20.

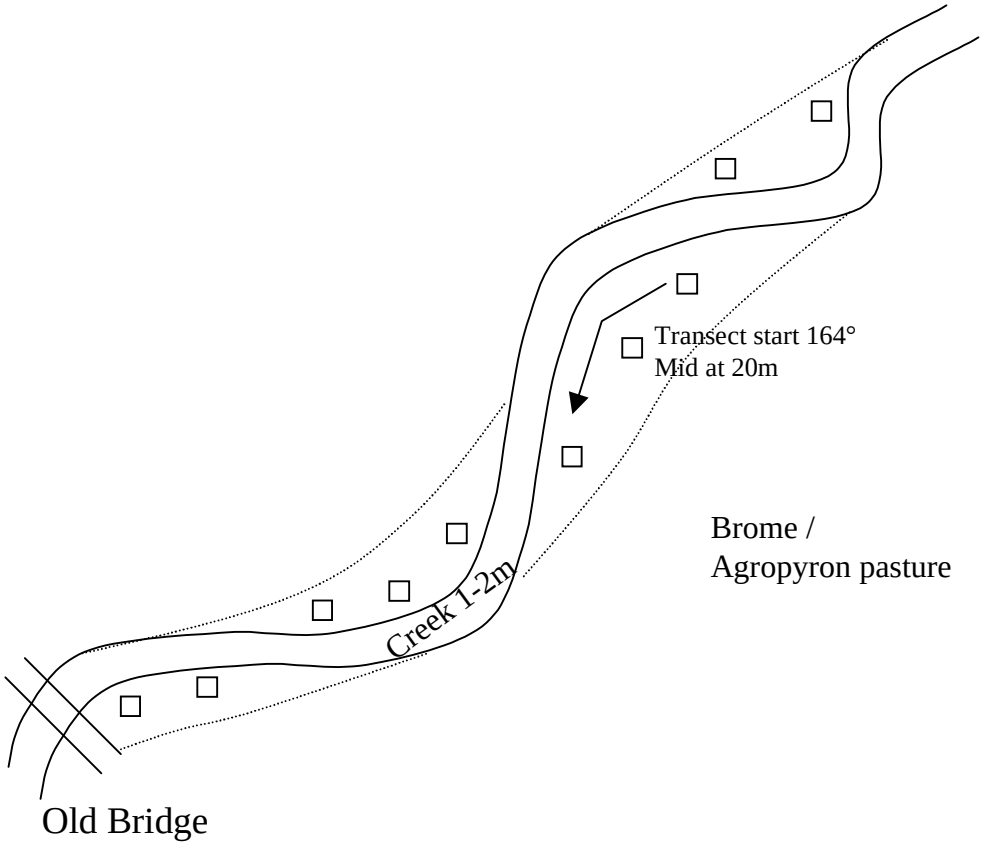
Current Grazing strategy: Used commonly like current year.

Historic Grazing strategy: Previous owner continually grazed pasture.

2003 Stocking Rate: 1.8 pair month / ha (July-August)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Ketchamoot Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Medicine River (South)

Sites: 2 Riparian; 1 Upland

Water Body Type: River (~20m wide)

Riparian Band Descriptions (including sampled): Single riparian band (~5m wide) next to river. Riparian site 1 is a recovering old watering area, with more bare soil than in Site 2. Both are around 20% slope and 150° aspects. Site 2 and upland are mainly domestic species. The upland is flat, just north of riparian sites.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian 1	ZUN19/SC2	Orthic Regosol	0%	Silty Clay
Riparian 2	ZUN19/SC2	Orthic Regosol	0%	Silty Clay
Upland	ZUN19/SC2	Orthic Black Chernozem*	0%	Sandy Loam

***** Soil is labeled in AGRASID as a Significant Soil.

Pasture Information:

Pasture Size: ~40acres Upland: 95% Riparian: 5% Water: None

Upland Type: Tame species. Large portion of flat area was seeded to tame grasses this year.

Water Sources: All access to creek has been fenced off recently. Cattle water through alternate watering systems (Solar pump trough, and nose pumps).

Current Year Grazing Time / Stocking Rate: 25 cow / calf pairs for 3 weeks in late September

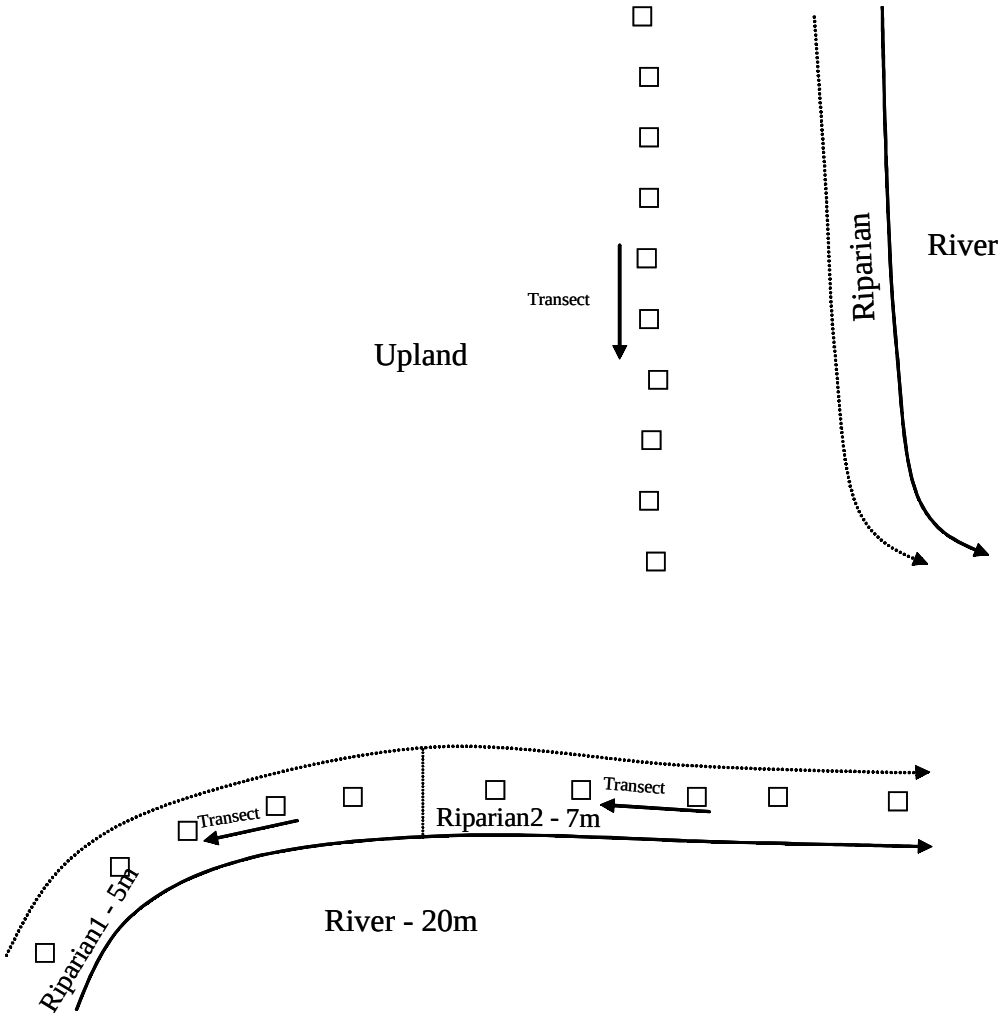
Current Grazing strategy: 20-25 cow / calf pairs put in field from May to October. This year the times were reduced to allow the seeding to establish.

Historic Grazing strategy: No fencing on riparian areas. Cattle were allowed full access to the river bank, and river was their primary source of water. Many years ago Riparian Site 1 was the main watering source for a much larger pasture.

2003 Stocking Rate: 1.1 pair months / ha (September)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Medicine River (S):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Medicine River (North)

Sites: 1 Riparian

Water Body Type: River (~20m wide)

Riparian Band Descriptions (including sampled): Sampled area is in old meander off of river. Bands from river are: Sand / *Rumex spp.* (1-2m wide), then a rise to a bench, mainly *Bromus spp.* (8m), then the sampled are in a slight depression of an old meander (11m to next high side). After this the riparian pasture is mainly *Symphoricarpos spp.* and S*alix spp.* to the fence (~40m).

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZUN19/SC2	Orthic Regosol	0%	Silty Clay

Pasture Information:

Pasture Size: 35 Acres Upland: 80% Riparian/Water: 20%

Upland Type: Mostly tame grass.

Water Sources: In spring there is an old oxbow not contained in the riparian used as primary water source. Summer and fall the river is main water source.

Current Year Grazing Time / Stocking Rate: 48-60 young cow / calf pairs grazed for 10 days in the spring. No access allowed to riparian. Cattle allowed in pasture again in August for a 2 week period and also allowed full access to riparian.

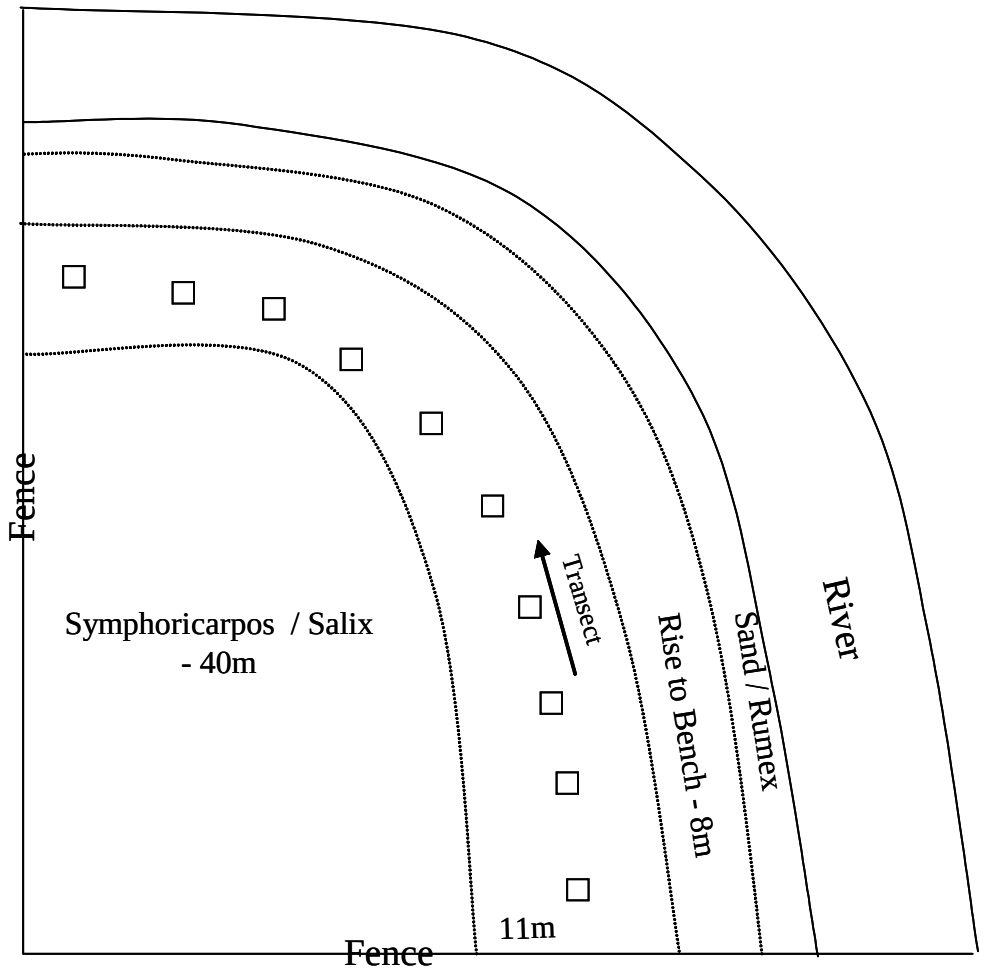
Current Grazing strategy: Pasture rotationally grazed, riparian area is fenced. In spring cattle do not need access to area as water is available in old oxbow upland. Summer and fall grazing the gate is opened to allow access to riparian and river as a water source.

Historic Grazing strategy: No fence. Pasture was rotationally grazed.

2003 Stocking Rate: 2.1 pair months / ha (August)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Medicine River (N):



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Ribstone Creek

Sites: 1 Riparian

Water Body Type: Creek (1-2m wide)

Riparian Band Descriptions (including sampled): Narrow riparian edge (1-4m wide) along small, slow flowing creek. Very little slope.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZUN1/SC1h	Orthic Regosol	0%	Silty Clay

Pasture Information:

Pasture Size: 2240 acres Upland: 80% Riparian / Water: 20%

Upland Type: Native range, some broke up in homesteading days then abandoned.

Water Sources: Three dugouts and beaver dams along the creek pool water.

Current Year Grazing Time / Stocking Rate: 237 cow / calf pairs from October 1 to December 18.

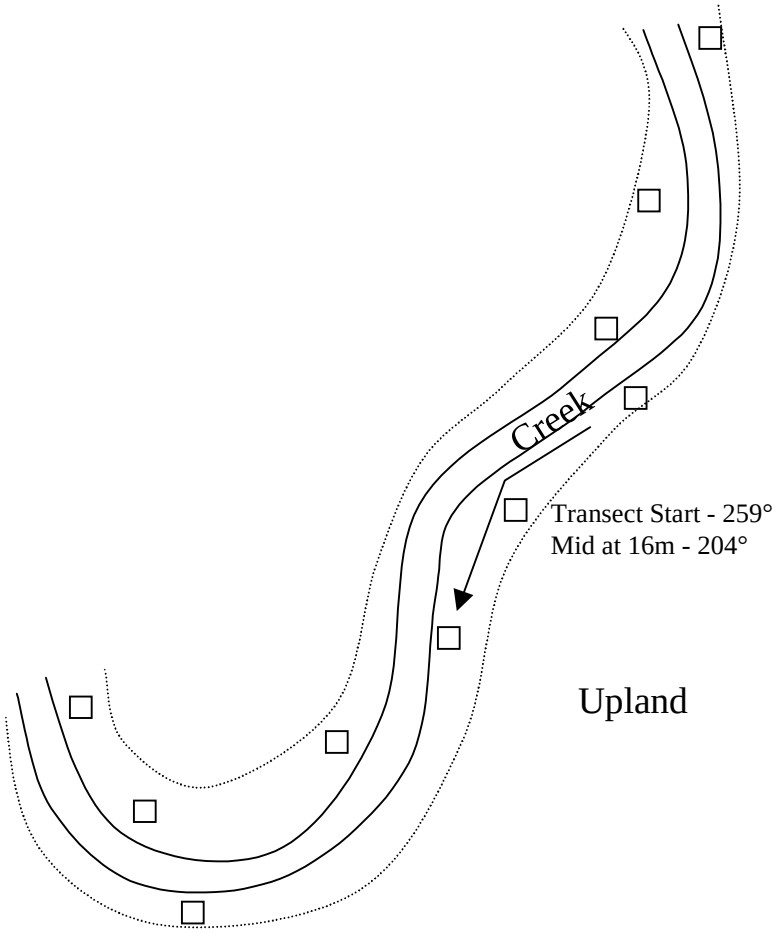
Current Grazing strategy: Since 2000 pasture has been grazed in the fall, usually after October 1.

Historic Grazing strategy: Previous owner grazed through season.

2003 Stocking Rate: 0.6 pair month / ha (October - December)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Ribstone Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Rosebud River

Sites: 1 Riparian

Water Body Type: River (3-8m wide)

Riparian Band Descriptions (including sampled): Sampled band (1-3m wide) is on bar side next to river, 0-8% slope with generally a 204° aspect. Bank side is steeper with some shrubs (*Rosa* / *Symphoricarpos spp.*).

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	ZgZU1/SC1h	Orthic Humic Gleysol*	0%	Sandy Clay Loam

*Soil is labeled in AGRASID as a Codominant soil along with Orthic Regosol.

Pasture Information:

Pasture Grazing Pattern / History:

Pasture Size: 7 acres Upland: 90% Riparian / Water: 10%

Upland Type: Primarily native range

Water Source: Creek is main water source

Current Year Grazing Time / Stocking Rate: Unknown. Some use as cattle entered in without knowing.

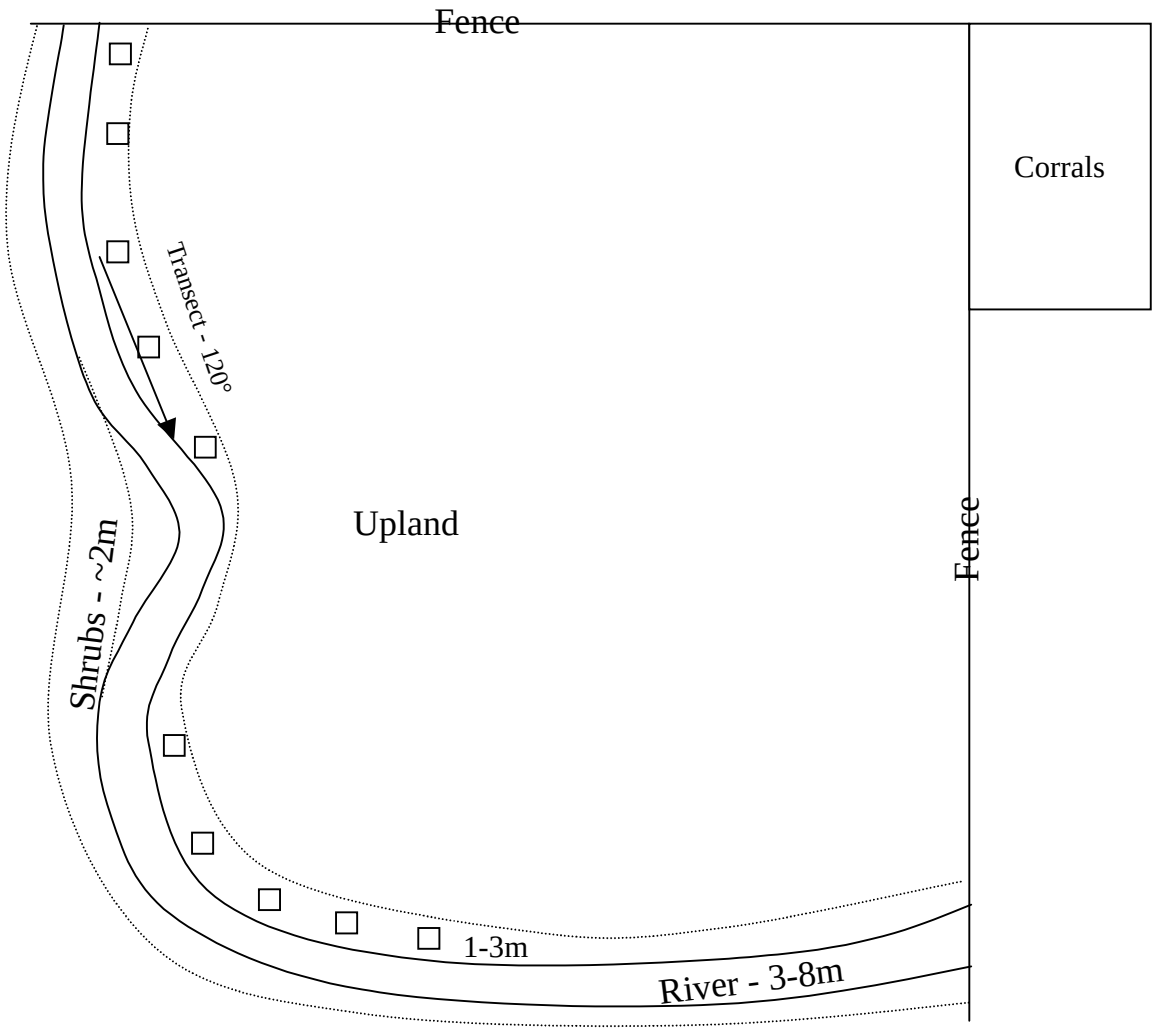
Current Grazing strategy: Small pasture surrounding creek is used minimally. This pasture was constructed 4 / 5 years ago with the goal of further fencing the rest of the creek in the future.

Historic Grazing strategy: Previously no fence and cattle were allowed full access to coulee containing creek.

2003 Stocking Rate: Unknown

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Rosebud River:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Rough Lake

Sites: 1 Riparian

Water Body Type: Lake (~25 ha)

Riparian Band Descriptions (including sampled): Sample riparian band (18m wide) is the 2nd from upper with very little slope. Other riparian bands are: mud (~5m) next to water, *Puccinella / Senecio spp.* (5-8m), sampled band, then small *Salix spp.* shrubs (~12m) to deciduous forest edge.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	SWA1/W3	Misc Water*	0%	Sandy Loam

*AGRASID has riparian in water polygon. Uplands are Chernozemic soils

Pasture Information:

Pasture Size: ~1000 acres Upland: 90% Riparian: 5% Water: 5%

Upland Type: Mainly native rangeland.

Water Sources: Dugout and lake are main water sources.

Current Year Grazing Time / Stocking Rate: Very light use (.06 AUM / acre) in October

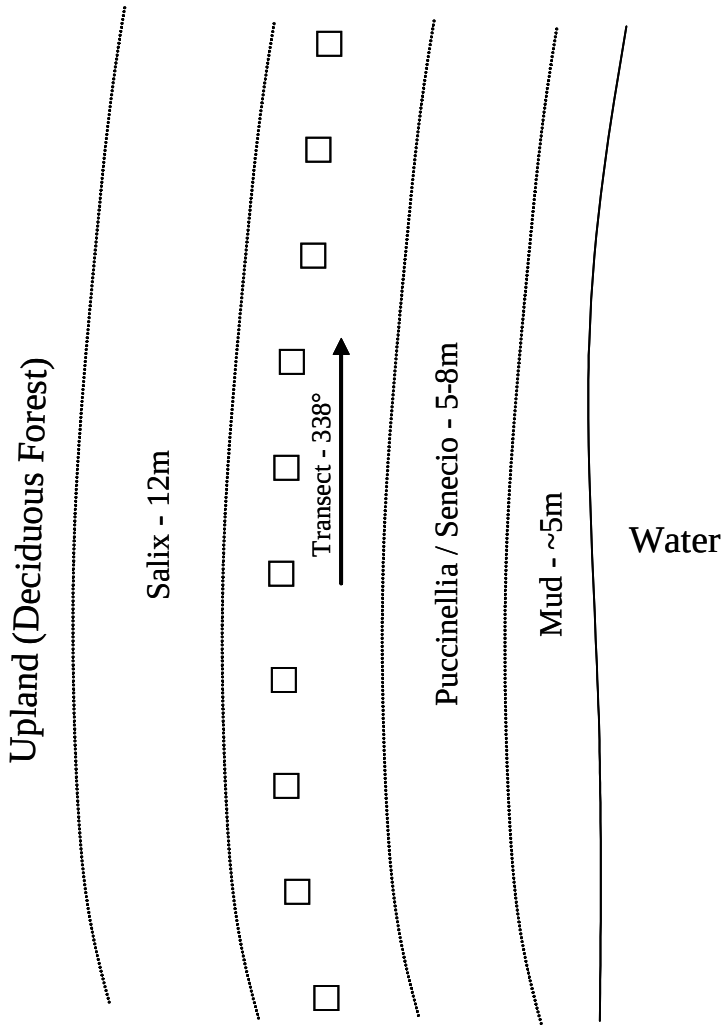
Current Grazing strategy: Normally this pasture is grazed at about .25 AUM / acre, the season of use varies from year to year.

Historic Grazing strategy: For the last 20 years this pasture has been part of a grazing rotation with the actual length of the grazing period at 4 to 6 weeks. Prior to the 1980's it was continuously grazed during the growing season.

2003 Stocking Rate: .1 AUM / ha (October)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Rough Lake:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Sounding Creek

Sites: 1 Riparian

Water Body Type: Ephemeral Creek

Riparian Band Descriptions (including sampled): Sampled band is upper riparian band (2-3m wide) along ephemeral creek. There are many species closer to middle (8m) and some bare soil. A concentration of *Typha spp.* (9m) exists in the center. Site is level.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	GLK7/FP1	Rego Gleysol	0%	Sandy Clay

Pasture Information:

Pasture Size: 1280 Acres Upland: ~95% Riparian/Water: ~5%

Upland Type: Mostly tame grass on flats, seeded to crested wheatgrass and alfalfa. Slopes to the east are mostly native species.

Water Source: Large dugout near creek in the middle of the pasture is the main livestock watering area. In the spring, the creek flows and there are seeps in the hilly parts that also provide water sources.

Current Year Grazing Time / Stocking Rate: 300 heifers grazed from September 10 to October 10.

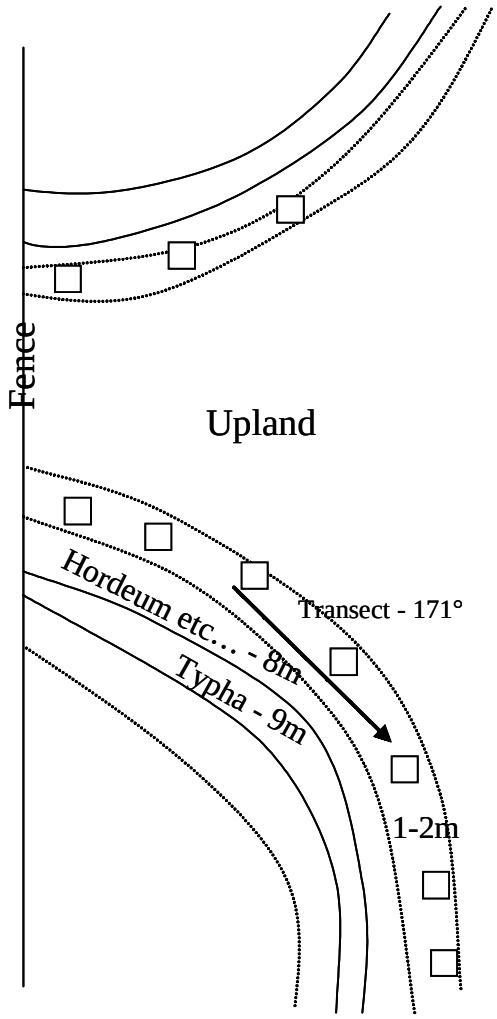
Current Grazing strategy: Pasture is used as required year by year. No established pattern. Landowner likes to ensure the area is used at different times to alternate season of use.

Historic Grazing strategy: The grazing strategy has been unchanged for quite a while.

2003 Stocking Rate: 0.6 heifer months / ha (September – October)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Sounding Creek:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Strome Carex Wetland

Sites: 1 Riparian; 1 Upland

Water Body Type: Marsh (~2ha)

Riparian Band Descriptions (including sampled): Marsh is mostly emergent *Carex spp.* and a little open water. Riparian band is *Salix spp.* covered, and somewhat wet throughout the year (~30m wide). Upland is a domestic seeded pasture next to marsh. No slope on either site.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	FMKL5/U1h	Solonetzic Humic Gleysol*	0%	Silty Clay Loam
Upland	FMKL5/U1h	Black Solodized Solonetz*	2% Gravel	Silty Clay

*Soils are labeled in AGRASID as a Codominant soils.

Pasture Information:

Pasture Size: 160 Acres Upland: ~80% Riparian: 10% Water: 10%

Upland Type: Cultivated tame pasture

Water Sources: One large dugout and wetland contains water in the spring.

Current Year Grazing Time / Stocking Rate: 15 cow / calf pairs for 30 days in June.

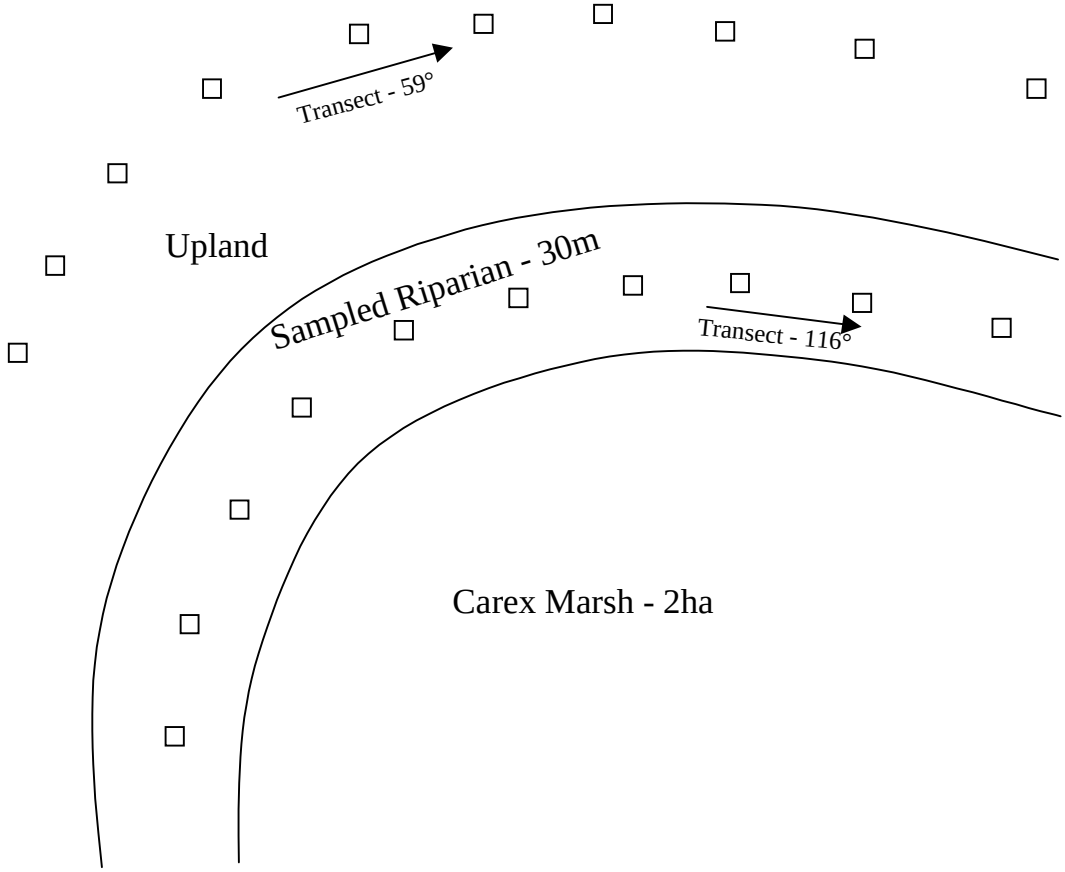
Current Grazing strategy: Used differently past few years. Last 2 years pasture was used for spring calving 250 cows for 2 months, Then 30 cow / calf pairs used pasture after July 15.

Historic Grazing strategy: No information.

2003 Stocking Rate: 0.23 pair month / ha (July)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Strome Carex Wetland:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Sunken Lake

Sites: 2 Riparian

Water Body Type: Lake (~20 – 30 ha)

Riparian Band Descriptions (including sampled): Mud (~5m wide) near water edge, first sampled band next (~30m), 5% slope / 6° aspect, then large band (75-100m) to Shrubby forest. Large band is in slight depression, no slope / aspect. This area has an exclosure and is sampled by Sustainable Resource Development staff.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparians	ZGZW20/W2	Orthic Humic Gleysol*	0%	Sandy Clay Loam

*Soil is labeled in AGRASID as a Codominant soil along with Misc. Water.

Pasture Information:

Pasture Size: 820 Acres Upland: 90% Riparian/Water: 10%

Upland Type: Mainly native rangeland.

Water Sources: Dugouts and springs throughout pasture

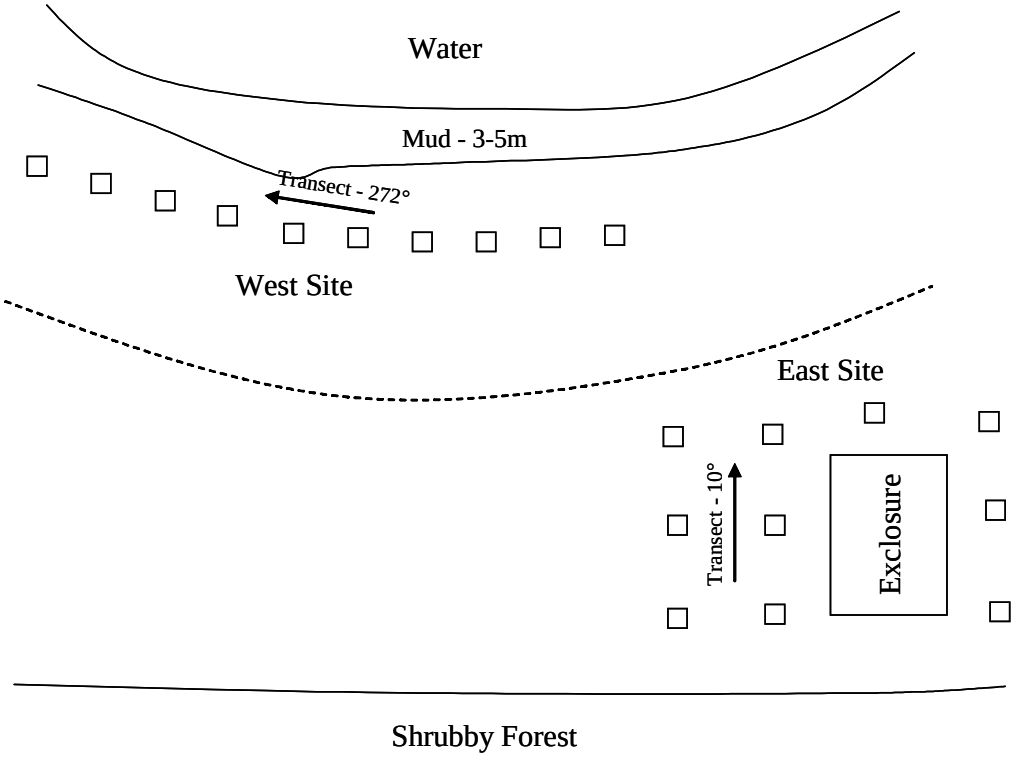
Current Year Grazing Time / Stocking Rate: Not known.

Current Grazing strategy: Grazing plan initialized by Sustainable Resource Management staff.

2003 Stocking Rate: Unknown

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Sunken Lake:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Toefield Carex Wetland

Sites: 1 Riparian

Water Body Type: Wetland Marsh (~10 ha)

Riparian Band Descriptions (including sampled): Sampled band is on edge of large ephemeral *Carex spp.* marsh. Marsh becomes more moist closer to the middle. Entire site is flat.

Soil Characteristics:

Site	Soil Landscape Model	Classification	Coarse Fragment	Texture
Riparian	CMO19/U1h	Orthic Humic Gleysol*	0%	Silty Clay Loam

***** Soil is labeled in AGRASID as a Significant Soil; Dominant soil is Black Solodized Solonetz

Pasture Information:

Pasture Size: 20 Acres Upland: 60% Riparian/Water: 40%

Upland Type: Mainly native rangeland.

Water Source: Dugout in the middle of pasture is the main water source.

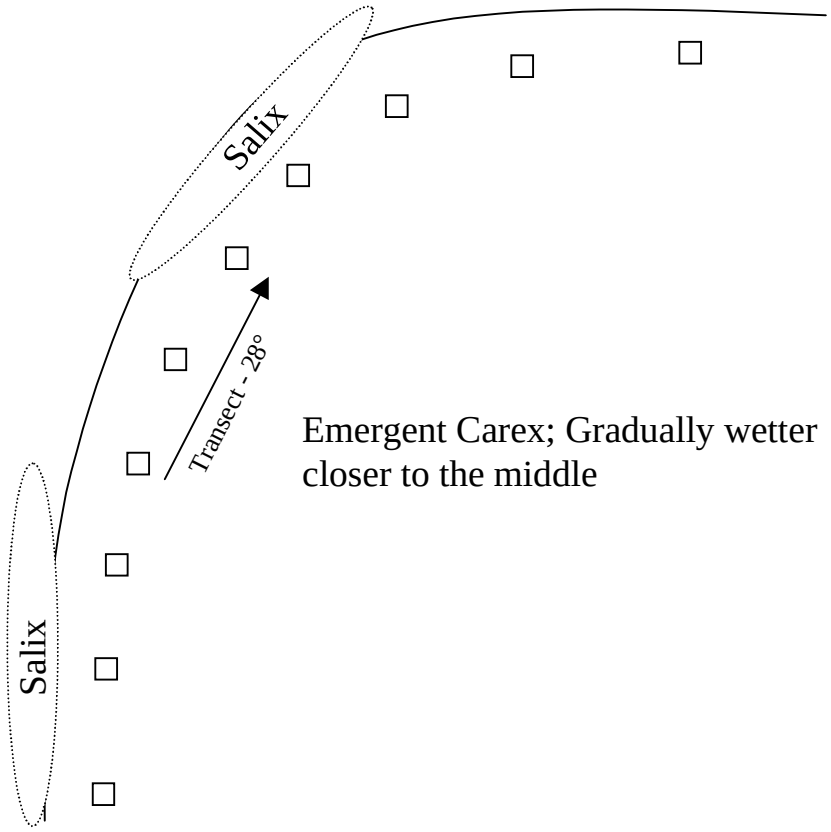
Current Year Grazing Time / Stocking Rate: Number of bulls in pasture in November, when feed is low they are allowed in neighboring cultivated pasture. Animals are fed here as well.

Current Grazing strategy: The above has been the strategy for this since 1983.

2003 Stocking Rate: Winter use with bulls (winter feeding occurs in adjacent pasture)

Appendix 1. Information of Sites Used in the Riparian Production Survey.

Schematic of Toefield Carex Wetland:



Appendix 1. Information of Sites Used in the Riparian Production Survey.

Site Name: Vilna Wetlands - White Rock, Center & Control

Sites: 3 Riparian

Water Type: Wetland

Riparian Band Descriptions (including sampled): Inner cattail band, mid ring of grasses / forbs, outer ring of willow / grasses / forbs.

Soil Characteristics:

Site	**Soil Landscape Model**	**Classification**	**Coarse Fragment**	Texture
WhiteRock	AGUC2/U1h	Typic Mesisol*****	N.D.	N.D.
Center	AGUC2/U1h	Typic Mesisol*	N.D.	N.D.
Control	AGUC2/U1h	Typic Mesisol*	N.D.	N.D.

***** Soil is labeled in AGRASID as a Significant Soil; Codominant soils are Dark Gray Luvisol and Eluviated Black Chernozem.

Pasture Information:

No evidence of grazing in any of the study areas prior to grazing in drought year 2002.

2002

Center Slough **–** Based on 70 cow / calf pairs, grazed heavily from mid June to mid July and again for a short time in the winter (fences were open to all pastures in this quarter)

White Rock Slough **–** grazed in October to November (40 days) with adjacent hay field

2003

Oct 17, 2003 – 64 cows, 3 bulls, 48 calves – 25 days of grazing in both White Rock and Center Slough. 2250 AU days.

Control has never been grazed by cattle.

No Schematic Provided

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (E) – Riparian

Plant Species Composition

Date Sampled: July 10, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
creeping spike-rush	*Eleocharis palustris*	12.7	33.3
fowl bluegrass	*Poa palustris*	11.0	53.3
small-fruited bulrush	*Scirpus microcarpus*	8.7	53.3
awned sedge	*Carex atherodes*	7.0	26.7
northern reed grass	*Calamagrostis inexpansa*	6.3	26.7
Kentucky bluegrass	*Poa pratensis*	5.3	33.3
quackgrass	*Agropyron repens*	2.0	26.7
great bulrush	*Scirpus acutus*	2.0	20.0
smooth brome	*Bromus inermis*	1.7	6.7
slough grass	*Beckmannia syzigachne*	1.4	26.7
beaked sedge	*Carex utriculata*	1.0	6.7
reed canary grass	*Phalaris arundinacea*	1.0	13.3
Grass / Grasslike Total		**60.1**	
Forb			
pale persicaria	*Polygonum lapathifolium*	6.7	46.7
western dock	*Rumex occidentalis*	2.2	33.3
Canada thistle	*Cirsium arvense*	1.7	20.0
perennial sow thistle	*Sonchus arvensis*	1.3	20.0
fireweed	*Epilobium angustifolium*	0.7	20.0
lamb's quarters	*Chenopodium album*	0.5	13.3
water parsnip	*Sium suave*	0.5	13.3
water avens	*Geum rivale*	0.3	6.7
common dandelion	*Taraxacum officinale*	0.2	6.7
long-stalked chickweed	*Stellaria longipes*	0.2	6.7
Philadelphia fleabane	*Erigeron philadelphicus*	0.2	6.7
wild mint	*Mentha arvensis*	0.2	6.7
Forb Total		**14.8**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (E) – Riparian (continued)

	Cover (%)	Freq (%)
Other		
Litter	42.3	73.3
Soil	28.3	60.0
Bryophytes	2.0	6.7
Other Total	**72.7**	

Shrub / Tree Plot (>2.5m)		**Cover (%)**	**Height (m)**
aspen	*Populus tremuloides*	2.0	8.0
beaked willow	*Salix bebbiana*	5.0	5.0
pussy willow	*Salix discolor*	2.0	5.0

Forage Production

Cage Installation: June 10, 2003

Date Clipped: August 26, 2003

Caged Plots n=10

	Kg/ha		**lb/acre**	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4743.6	775.8	4235.4	692.7
Forb	707.4	86.7	631.6	77.5
Shrub	-	-	-	-
Total Forage	5451.0	789.4	4867.0	704.8
Litter	1646.4	356.8	1470.0	318.6

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (E) – Upland

Plant Species Composition

Date: July 10, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Kentucky bluegrass	*Poa pratensis*	36.0	93.3
smooth brome	*Bromus inermis*	15.3	53.3
quackgrass	*Agropyron repens*	12.1	60.0
foxtail barley	*Hordeum jubatum*	1.5	13.3
Grass / Grasslike Total		**64.9**	
Forb			
northern bedstraw	*Galium boreale*	6.0	46.7
yarrow	*Achillea millefolium*	3.8	33.3
alfalfa	*Medicago sativa*	3.0	20.0
wild vetch	*Vicia americana*	0.7	6.7
tufted phlox	*Phlox caespitosa*	0.2	6.7
Forb Total		**13.7**	
Shrub / Tree			
buckbrush	*Symphoricarpos occidentalis*	5.9	73.3
Shrub / Tree Total		**5.9**	
Other			
Litter		67.3	100.0
Soil		5.0	26.7
Other Total		**72.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (E) – Upland (continued)

Forage Production

Cage Installation: June 10, 2003

Date Clipped: August 26, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4675.4	447.0	4174.5	399.1
Forb	296.2	107.7	264.5	96.2
Shrub	62.6	58.2	55.9	52.0
Total Forage	5034.2	401.3	4494.9	358.3
Litter	706.8	154.1	631.1	137.6

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (W) – Riparian

Plant Species Composition

Date: July 10,2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Kentucky bluegrass	*Poa pratensis*	21.0	53.3
fowl bluegrass	*Poa palustris*	9.7	33.3
smooth brome	*Bromus inermis*	8.3	60.0
Grass / Grasslike Total		**39.0**	
Forb			
purple peavine	*Lathyrus venosus*	4.5	40.0
common dandelion	*Taraxacum officinale*	4.4	73.3
yellow avens	*Geum macrophyllum*	4.3	20.0
wild strawberry	*Fragaria virginiana*	1.3	13.3
western meadow rue	*Thalictrum occidentale*	1.3	26.7
marsh aster	*Aster borealis*	1.0	6.7
wild vetch	*Vicia americana*	0.7	20.0
perennial sow thistle	*Sonchus arvensis*	0.3	6.7
unknown species	*Unknown species*	0.3	6.7
northern bedstraw	*Galium boreale*	0.2	6.7
Philadelphia fleabane	*Erigeron philadelphicus*	0.2	6.7
yarrow	*Achillea millefolium*	0.2	6.7
Forb Total		**18.9**	
Shrub / Tree			
buckbrush	*Symphoricarpos occidentalis*	23.7	86.7
narrow-leaved meadowsweet	*Spiraea alba*	15.7	80.0
sandbar willow	*Salix exigua*	13.0	93.3
common wild rose	*Rosa woodsii*	11.3	86.7
bristly black currant	*Ribes lacustre*	2.0	26.7
saskatoon	*Amelanchier alnifolia*	2.0	13.3
wild red raspberry	*Rubus idaeus*	1.4	20.0
red osier dogwood	*Cornus stolonifera*	0.7	13.3
pussy willow	*Salix discolor*	0.3	6.7
Shrub / Tree Total		**70.1**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Amisk Creek (W) – Riparian (continued)

		Cover (%)	Freq (%)
Other			
Litter		90.3	100.0
Soil		1.0	6.7
Other Total		**91.3**	**100.0**

Shrub / Tree Plot (>2.5m)		**Cover (%)**	**Height (m)**
Shrub Plot			
sandbar willow	*Salix exigua*	80.0	5.0
pussy willow	*Salix discolor*	2.0	3.0

Forage Production

Cage Installation: June 10, 2003

Date Clipped: August 27, 2003

Caged Plots n=10

	Kg/ha		**lb/acre**	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	3410.2	537.4	3044.9	479.9
Forb	435.0	173.0	388.4	154.5
Shrub	443.6	181.9	396.1	162.4
Total Forage	4288.8	542.7	3829.4	484.6
Litter	1877.6	558.2	1676.5	498.4

Uncaged Plots n=5

Grass / Grasslike	1331.2	156.7	1188.6	139.9
Forb	160.4	88.8	143.2	79.3
Shrub	412.4	222.5	368.2	198.6
Total Forage	1904.0	334.9	1700.0	299.1

Forage Utilization at Clipping: 59%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Bashaw Shallow Open Water (N) – Riparian

Plant Species Composition

Date: July 9, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
awned sedge	*Carex atherodes*	8.8	73.3
three-square rush	*Scirpus pungens*	5.9	73.3
Baltic rush	*Juncus balticus*	5.7	26.7
redtop	*Agrostis stolonifera*	4.7	46.7
foxtail barley	*Hordeum jubatum*	4.3	46.7
quackgrass	*Agropyron repens*	2.0	20.0
great bulrush	*Scirpus acutus*	1.7	20.0
creeping spike-rush	*Eleocharis palustris*	0.3	6.7
fowl manna grass	*Glyceria striata*	0.2	6.7
Grass / Grasslike Total		**33.6**	
Forb			
perennial sow thistle	*Sonchus arvensis*	26.3	93.3
sea milkwort	*Glaux maritima*	7.3	66.7
silverweed	*Potentilla anserina*	7.1	73.3
seaside arrow-grass	*Triglochin maritima*	2.0	26.7
beard-tongue	*Penstemon species*	0.2	6.7
creeping buttercup	*Ranunculus cymbalaria*	0.2	13.3
common dandelion	*Taraxacum officinale*	0.1	6.7
marsh aster	*Aster borealis*	0.1	13.3
Forb Total		**43.4**	
Other			
Litter		68.3	100.0
Soil		10.3	53.3
Bryophytes		0.3	6.7
Other Total		**79.0**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Bashaw Shallow Open Water (N) – Riparian (continued)

Forage Production

Cage Installation: June 3, 2003

Date Clipped: August 23, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	1647.6	143.2	1471.1	127.9
Forb	810.0	94.2	723.2	84.2
Shrub	-	-	-	-
Total Forage	2457.6	105.2	2194.3	93.9
Litter	2128.0	570.7	1900.0	509.5

Uncaged Plots n=5

Grass / Grasslike	1100.0	125.7	982.2	112.2
Forb	511.6	14.9	456.8	13.3
Shrub	-	-	-	-
Total Forage	1611.6	115.0	1439.0	102.7

Forage Utilization at Clipping: 35%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Bashaw Shallow Open Water (S) – Riparian

Plant Species Composition

Date: July 9, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Nuttall's alkaligrass	*Puccinellia nuttalliana*	42.3	100.0
foxtail barley	*Hordeum jubatum*	8.0	46.7
three-square rush	*Scirpus pungens*	4.7	26.7
common great bulrush	*Scirpus validus*	3.3	40.0
Baltic rush	*Juncus balticus*	3.0	13.3
Grass / Grasslike Total		**61.3**	
Forb			
marsh aster	*Aster borealis*	7.3	73.3
lamb's quarters	*Chenopodium album*	5.8	66.7
western dock	*Rumex occidentalis*	0.4	13.3
creeping buttercup	*Ranunculus cymbalaria*	0.3	13.3
perennial sow thistle	*Sonchus arvensis*	0.1	6.7
Forb Total		**13.9**	
Other			
Soil		44.0	100.0
Bryophytes		18.3	53.3
Litter		8.3	60.0
Other Total		**70.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Bashaw Shallow Open Water (S) – Riparian (continued)

Forage Production

Cage Installation: June 3, 2003

Date Clipped: August 25, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	3531.2	364.3	3152.9	325.3
Forb	1001.4	202.7	894.1	181.0
Shrub	-	-	-	-
Total Forage	4532.6	408.2	4047.0	364.4
Litter	386.4	91.3	345.0	81.5

UnCaged Plots n=5

Grass / Grasslike	2765.6	502.9	2469.3	449.0
Forb	472.0	71.1	421.4	63.5
Shrub	-	-	-	-
Total Forage	3237.6	528.4	2890.8	471.8

Forage Utilization at Clipping: 33%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Beaver Creek – Riparian

No Plant Species Composition for all Beaver Creek Riparian Sites. Vegetation types were recorded by riparian classification[2].

Beaver Creek – Agropyron: Western Wheat Grass (*Agropyron smithii*) Habitat Type

Beaver Creek – Rosa: Common Wild Rose (*Rosa woodsii*) Community Type

Beaver Creek – Salix: Sandbar Willow (*Salix exigua*) Community Type

Forage Production

Date Clipped: September 4,5 2003

Agropyron Caged Plots n=3

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	1460.7	137.5	1304.2	122.8
Forb	426.7	117.8	381.0	105.2
Shrub	72.0	-	64.3	-
Total Forage	1959.3	55.5	1749.4	49.5
Litter	573.3	112.2	511.9	100.2

No Uncaged Plots

Rosa Caged Plots n=9

Grass / Grasslike	1342.4	138.2	1198.6	123.4
Forb	357.8	139.9	319.4	124.9
Shrub	886.4	136.7	791.5	122.0
Total Forage	2586.7	184.1	2309.6	164.4
Litter	1211.6	203.3	1081.8	181.5

No Uncaged Plots

[2] Thompson, William H. and Paul L. Hansen. 2002. Classification and management of riparian and wetland sites of the Alberta Grassland Natural Region and adjacent subregions. Bitterroot Restoration Inc. Prepared for the Alberta Riparian Habitat Management Program – Cows and Fish, Lethbridge Alberta. 416 pages.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Beaver Creek – Riparian (continued)

Salix Caged Plots n=9

Grass / Grasslike	2764.0	442.4	2467.9	395.0
Forb	146.7	54.2	131.0	48.4
Shrub	1367.8	364.6	1221.3	325.6
Total Forage	4278.4	522.6	3820.1	466.6
Litter	530.2	134.5	473.4	120.1

No Uncaged Plots

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Beaver Creek – Upland

Plant Species Composition

Date: July 28, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
northern wheatgrass	*Agropyron dasystachyum*	47.3	100.0
June grass	*Koeleria macrantha*	10.5	93.3
low sedge	*Carex stenophylla*	6.0	93.3
thread-leaved sedge	*Carex filifolia*	2.8	53.3
green needlegrass	*Stipa viridula*	2.6	53.3
blue grama	*Bouteloua gracilis*	2.1	46.7
needle-and-thread	*Stipa comata*	2.1	53.3
early bluegrass	*Poa cusickii*	0.7	6.7
Kentucky bluegrass	*Poa pratensis*	0.7	6.7
plains reed grass	*Calamagrostis montanensis*	0.3	33.3
Idahoe fescue	*Festuca idahoensis*	0.3	13.3
Grass / Grasslike Total		**75.3**	
Forbs			
pasture sagewort	*Artemisia frigida*	10.9	73.3
wild vetch	*Vicia americana*	1.1	46.7
locoweed	*Oxytropis spp.*	1.0	20.0
early yellow locoweed	*Oxytropis sericea*	0.5	13.3
moss phlox	*Phlox hoodii*	0.3	53.3
showy everlasting	*Antennaria pulcherrima*	0.3	6.7
purple milk vetch	*Astragalus dasyglottis*	0.2	13.3
small-leaved everlasting	*Antennaria parvifolia*	0.2	13.3
bastard toadflax	*Comandra umbellata*	0.1	6.7
golden aster	*Heterotheca villosa*	0.1	6.7
tufted fleabane	*Erigeron caespitosus*	0.1	6.7
Forbs Total		**14.8**	
Other			
Soil		13.0	100.0
Bryophytes		1.2	66.7
Other Total		**14.2**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Beaver Creek – Upland (continued)

Forage Production

Date Clipped: September 4,5 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	795.6	110.2	710.4	98.4
Forb	108.2	18.2	96.6	16.3
Shrub	-	-	-	-
Total Forage	903.8	103.3	807.0	92.2
Litter	358.0	34.2	319.6	30.5

No Uncaged Plots

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Berry Creek – Riparian

Plant Species Composition

Date: July 12, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
slender sedge	*Carex lasiocarpa*	23.7	80.0
small-fruited bulrush	*Scirpus microcarpus*	13.7	80.0
water sedge	*Carex aquatilis*	4.7	40.0
foxtail barley	*Hordeum jubatum*	4.2	40.0
creeping spike-rush	*Eleocharis palustris*	3.0	20.0
narrow reed grass	*Calamagrostis stricta*	3.0	20.0
Baltic rush	*Juncus balticus*	2.3	20.0
three-square rush	*Scirpus pungens*	1.7	33.3
fowl manna grass	*Glyceria striata*	1.7	13.3
tall manna grass	*Glyceria grandis*	1.3	6.7
common great bulrush	*Scirpus validus*	1.0	6.7
Grass / Grasslike Total		**60.3**	
Forb			
marsh aster	*Aster borealis*	2.5	26.7
wild licorice	*Glycyrrhiza lepidota*	1.3	6.7
aster	*Aster species*	1.3	26.7
wild mint	*Mentha arvensis*	1.2	20.0
northern water-horehound	*Lycopus uniflorus*	1.0	13.3
silverweed	*Potentilla anserina*	0.7	6.7
perennial sow thistle	*Sonchus arvensis*	0.3	6.7
Forb Total		**8.3**	
Shrub / Tree			
buckbrush	*Symphoricarpos occidentalis*	2.1	13.3
common wild rose	*Rosa woodsii*	1.9	33.3
basket willow	*Salix petiolaris*	0.2	13.3
Shrub / Tree Total		**4.2**	
Other			
Litter		59.3	100.0
Water		25.0	53.3
Other Total		**84.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Berry Creek – Riparian (continued)

Forage Production

Cage Installation: June 12, 2003

Date Clipped: August 20, 2003

Caged Plots n=8

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	3108.8	320.6	2775.7	286.2
Forb	373.0	106.8	333.0	95.3
Shrub	38.3	38.3	34.2	34.2
Total Forage	3520.0	315.2	3142.9	281.4
Litter	1623.0	462.4	1449.1	412.9

Uncaged Plots n=5

Grass / Grasslike	468.8	120.9	418.6	108.0
Forb	81.6	29.0	72.9	25.9
Shrub	2.8	-	2.5	-
Total Forage	553.2	145.1	493.9	129.6

Forage Utilization at Clipping: 83%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Berry Creek – Upland

Plant Species Composition

Date: July 12, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
porcupine grass	*Stipa curtiseta*	35.7	100.0
june grass	*Koeleria macrantha*	7.7	80.0
sand grass	*Calamovilfa longifolia*	6.7	46.7
needle-and-thread	*Stipa comata*	2.0	33.3
hairy wild rye	*Elymus innovatus*	1.3	13.3
plains rough fescue	*Festuca hallii*	0.3	6.7
Grass / Grasslike Total		**53.7**	
Forb			
pasture sagewort	*Artemisia frigida*	3.5	26.7
compact selaginella	*Selaginella densa*	2.7	13.3
prickly pear cactus	*Opuntia fragilis*	1.2	20.0
unknown species	*Unknown species*	0.7	6.7
prairie goldenbean	*Thermopsis rhombifolia*	0.6	20.0
lamb's quarters	*Chenopodium album*	0.1	6.7
Forb Total		**8.8**	
Shrub / Tree			
common wild rose	*Rosa woodsii*	5.3	53.3
sagebrush	*Artemisia cana*	1.7	6.7
Shrub / Tree Total		**6.9**	
Other			
Litter		38.7	100.0
Soil		22.3	100.0
Bryophytes		9.7	60.0
Other Total		**70.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Berry Creek – Upland (continued)

Forage Production

Cage Installation: June 12, 2003

Date Clipped: August 20, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	660.6	54.3	589.8	48.4
Forb	150.6	91.0	134.5	81.2
Shrub	2.8	-	2.5	-
Total Forage	814.0	95.5	726.8	85.2
Litter	178.8	29.7	159.6	26.5

Uncaged Plots n=5

Grass / Grasslike	251.2	38.7	224.3	34.6
Forb	14.0	6.5	12.5	5.8
Shrub	-	-	-	-
Total Forage	265.2	36.2	236.8	32.3

Forage Utilization at Clipping: 60%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Gull Lake – Riparian

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Baltic rush	*Juncus balticus*	34.7	100.0
slender sedge	*Carex lasiocarpa*	1.9	46.7
tufted hair grass	*Deschampsia cespitosa*	0.9	26.7
redtop	*Agrostis stolonifera*	0.7	13.3
northern reed grass	*Calamagrostis inexpansa*	0.5	33.3
Kentucky bluegrass	*Poa pratensis*	0.3	13.3
Grass / Grasslike Total		**38.9**	
Forb			
wild mint	*Mentha arvensis*	4.5	80.0
perennial sow thistle	*Sonchus arvensis*	4.0	53.3
common dandelion	*Taraxacum officinale*	3.3	53.3
unknown species	*Unknown species*	3.3	40.0
bog violet	*Viola nephrophylla*	1.4	33.3
red clover	*Trifolium pratense*	1.3	20.0
creeping buttercup	*Ranunculus cymbalaria*	0.3	6.7
beard-tongue	*Penstemon species*	0.2	6.7
meadow horsetail	*Equisetum pratense*	0.2	6.7
skullcap	*Scutellaria galericulata*	0.1	6.7
Forb Total		**18.7**	
Shrub / Tree			
autumn willow	*Salix serissima*	3.3	40.0
beaked willow	*Salix bebbiana*	2.2	33.3
balsam poplar	*Populus balsamifera*	1.7	40.0
yellow willow	*Salix lutea*	1.1	13.3
basket willow	*Salix petiolaris*	0.5	13.3
Shrub / Tree Total		**8.7**	
Other			
Litter		68.0	100.0
Bryophytes		12.0	93.3
Other Total		**80.0**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Gull Lake – Riparian (continued)

Forage Production

Cage Installation: June 09, 2003

Date Clipped: September 02, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	2172.2	242.8	1939.5	216.8
Forb	400.4	102.8	357.5	91.8
Shrub	570.4	159.6	509.3	142.5
Total Forage	3143.0	259.6	2806.3	231.8
Litter	951.6	250.4	849.7	223.5

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Gull Lake – Upland

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Kentucky bluegrass	*Poa pratensis*	33.7	100.0
slender wheatgrass	*Agropyron trachycaulum*	16.3	66.7
timothy	*Phleum pratense*	3.7	40.0
Grass / Grasslike Total		**53.7**	
Forb			
red clover	*Trifolium pratense*	40.0	93.3
common dandelion	*Taraxacum officinale*	5.1	73.3
common plantain	*Plantago major*	1.0	13.3
Forb Total		**46.1**	
Other			
Litter		52.0	100.0
Feces		1.3	6.7
Other Total		**53.3**	

Forage Production

Cage Installation: June 09, 2003

Date Clipped: September 02, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	3057.4	332.1	2729.9	296.5
Forb	182.4	49.5	162.9	44.2
Shrub	-	-	-	-
Total Forage	3239.8	317.1	2892.7	283.1
Litter	575.6	238.0	513.9	212.5

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Iron Creek - Riparian

Plant Species Composition

Date: July 09, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
beaked sedge	*Carex utriculata*	55.7	100.0
small-fruited bulrush	*Scirpus microcarpus*	5.0	46.7
water sedge	*Carex aquatilis*	4.0	26.7
tall manna grass	*Glyceria grandis*	2.7	40.0
slough grass	*Beckmannia syzigachne*	2.2	26.7
creeping spike-rush	*Eleocharis palustris*	0.7	6.7
Grass / Grasslike Total		**70.3**	
Forb			
yellow avens	*Geum macrophyllum*	0.2	6.7
Forb Total		**0.2**	
Other			
Soil		40.0	100.0
Litter		31.0	93.3
Bryophytes		2.7	20.0
Other Total		**73.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Iron Creek – Riparian (continued)

Forage Production

Cage Installation: June 08, 2003

Date Clipped: August 30, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4239.6	255.1	3785.4	227.8
Forb	234.4	93.1	209.3	83.1
Shrub	-	-	-	-
Total Forage	4474.0	179.7	3994.7	160.5
Litter	2430.4	429.0	2170.0	383.0

Uncaged Plots n=5

Grass / Grasslike	4751.6	725.5	4242.6	647.8
Forb	107.2	61.1	95.7	54.5
Shrub	-	-	-	-
Total Forage	4858.8	696.9	4338.3	622.3

Forage Utilization at Clipping: -7%* (negligible)

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Ketchamoot Creek - Riparian

Plant Species Composition

Date: July 10, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
quackgrass	*Agropyron repens*	19.3	73.3
small-fruited bulrush	*Scirpus microcarpus*	10.7	53.3
spike redtop	*Agrostis exarata*	5.7	40.0
Kentucky bluegrass	*Poa pratensis*	4.7	33.3
Baltic rush	*Juncus balticus*	1.3	6.7
foxtail barley	*Hordeum jubatum*	1.2	13.3
tall manna grass	*Glyceria grandis*	1.0	6.7
water foxtail	*Alopecurus aequalis*	1.0	6.7
Grass / Grasslike Total		**44.9**	
Forb			
silverweed	*Potentilla anserina*	9.3	73.3
perennial sow thistle	*Sonchus arvensis*	4.5	53.3
Canada thistle	*Cirsium arvense*	3.0	26.7
white Dutch clover	*Trifolium repens*	2.3	26.7
black medic	*Medicago lupulina*	0.7	13.3
common dandelion	*Taraxacum officinale*	0.7	13.3
field horsetail	*Equisetum arvense*	0.7	6.7
common plantain	*Plantago major*	0.3	6.7
western dock	*Rumex occidentalis*	0.3	6.7
Forb Total		**21.9**	
Other			
Litter		81.3	100.0
Soil		1.7	13.3
Other Total		**83.0**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Ketchamoot Creek – Riparian (continued)

Forage Production

Cage Installation: June 07, 2003

Date Clipped: August 28, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	5420.0	277.9	4839.4	248.2
Forb	577.0	130.2	515.2	116.3
Shrub	-	-	-	-
Total Forage	5997.0	246.3	5354.6	219.9
Litter	1046.8	311.0	934.7	277.7

Uncaged Plots n=5

Grass / Grasslike	2717.6	690.1	2426.5	616.1
Forb	122.8	34.0	109.6	30.3
Shrub	-	-	-	-
Total Forage	2840.4	712.8	2536.1	636.4

Forage Utilization at Clipping: 53%*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S1) – Riparian

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
small-fruited bulrush	*Scirpus microcarpus*	19.7	66.7
redtop	*Agrostis stolonifera*	11.2	53.3
reed canary grass	*Phalaris arundinacea*	7.0	20.0
bent grass	*Agrostis species*	4.3	20.0
creeping spike-rush	*Eleocharis palustris*	2.2	20.0
slender wheatgrass	*Agropyron trachycaulum*	1.7	13.3
smooth brome	*Bromus inermis*	0.5	13.3
fowl manna grass	*Glyceria striata*	0.3	6.7
Kentucky bluegrass	*Poa pratensis*	0.3	6.7
Grass / Grasslike Total		**47.3**	
Forb			
Macoun's buttercup	*Ranunculus macounii*	19.3	66.7
common plantain	*Plantago major*	7.3	53.3
meadow horsetail	*Equisetum pratense*	6.0	33.3
mustard	*Mustard spp.*	2.3	60.0
buck-bean	*Menyanthes trifoliata*	1.7	6.7
western dock	*Rumex occidentalis*	1.2	26.7
common nettle	*Urtica dioica*	1.0	6.7
field mouse-ear chickweed	*Cerastium arvense*	0.7	13.3
common dandelion	*Taraxacum officinale*	0.5	13.3
Forb Total		**40.0**	
Shrub / Tree			
aspen	*Populus tremuloides*	0.1	6.7
Shrub / Tree Total		**0.1**	
Other			
Bryophytes		50.0	93.3
Soil		32.0	86.7
Litter		0.7	13.3
Other Total		**82.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S1) – Riparian (continued)

Forage Production

Cage Installation: June 9, 2003

Date Clipped: September 1, 200**3**

Caged Plots n=5

	Kg/ha		**lb/acre**	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4610.0	747.9	4116.1	667.8
Forb	811.6	402.9	724.7	359.8
Shrub	-	-	-	-
Total Forage	5421.6	706.0	4840.8	630.4
Litter	137.6	73.3	122.9	65.4

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S2) – Riparian

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
reed canary grass	*Phalaris arundinacea*	33.3	73.3
smooth brome	*Bromus inermis*	26.0	73.3
slender wheatgrass	*Agropyron trachycaulum*	4.3	33.3
Kentucky bluegrass	*Poa pratensis*	1.3	20.0
marsh reed grass	*Calamagrostis canadensis*	0.3	6.7
tall manna grass	*Glyceria grandis*	0.3	6.7
Grass / Grasslike Total		**65.7**	
Forb			
meadow horsetail	*Equisetum pratense*	11.3	73.3
common dandelion	*Taraxacum officinale*	2.4	40.0
Canada goldenrod	*Solidago canadensis*	1.9	33.3
beard-tongue	*Penstemon species*	0.4	13.3
red clover	*Trifolium pratense*	0.3	6.7
avens	*Geum spp.*	0.2	13.3
wild vetch	*Vicia americana*	0.1	6.7
wormseed mustard	*Erysimum cheiranthoides*	0.1	6.7
mustard	*Mustard spp.*	0.1	6.7
stinkweed	*Thlaspi arvense*	0.1	6.7
Forb Total		**16.9**	
Shrub / Tree			
mountain willow	*Salix pseudomonticola*	0.4	13.3
Shrub / Tree Total		**0.4**	
Other			
Litter		67.7	100.0
Soil		31.0	100.0
Other Total		**98.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S2) – Riparian (continued)

Forage Production

Cage Installation: June 9, 2003

Date Clipped: September 1, 2003

Caged Plots n=5

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	5393.2	353.7	4815.4	315.8
Forb	848.4	311.7	757.5	278.4
Shrub	26.0	-	23.2	-
Total Forage	6267.6	305.7	5596.2	273.0
Litter	575.2	213.9	513.6	191.0

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S) – Upland

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
red fescue	*Festuca rubra*	17.9	73.3
slender wheatgrass	*Agropyron trachycaulum*	15.0	80.0
Kentucky bluegrass	*Poa pratensis*	13.7	73.3
timothy	*Phleum pratense*	6.5	60.0
Grass / Grasslike Total		**53.1**	
Forb			
common dandelion	*Taraxacum officinale*	15.3	93.3
alfalfa	*Medicago sativa*	4.3	46.7
yarrow	*Achillea millefolium*	3.0	46.7
meadow horsetail	*Equisetum pratense*	1.5	26.7
bog violet	*Viola nephrophylla*	0.7	6.7
red clover	*Trifolium pratense*	0.5	20.0
Forb Total		**25.2**	
Other			
Litter		79.1	100.0
Soil		14.7	80.0
Other Total		**93.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (S) – Upland (continued)

Forage Production

Cage Installation: June 9, 2003

Date Clipped: September 1, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	2621.6	365.8	2340.8	326.6
Forb	393.2	106.7	351.1	95.3
Shrub	-	-	-	-
Total Forage	3014.8	346.1	2691.8	309.0
Litter	133.6	25.8	119.3	23.0

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (N) – Riparian

Plant Species Composition

Date: July 08, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
slender wheatgrass	*Agropyron trachycaulum*	46.3	100.0
Kentucky bluegrass	*Poa pratensis*	27.3	100.0
fowl manna grass	*Glyceria striata*	1.7	26.7
redtop	*Agrostis stolonifera*	0.3	6.7
Grass / Grasslike Total		**75.7**	
Forb			
common dandelion	*Taraxacum officinale*	12.9	86.7
silverweed	*Potentilla anserina*	4.4	40.0
Macoun's buttercup	*Ranunculus macounii*	3.3	33.3
alsike clover	*Trifolium hybridum*	1.5	13.3
common plantain	*Plantago major*	1.2	13.3
wormseed mustard	*Erysimum cheiranthoides*	0.8	20.0
western dock	*Rumex occidentalis*	0.7	13.3
red clover	*Trifolium pratense*	0.5	13.3
Philadelphia fleabane	*Erigeron philadelphicus*	0.3	6.7
cinquefoil	*Potentilla species*	0.2	6.7
Forb Total		**25.9**	
Other			
Soil		56.0	100.0
Litter		28.0	100.0
Other Total		**84.0**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Medicine River (N) – Riparian (continued)

Forage Production

Cage Installation: June 9, 2003

Date Clipped: September 3, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4542.8	481.8	4056.1	430.2
Forb	381.4	109.6	340.5	97.8
Shrub	-	-	-	-
Total Forage	4924.2	418.1	4396.7	373.3
Litter	132.9	35.8	118.7	32.0

Uncaged Plots n=5

Grass / Grasslike	2447.2	74.7	2185.0	66.7
Forb	32.0	9.5	28.6	8.5
Shrub	-	-	-	-
Total Forage	2479.2	79.7	2213.6	71.2

Forage Utilization at Clipping: 42 %*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Ribstone Creek – Riparian

Plant Species Composition

Date: July 11, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Baltic rush	*Juncus balticus*	35.3	66.7
three-square rush	*Scirpus pungens*	8.0	46.7
creeping spike-rush	*Eleocharis palustris*	6.7	20.0
Nuttall's alkaligrass	*Puccinellia nuttalliana*	3.9	46.7
foxtail barley	*Hordeum jubatum*	3.5	60.0
fowl bluegrass	*Poa palustris*	0.7	6.7
salt grass	*Distichlis stricta*	0.3	6.7
Grass / Grasslike Total		**58.4**	
Forb			
lamb's quarters	*Chenopodium album*	6.5	60.0
sea milkwort	*Glaux maritima*	2.0	6.7
marsh aster	*Aster borealis*	1.0	6.7
northern ragwort	*Senecio streptanthifolius*	0.9	13.3
Forb Total		**10.3**	
Other			
Litter		38.0	86.7
Soil		36.3	80.0
Water		2.3	6.7
Bryophytes		0.7	6.7
Other Total		**77.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Ribstone Creek – Riparian (continued)

Forage Production

Cage Installation: June 11, 2003

Date Clipped: August 21, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4649.0	390.5	4151.0	348.7
Forb	695.0	201.5	620.5	179.9
Shrub	-	-	-	-
Total Forage	5344.0	426.2	4771.5	380.6
Litter	1749.2	879.3	1561.8	785.1

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Rosebud River – Riparian

Plant Species Composition

Date: July 12, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
three-square rush	*Scirpus pungens*	17.7	100.0
creeping spike-rush	*Eleocharis palustris*	15.0	80.0
redtop	*Agrostis stolonifera*	7.5	40.0
foxtail barley	*Hordeum jubatum*	1.4	26.7
fowl bluegrass	*Poa palustris*	0.3	6.7
Grass / Grasslike Total		**41.9**	
Forb			
creeping buttercup	*Ranunculus cymbalaria*	1.5	26.7
sea milkwort	*Glaux maritima*	0.7	6.7
silverweed	*Potentilla anserina*	0.1	6.7
Forb Total		**2.3**	
Other			
Soil		50.7	93.3
Litter		25.3	93.3
Bryophytes		0.3	6.7
Other Total		**76.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Rosebud River - Riparian (continued)

Forage Production

Cage Installation: June 12, 2003

Date Clipped: September 3, 2003

Caged Plots n=9

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4308.0	398.2	3846.5	355.6
Forb	25.8	12.5	23.0	11.2
Shrub	-	-	-	-
Total Forage	4333.8	398.3	3869.5	355.7
Litter	652.4	223.2	582.5	199.3

Uncaged Plots n=5

Grass / Grasslike	1435.2	208.7	1281.5	186.3
Forb	17.6	6.3	15.7	5.6
Shrub	-	-	-	-
Total Forage	1452.8	209.6	1297.2	187.1

Forage Utilization at Clipping: 67 %*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Rough Lake – Riparian

Plant Species Composition

Date: July 11, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
creeping spike-rush	*Eleocharis palustris*	23.3	86.7
slender rush	*Juncus tenuis*	9.9	80.0
three-square rush	*Scirpus pungens*	8.8	86.7
hair grass	*Agrostis scabra*	6.0	46.7
slender sedge	*Carex lasiocarpa*	2.7	20.0
big-head rush	*Juncus vaseyi*	2.5	40.0
foxtail barley	*Hordeum jubatum*	1.3	13.3
Kentucky bluegrass	*Poa pratensis*	0.7	6.7
Nevada bulrush	*Scirpus nevadensis*	0.2	6.7
Nuttall's alkaligrass	*Puccinellia nuttalliana*	0.2	6.7
Grass / Grasslike Total		**55.6**	
Forb			
creeping buttercup	*Ranunculus cymbalaria*	12.9	100.0
perennial sow thistle	*Sonchus arvensis*	7.5	60.0
marsh marigold	*Caltha palustris*	0.9	13.3
red clover	*Trifolium pratense*	0.3	6.7
common chickweed	*Stellaria media*	0.2	6.7
wild mint	*Mentha arvensis*	0.2	6.7
Forb Total		**22.0**	
Shrub / Tree			
beaked willow	*Salix bebbiana*	1.3	13.3
willow	*Salix species*	0.5	33.3
balsam poplar	*Populus balsamifera*	0.1	6.7
aspen	*Populus tremuloides*	0.1	6.7
basket willow	*Salix petiolaris*	0.1	6.7
Shrub / Tree Total		**2.1**	
Other			
Litter		73.7	93.3
Soil		11.7	40.0
Bryophytes		1.3	6.7
Other Total		**86.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Rough Lake – Riparian (continued)

Forage Production

Cage Installation: June 06, 2003

Date Clipped: August 22, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	2189.2	299.4	1954.7	267.3
Forb	241.8	88.5	215.9	79.1
Shrub	182.6	65.0	163.0	58.0
Total Forage	2613.6	253.0	2333.6	225.9
Litter	1019.2	197.0	910.0	175.9

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sounding Creek – Riparian

Plant Species Composition

Date: July 11, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
three-square rush	*Scirpus pungens*	13.7	86.7
foxtail barley	*Hordeum jubatum*	0.5	13.3
Grass / Grasslike Total		**14.2**	
Forb			
sea milkwort	*Glaux maritima*	15.7	66.7
seaside arrow-grass	*Triglochin maritima*	15.2	100.0
lamb's quarters	*Chenopodium album*	8.6	73.3
silverweed	*Potentilla anserina*	6.7	20.0
creeping buttercup	*Ranunculus cymbalaria*	2.2	26.7
northern water-horehound	*Lycopus uniflorus*	1.0	6.7
perennial sow thistle	*Sonchus arvensis*	1.0	20.0
unknown species	*Unknown species*	0.5	20.0
marsh aster	*Aster borealis*	0.4	13.3
Forb Total		**51.2**	
Other			
Litter		20.0	86.7
Rock		0.7	6.7
Soil		57.0	86.7
Other Total		**77.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sounding Creek – Riparian (continued)

Forage Production

Cage Installation: June 11, 2003

Date Clipped: August 21, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	1179.8	153.2	1053.4	136.8
Forb	1702.6	262.3	1520.2	234.2
Shrub	-	-	-	-
Total Forage	2882.4	315.5	2573.6	281.7
Litter	920.4	273.2	821.8	243.9

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Strome Carex Wetland – Riparian

Plant Species Composition

Date: July 10, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
quackgrass	*Agropyron repens*	33.7	100.0
Wheeler's bluegrass	*Poa nervosa*	2.7	20.0
smooth brome	*Bromus inermis*	2.7	6.7
timothy	*Phleum pratense*	1.3	6.7
Grass / Grasslike Total		**40.3**	
Forb			
wild strawberry	*Fragaria virginiana*	2.3	26.7
water avens	*Geum rivale*	1.7	6.7
curled dock	*Rumex crispus*	1.3	20.0
common dandelion	*Taraxacum officinale*	0.9	13.3
Canada goldenrod	*Solidago canadensis*	0.3	6.7
unknown species	*Unknown species*	0.3	6.7
common groundsel	*Senecio vulgaris*	0.2	6.7
Forb Total		**7.1**	
Shrub / Tree			
common wild rose	*Rosa woodsii*	6.6	46.7
beaked willow	*Salix bebbiana*	1.3	6.7
basket willow	*Salix petiolaris*	0.7	13.3
buckbrush	*Symphoricarpos occidentalis*	0.2	6.7
Shrub / Tree Total		**8.8**	
Other			
Litter		53.3	86.7
Soil		30.3	80.0
Dead wood		7.3	53.3
Bryophytes		1.7	13.3
Live Wood		0.7	6.7
Other Total		**93.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Strome Carex Wetland – Riparian (continued)

Shrub / Tree Plot (>2.5m)	**Cover (%)**	**Height (m)**
Populus tremuloides	*45.0*	*8.0*
Salix bebbiana	*20.0*	*5.0*
Salix petiolaris	*15.0*	*5.0*

Forage Production

Cage Installation: June 08, 2003

Date Clipped: August 29, 2003

Caged Plots n=10

	Kg/ha		**lb/acre**	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4540.0	508.2	4053.6	453.8
Forb	141.0	68.8	125.9	61.5
Shrub	82.0	48.8	73.2	43.5
Total Forage	4763.0	443.6	4252.8	396.1
Litter	919.6	230.9	821.1	206.2

Uncaged Plots n=5

Grass / Grasslike	2942.4	270.4	2627.2	241.4
Forb	47.2	34.4	42.1	30.7
Shrub	-	-	-	-
Total Forage	2989.6	248.3	2669.3	221.7

Forage Utilization at Clipping: 44 %*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Strome Carex Wetland – Upland

Plant Species Composition

Date: July 09, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Siberian wheatgrass	*Agropyron sibiricum*	13.7	80.0
fringed brome	*Bromus ciliatus*	11.3	86.7
crested wheatgrass	*Agropyron pectiniforme*	8.3	66.7
quackgrass	*Agropyron repens*	1.0	13.3
foxtail barley	*Hordeum jubatum*	0.9	20.0
Grass / Grasslike Total		**35.2**	
Forb			
alfalfa	*Medicago sativa*	1.3	6.7
lamb's quarters	*Chenopodium album*	0.6	20.0
common dandelion	*Taraxacum officinale*	0.5	13.3
pineapple-weed	*Matricaria matricarioides*	0.1	6.7
Forb Total		**2.5**	
Other			
Soil		76.7	100.0
Litter		2.0	6.7
Other Total		**78.7**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Strome Carex Wetland – Upland (continued)

Forage Production

Cage Installation: June 08, 2003

Date Clipped: August 29, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	3291.0	189.5	2938.4	169.2
Forb (n=9)	26.7	11.0	23.8	9.8
Shrub	-	-	-	-
Total Forage	3315.0	189.2	2959.9	169.0
Litter	74.0	24.7	66.1	22.0

Uncaged Plots n=5

Grass / Grasslike	3006.8	419.6	2684.7	374.7
Forb	25.2	15.5	22.5	13.8
Shrub	-	-	-	-
Total Forage	3032.0	418.0	2707.2	373.2

Forage Utilization at Clipping: 10 %*

* Utilization is measured by pairing the first five production plots with uncaged plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sunken Lake (E) – Riparian

Plant Species Composition

Date: July 11, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
Dewey's sedge	*Carex deweyana*	19.0	80.0
salt grass	*Distichlis stricta*	14.5	93.3
Kentucky bluegrass	*Poa pratensis*	11.0	46.7
three-square rush	*Scirpus pungens*	8.0	66.7
Baltic rush	*Juncus balticus*	0.7	6.7
quackgrass	*Agropyron repens*	0.2	6.7
tufted hair grass	*Deschampsia cespitosa*	0.1	6.7
Grass / Grasslike Total		**53.5**	
Forb			
small-leaved pussytoes	*Antennaria parvifolia*	61.3	93.3
perennial sow thistle	*Sonchus arvensis*	0.9	33.3
yarrow	*Achillea millefolium*	0.5	13.3
unknown species	*Unknown spp.*	0.3	13.3
tufted white prairie aster	*Aster ericoides*	0.3	20.0
sea milkwort	*Glaux maritima*	0.2	6.7
common peppergrass	*Lepidium densiflorum*	0.1	6.7
Forb Total		**63.6**	
Other			
Litter		18.0	100.0
Soil		8.3	53.3
Other Total		**26.3**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sunken Lake (E) – Riparian (continued)

Forage Production

Cage Installation: previous fall

Date Clipped: not known

Caged Plots n=10 (.25m² plots clipped by Sustainable Resource Development)

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	1054.0	197.7	941.1	176.5
Forb	335.7	131.7	299.7	117.6
Shrub	-	-	-	-
Total Forage	1389.7	159.3	1240.8	142.2
Litter	842.0	99.0	751.8	88.4

No Uncaged Plots

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sunken Lake (W) – Riparian

Plant Species Composition

Date: July 11, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
salt grass	*Distichlis stricta*	30.7	100.0
long-styled rush	*Juncus longistylis*	14.3	86.7
Nuttall's alkaligrass	*Puccinellia nuttalliana*	8.4	93.3
foxtail barley	*Hordeum jubatum*	8.2	80.0
Dewey's sedge	*Carex deweyana*	0.3	6.7
Grass / Grasslike Total		**61.9**	
Forb			
tufted white prairie aster	*Aster ericoides*	1.8	26.7
common peppergrass	*Lepidium densiflorum*	1.1	40.0
perennial sow thistle	*Sonchus arvensis*	1.0	6.7
small-leaved pussytoes	*Antennaria parvifolia*	0.2	6.7
Forb Total		**4.1**	
Other			
Soil		44.3	93.3
Litter		33.7	100.0
Other Total		**78.0**	

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Sunken Lake (W) – Riparian (continued)

Forage Production

Cage Installation: June 06 2003

Date Clipped: August 22, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	1234.0	93.8	1101.8	83.8
Forb	38.8	14.7	34.6	13.1
Shrub	-	-	-	-
Total Forage	1272.8	86.0	1136.4	76.8
Litter	1225.6	187.9	1094.3	167.8

Uncaged Plots n=5

Grass / Grasslike	834.0	238.3	744.7	212.8
Forb	2.0	1.5	1.8	1.4
Shrub	-	-	-	-
Total Forage	836.0	239.8	746.4	214.1

Forage Utilization at Clipping: 40 %*

* Utilization is measured by percent difference between the uncaged plots and the first five production plots.

Appendix 2. Plant Species Composition and Forage Production of Sites in the Riparian Production Survey.

Site: Toefield Carex Wetland – Riparian

Plant Species Composition

Date: July 10, 2003

		Cover (%)	Freq (%)
Grass / Grasslike			
awned sedge	*Carex atherodes*	38.3	100.0
tall manna grass	*Glyceria grandis*	10.2	60.0
narrow reed grass	*Calamagrostis stricta*	4.2	26.7
Grass / Grasslike Total		**52.7**	
Other			
Litter		88.0	100.0
Other Total		**88.0**	

Forage Production

Cage Installation: June 10, 2003

Date Clipped: August 29, 2003

Caged Plots n=10

	Kg/ha		lb/acre	
Forage Type	**Mean**	**SE**	**Mean**	**SE**
Grass / Grasslike	4974.0	636.9	4441.1	568.7
Forb	29.0	18.5	25.9	16.5
Shrub	-	-	-	-
Total Forage	5003.0	635.8	4467.0	567.7
Litter	5193.2	548.4	4636.9	489.6

No Uncaged Plots

Forage Utilization at Clipping: 0%

Appendix 3. Riparian Production Survey Species List

Common Name	Scientific Name
alfalfa	*Medicago sativa*
alsike clover	*Trifolium hybridum*
aspen	*Populus tremuloides*
aster	*Aster species*
autumn willow	*Salix serissima*
avens	*Geum species*
awned sedge	*Carex atherodes*
balsam poplar	*Populus balsamifera*
Baltic rush	*Juncus balticus*
basket willow	*Salix petiolaris*
bastard toadflax	*Comandra umbellata*
beaked sedge	*Carex utriculata*
beaked willow	*Salix bebbiana*
beard-tongue	*Penstemon species*
bent grass	*Agrostis species*
big-head rush	*Juncus vaseyi*
black medic	*Medicago lupulina*
blue grama	*Bouteloua gracilis*
bog violet	*Viola nephrophylla*
bristly black currant	*Ribes lacustre*
buck-bean	*Menyanthes trifoliata*
buckbrush	*Symphoricarpos occidentalis*
Canada goldenrod	*Solidago canadensis*
Canada thistle	*Cirsium arvense*
cinquefoil	*Potentilla species*
common chickweed	*Stellaria media*
common dandelion	*Taraxacum officinale*
common great bulrush	*Scirpus validus*
common groundsel	*Senecio vulgaris*
common nettle	*Urtica dioica*
common peppergrass	*Lepidium densiflorum*
common plantain	*Plantago major*
common wild rose	*Rosa woodsii*
compact selaginella	*Selaginella densa*
creeping buttercup	*Ranunculus cymbalaria*
creeping spike-rush	*Eleocharis palustris*
crested wheatgrass	*Agropyron pectiniforme*
curled dock	*Rumex crispus*
Dewey's sedge	*Carex deweyana*
early bluegrass	*Poa cusickii*
early yellow locoweed	*Oxytropis sericea*
field horsetail	*Equisetum arvense*
field mouse-ear chickweed	*Cerastium arvense*
fireweed	*Epilobium angustifolium*
fowl bluegrass	*Poa palustris*

Appendix 3. Riparian Production Survey Species List

Common Name	**Scientific Name**
fowl manna grass	*Glyceria striata*
foxtail barley	*Hordeum jubatum*
fringed brome	*Bromus ciliatus*
golden aster	*Heterotheca villosa*
great bulrush	*Scirpus acutus*
green needlegrass	*Stipa viridula*
hair grass	*Agrostis scabra*
hairy wild rye	*Elymus innovatus*
Idaho fescue	*Festuca idahoensis*
june grass	*Koeleria macrantha*
Kentucky bluegrass	*Poa pratensis*
lamb's quarters	*Chenopodium album*
locoweed	*Oxytropis species*
long-stalked chickweed	*Stellaria longipes*
long-styled rush	*Juncus longistylis*
low sedge	*Carex stenophylla*
Macoun's buttercup	*Ranunculus macounii*
marsh aster	*Aster borealis*
marsh marigold	*Caltha palustris*
marsh reed grass	*Calamagrostis canadensis*
meadow horsetail	*Equisetum pratense*
moss phlox	*Phlox hoodii*
mountain willow	*Salix pseudomonticola*
mustard	*Mustard species*
narrow reed grass	*Calamagrostis stricta*
narrow-leaved meadowsweet	*Spiraea alba*
needle-and-thread	*Stipa comata*
Nevada bulrush	*Scirpus nevadensis*
northern bedstraw	*Galium boreale*
northern ragwort	*Senecio streptanthifolius*
northern reed grass	*Calamagrostis inexpansa*
northern water-horehound	*Lycopus uniflorus*
northern wheatgrass	*Agropyron dasystachyum*
Nuttall's alkaligrass	*Puccinellia nuttalliana*
pale persicaria	*Polygonum lapathifolium*
pasture sagewort	*Artemisia frigida*
perennial sow thistle	*Sonchus arvensis*
Philadelphia fleabane	*Erigeron philadelphicus*
pineapple-weed	*Matricaria matricarioides*
plains reed grass	*Calamagrostis montanensis*
plains rough fescue	*Festuca hallii*
porcupine grass	*Stipa curtiseta*
prairie goldenbean	*Thermopsis rhombifolia*
prickly pear cactus	*Opuntia fragilis*
purple milk vetch	*Astragalus dasyglottis*
purple peavine	*Lathyrus venosus*
pussy willow	*Salix discolor*

Appendix 3. Riparian Production Survey Species List

Common Name	**Scientific Name**
quackgrass	*Agropyron repens*
red clover	*Trifolium pratense*
red fescue	*Festuca rubra*
red osier dogwood	*Cornus stolonifera*
redtop	*Agrostis stolonifera*
reed canary grass	*Phalaris arundinacea*
sagebrush	*Artemisia cana*
salt grass	*Distichlis stricta*
sand grass	*Calamovilfa longifolia*
sandbar willow	*Salix exigua*
saskatoon	*Amelanchier alnifolia*
sea milkwort	*Glaux maritima*
seaside arrow-grass	*Triglochin maritima*
showy everlasting	*Antennaria pulcherrima*
Siberian wheatgrass	*Agropyron sibiricum*
silverweed	*Potentilla anserina*
skullcap	*Scutellaria galericulata*
slender rush	*Juncus tenuis*
slender sedge	*Carex lasiocarpa*
slender wheatgrass	*Agropyron trachycaulum*
slough grass	*Beckmannia syzigachne*
small-fruited bulrush	*Scirpus microcarpus*
small-leaved everlasting	*Antennaria parvifolia*
small-leaved pussytoes	*Antennaria parvifolia*
smooth brome	*Bromus inermis*
spike redtop	*Agrostis exarata*
stinkweed	*Thlaspi arvense*
tall manna grass	*Glyceria grandis*
thread-leaved sedge	*Carex filifolia*
three-square rush	*Scirpus pungens*
timothy	*Phleum pratense*
tufted fleabane	*Erigeron caespitosus*
tufted hair grass	*Deschampsia cespitosa*
tufted phlox	*Phlox caespitosa*
tufted white prairie aster	*Aster ericoides*
water avens	*Geum rivale*
water foxtail	*Alopecurus aequalis*
water parsnip	*Sium suave*
water sedge	*Carex aquatilis*
western dock	*Rumex occidentalis*
western meadow rue	*Thalictrum occidentale*
Wheeler's bluegrass	*Poa nervosa*
white Dutch clover	*Trifolium repens*
wild licorice	*Glycyrrhiza lepidota*
wild mint	*Mentha arvensis*
wild red raspberry	*Rubus idaeus*
wild strawberry	*Fragaria virginiana*

Appendix 3. Riparian Production Survey Species List

Common Name	**Scientific Name**
wild vetch	*Vicia americana*
willow	*Salix species*
wormseed mustard	*Erysimum cheiranthoides*
yarrow	*Achillea millefolium*
yellow avens	*Geum macrophyllum*
yellow willow	*Salix lutea*

Appendix 4. Site Photographs of the Riparian Production Survey
Site Name: Amisk Creek (East) - Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Amisk Creek (East) - Upland

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Amisk Creek (East) - Exclosure

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Amisk Creek (West) - Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

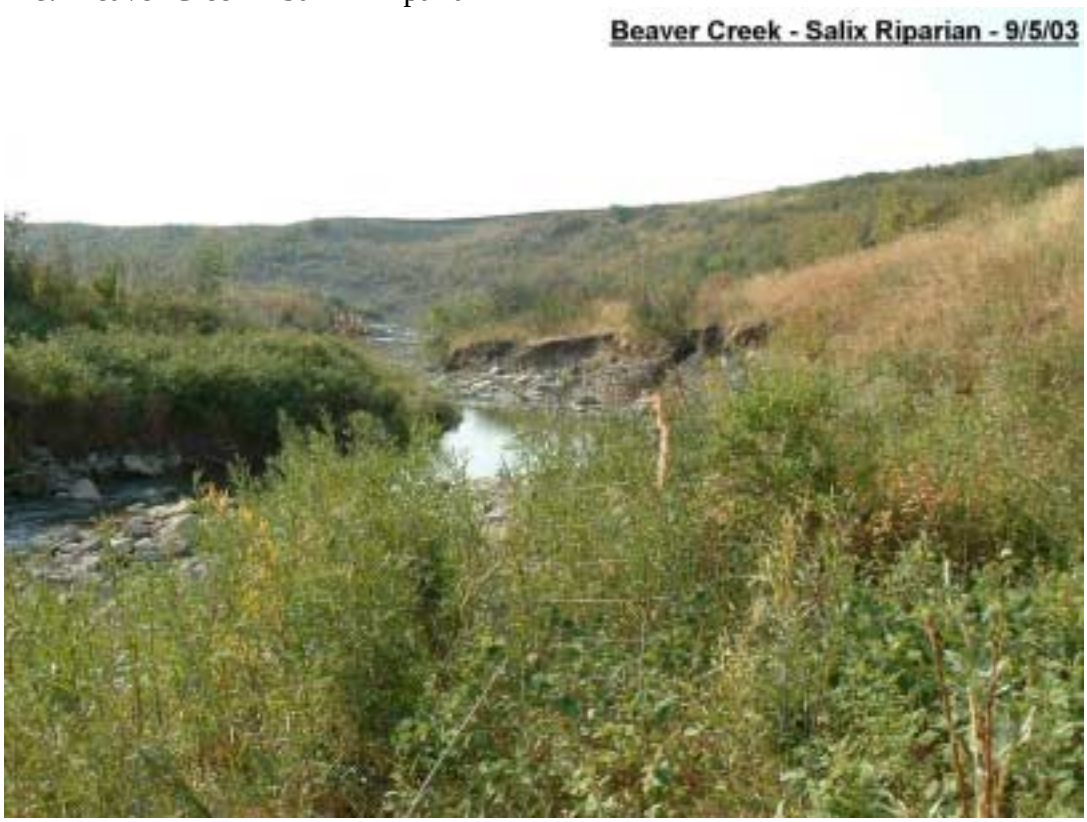
Site Name: Bashaw Shallow Open Water (North)

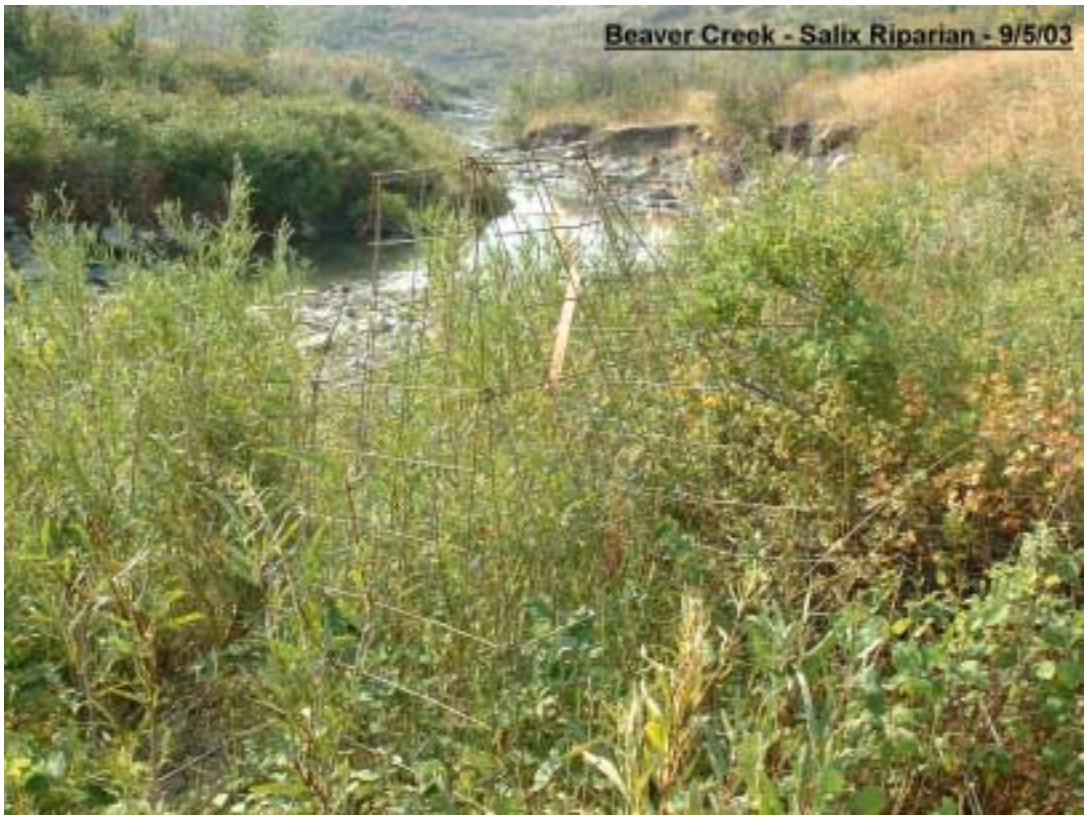
Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Bashaw Shallow Open Water (South)

Appendix 4. Site Photographs of the Riparian Production Survey

Name: Beaver Creek – Salix - Riparian





Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Beaver Creek – Rosa – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Beaver Creek – Upland

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Berry Creek – Riparian

Site Name: Berry Creek – Upland

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Gull Lake – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Gull Lake – Upland

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Gull Lake – Exclosure

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Iron Creek – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Iron Creek – Exclosure Cages

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Ketchamoot Creek – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Medicine River (South) – Riparian 1

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Medicine River (South) – Riparian 2

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Medicine River (South) – Upland

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Medicine River (North) – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Ribstone Creek

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Rosebud River – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Rough Lake – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Sounding Creek – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Strome Carex Wetland – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Sunken Lake – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Toefield Carex Wetland – Riparian

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Vilna Wetland – Control

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Vilna Wetland – Center

Appendix 4. Site Photographs of the Riparian Production Survey

Site Name: Vilna Wetland – White Rock