Fish & Wildlife Division

WILDLIFE CONSERVATION AND BIODIVERSITY SECTION

A Multi-Species Conservation Strategy for Species at Risk in the Milk River Basin:

Year 1 – Progress Report

Alberta Species at Risk Report No. 72

Alberta SUSTAINABLE RESOURCE DEVELOPMENT

A Multi-Species Conservation Strategy for Species at Risk in the Milk River Basin:

Year 1 – Progress Report

Compiled and Edited by

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Maps for the habitat models were prepared by the Sustainable Resource Development Resource Information Unit (RIU) – Prairie Region. Lana Robinson is thanked for allocating staff to this project. Maps were prepared by Oriano Castelli and Vernon Remesz (both of RIU).

The Milk River Basin Species at Risk Conservation Project is a collaborative effort of three agencies and many other participants. It is succeeding because of the co-operative teamwork of all partners. This demonstrates a special open - minded attitude that goes beyond commitment and pride in any one organization, and is indicative of a desire in our society for multi-species and landscape-level conservation.

EXECUTIVE SUMMARY

The Milk River Basin Species at Risk Conservation Strategy outlines a process to provide appropriate management on critical parts of the landscape to achieve multi-species conservation. Included are a summary of existing information on species at risk, identification of data gaps, results of fish and wildlife inventories from within the project area, and a species selection process. Also included are habitat suitability models for project management species, maps showing habitat distribution throughout the Milk River Basin, descriptions of natural processes within the grassland natural region, and a demonstration of beneficial management practices.

The project began as a concept within Alberta's Habitat Stewardship Program committee, and was subsequently designed by Alberta Fish and Wildlife and Alberta Conservation Association biologists. It has been delivered through a concerted effort involving permanent and project staff of Alberta Conservation Association and Alberta Fish and Wildlife Division, plus private biologists in the disciplines of wildlife, fishery, and range science.

Year 1 of the project included several fish and wildlife inventories within the Milk River Basin. Results included range extensions for amphibian and fish species, valuable information on raptor nesting habitat, and critical data on amphibian habitat associations.

Through a species selection process that recognized the importance of habitat structure, ecological tolerances, species assemblages, keystone species, and affiliation with native habitats, several project management species were selected. These species include 7 birds, 5 mammals, 2 reptiles, 2 amphibians, and 1 invertebrate.

Habitat suitability index (HSI) models have been developed for 15 of the 17 project management species, 5 of which are displayed in this report. The models' variables were based upon digital map databases available for the Milk River Basin. This enabled the production of maps showing areas of relative habitat suitability across the Milk River Basin.

A review was carried out of natural processes existing on the landscape, plus a summary of range management systems available, and evaluation of them for application to each species or species group. This resulted in development of "beneficial management practices". The process is described for one example species in this report and will be further expanded for all project management species in year 2.

A multi-species approach to species at risk was designed and initiated in year 1 of the project. Year 2 will concentrate on completion of species inventories, model and map refinement, use of the information for prioritization of the landscape, and stewardship activities.

CHAPTER 1

INTRODUCTION TO THE MILK RIVER BASIN SPECIES AT RISK PROJECT

1.0 INTRODUCTION

Richard W. Quinlan, Alberta Sustainable Resource Development, Fish and Wildlife Division, Lethbridge, AB

All Albertans have an interest in species at risk management. For some, this interest is expressed in a desire for actions to avoid declines or allow recovery of native species. For others, there is a concern that rural economy and lifestyles may be impacted by species at risk initiatives. Management agencies and conservation organizations face a formidable challenge to reconcile differences of perception with respect to species at risk.

Management initiatives have historically concentrated on inventory and conservation of individual species prioritized through species status processes. As more wildlife become categorized as "At Risk", "May be at Risk", and "Sensitive" the challenge of management and recovery becomes greater. In situations where numerous priority species are present on the same landscape the challenge is further confounded by management objectives that may conflict between species. While continued attention is needed for individual species at risk, it is clear that a more innovative approach is needed to meet the multi-species challenge.

The increasing need for conservation of an increasing number of species at risk led to a discussion within the Prairie and Northern Region Habitat Stewardship Committee. That committee, responsible for allocating the Environment Canada Habitat Stewardship Fund, put forth the suggestion that the Milk River Basin may be worthy of consideration for development of a multi-species approach for conservation of species at risk. Planning proceeded coordinated jointly by the Alberta Fish and Wildlife Species at Risk Biologist and the Alberta Conservation Association Wildlife Coordinator (both located in Lethbridge). This led to a Habitat Stewardship Project being approved for initiation in April 2002. The allocation from the Habitat Stewardship Program was supplemented with funds from Alberta Fish and Wildlife Division's species at risk program. In addition, throughout the first year the Alberta Conservation Association and Alberta Fish and Wildlife Division provided considerable in-kind support.

The Milk River Basin Species at Risk Conservation Strategy outlines a process to provide appropriate management on critical parts of the landscape to achieve multi-species conservation. It emphasizes voluntary stewardship activities to achieve conservation of species at risk. The strategy advocates stewardship through participation of residents and conservation groups with an interest in the landscape.

1.1 Goal

The primary goal of the Milk River Basin Species at Risk Project is to develop an effective process to manage multiple species at risk on a defined landscape. The Milk River Basin was chosen because it may contain the highest number of species at risk of any definable landscape in Alberta. The cumulative total of At Risk, May be at Risk, and Sensitive species in the Milk River Basin is approximately 40 species. This, combined with the relatively small size of the drainage basin (6776 sq. km.), led to this landscape being selected for Alberta's first venture into multi-species management of species at risk.

1.2 Objectives

To achieve the goal, a number of specific objectives were identified, they include:

- To summarize existing information for species at risk in the Milk River Basin.
- To identify data gaps and design inventories for those species for which data is lacking.
- To carry out inventories of species at risk for which data is lacking.
- To determine, through a species selection process, priority management species for the project.
- To identify habitat associations of selected management species, and describe these through Habitat Suitability Index (HSI) Models.
- To produce a map of the drainage basin showing relative habitat suitability for each selected management species.
- To identify portions of the drainage basin which are highly important to individual and multiple species at risk (terrestrial and aquatic).
- To discern the natural landscape processes of importance in the Milk River Basin.
- To evaluate range management systems for their relative value in providing habitat for species at risk.
- To develop a summary of beneficial management practices for Milk River Basin species at risk.
- To provide specific conservation and stewardship recommendations for high priority areas of the Milk River Basin.
- To report results of the project to Milk River Basin communities and conservation groups with an interest in the Milk River Basin.
- To facilitate partnerships to achieve conservation of species at risk through voluntary stewardship actions.

1.3 General Overview of Process

A general overview of the process employed in the Milk River Basin Species at Risk Conservation Strategy is provided here. It is not a thorough description of project methodology. Detailed descriptions of methods are included in several other chapters in this report.

In April 2002 the scoping phase of the project was carried out to determine occurrences and distribution of approximately 40 species at risk (At Risk, May be at Risk, Sensitive) within the Milk River Basin. This exercise was followed by a review to determine data gaps for both species and portions of the landscape. From this stage a prioritization of required wildlife surveys was developed and scheduled according to available resources. Several of these inventories were completed in the spring and summer of 2002. Results were used to better understand species distribution and habitat associations. A species selection process was developed that resulted in 17 project management species for which habitat models are being prepared. Variables used to describe habitat were based on data available in electronic map bases. This led to creation of maps showing relative habitat values for the species throughout the basin.

The fisheries component of the project included completion of a Milk River fish inventory that had been initiated in 2001. In addition to this mainstem river inventory a survey of tributaries was started in 2002 to determine areas of particular importance in providing drought refugia for fish and other aquatic species. Fish refugia will be mapped and identified as areas of high habitat value on the landscape.

While the inventory, modelling and mapping initiatives were underway, a review was also being carried out of natural processes on the landscape and current range management systems. A compilation of "beneficial management practices" for the project management species was initiated. The resultant increased understanding of species distribution and habitat associations, combined with improved knowledge of appropriate management, will allow for conservation and stewardship options to be presented in year 2 of the project. These will be developed through partnerships between the project managers, local communities and conservation organizations, and will be based on cooperative voluntary approaches.

2.0 STUDY AREA: THE MILK RIVER BASIN

Brad N. Taylor and Brad A. Downey, Alberta Conservation Association, Lethbridge, AB

2.1 General

The study area was defined by the Milk River Basin (Figure 1.0) in southern Alberta, Canada. The basin is approximately 6,776 km^2 in size and the boundaries extend north from the United States border along the Saskatchewan border to Cypress Hills Provincial Park and west from the Saskatchewan border to Whiskey Gap, just east of Cardston.

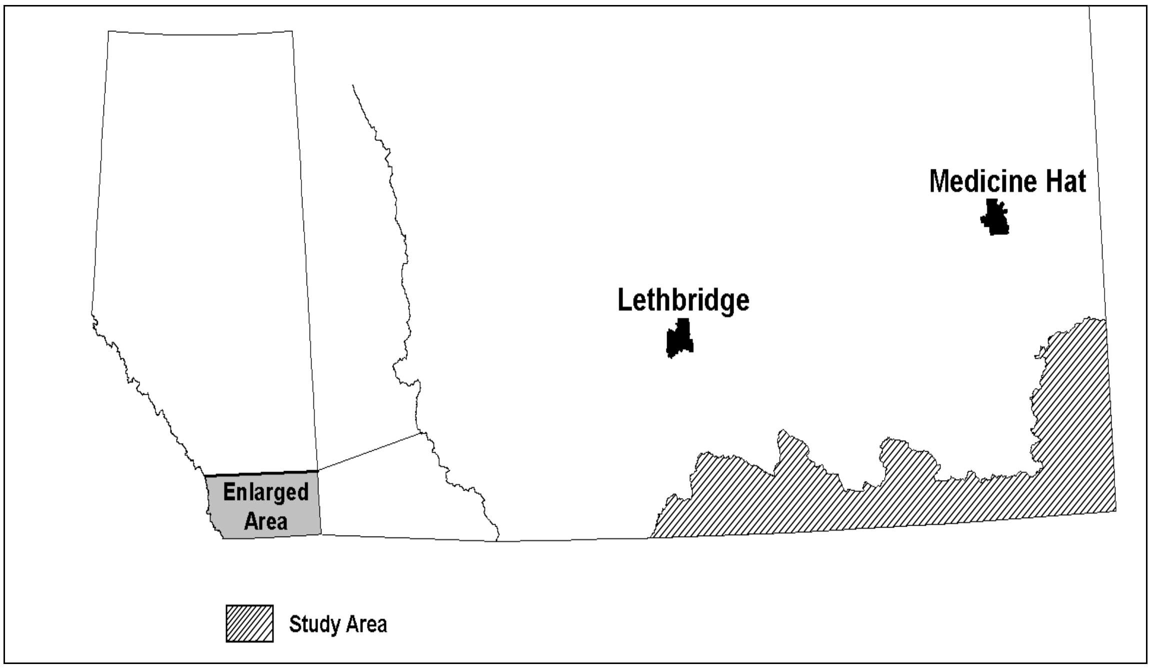

Figure 1.0 Milk River basin study area

2.2 Milk River

The Milk River Basin is unique to Alberta, in that it is part of the Mississippi Watershed flowing into the Gulf of Mexico. Within Alberta, it is made up of the North Milk and Milk rivers. The two forks join approximately 20 km west of the town of Milk River. The North Milk River is approximately 90 km in length, while the Milk River is approximately 271 km long (Clayton and Ash 1980). Some of the main tributaries to the Milk River include: Red Creek, Lodge Creek, Sage Creek, Shanks Creek, MacDonald Creek, Deer Creek, Bear Creek, Police Creek, Lonely Valley Creek, and Lost River.

2.3 Topography

Badlands, plains, uplands, and valleys are all components of the basin. Badlands are evident primarily in the downstream section near Lost River and are characterized by steep slopes and heavily eroded areas. Gently undulating plains primarily occur in the north east corner of the basin south of Cypress Hills Provincial Park and in the west central portion of the drainage surrounding the town of Milk River. Uplands habitat, characterized by rolling hills, occurs in the south central portion of the drainage as an effect of the Sweet Grass Buttes in Montana and in the north west corner along the Milk River Ridge. Valleys are limited to the area surrounding the

Milk River and its tributaries. Many areas along the valleys contain eroded sandstone cliffs and hoodoos. This is particularly evident in the Writing-on-Stone Provincial Park area.

2.4 Vegetation

The Milk River Basin is located within the Grassland Natural Region and contains areas of the Dry Mixed Grass, Mixed Grass, and Foothills Fescue subregions (Achuff 1994). The dry mixed grass ecoregion encompasses the largest area within the drainage and is characterized by both short grasses, such as blue grama *(Bouteloua gracilis),* and mid-grasses including western wheat grass *(Agropyron smithii)*, June grass *(Koeleria macrantha)*, and spear grass *(Stipa spp.)*. The mixed grass ecoregion is only found in the north east corner of the basin near the Cypress Hills and in the south central area north of the Sweet Grass Buttes. It contains similar vegetation as the dry mixed grass subregion however, more western porcupine grass *(Stipa curtiseta)* and northern wheat grass *(Agropyron dasystachyum)* are found in this ecoregion resulting from the slightly moister and cooler climate. The fescue ecoregion makes up a small percentage of the basin's total area. This ecoregion is found in the western part of the basin and is dominated by grasses such as rough fescue *(Festuca scabrella),* Idaho fescue *(Festuca idahoensis),* Parry's oatgrass *(Danthonia parryi)* and intermediate oatgrass *(Danthonia intermedia)*. Differences in vegetative communities are representative of differences in soils and climate (Achuff 1994).

Most of the shrubs and trees found in the study area are natural communities of thorny buffaloberry *(Shepherdia argentea)*, willow *(Salix spp.),* and cottonwoods *(Populus spp.)* scattered along the riparian zones and valley draws in the basin. Silver sagebrush (*Artemesia cana*) is also prevalent throughout the basin and particularly extensive in the southeast corner of the basin. Other shrub species found in the basin include rose *(Rosa spp.),* buckbrush *(Symphoricarpos occidentalis),* saskatoon *(Amelanchier alnifolia),* chokecherry *(Prunus virginiana),* and skunkbrush *(Rhus trilobata).*

Numerous forb species are present throughout the basin, two of which are of particular interest, western blue flag (*Iris missouriensis*) and soapweed (*Yucca glauca*). Both species are restricted to the Milk River Basin in southern Alberta.

Introduced species, such as common caragana *(Caragana arborescens),* Manitoba maple (*Acer negundo*), Russian olive *(Elaeagnus angustifolia),* and Siberian elm *(Ulmus rubra)* are found primarily in shelterbelts and hedgerow plantings within fields or around active or abandoned farmyards. Russian olive is becoming a concern in areas where it is found in riparian zones. Other weedy species such as spotted knapweed (*Centaurea maculosa*) and yellow toadflax (*Linaria vulgaris*) are beginning to appear in the western portion of the basin (M. Uchikura, pers. comm).

2.5 Land Use

The study area is sparsely populated with only two towns, Milk River and Coutts, and the small community of Del Bonita located within its boundaries. The primary land use in the Milk River Basin is cattle grazing. Three large provincial grazing reserves (Pinhorn, Sage Creek, and Twin River), an Agriculture and Agri-food Canada research substation (Onefour), as well as numerous grazing leases preserve some of the natural grasslands. Roughly 30 percent of the basin is cultivated and this activity is primarily centered around the town of Milk River. Oil and gas activity is present throughout the basin. Several important ecological areas also occur within the study area including: Writing-on-Stone Provincial Park, portions of Cypress Hills Provincial Park, the Milk River Natural Area, and Kennedy Coulee Ecological Reserve.

3.0 Literature Cited

Achuff, P.L. 1994. Natural regions, subregions and natural history themes of Alberta: a classification for protected areas management (revised December 1994). Prepared for Alberta Environmental Protection, Parks Services. 72 pp.

Clayton, T.D. and G.R. Ash. 1980. A fisheries overview of the Milk River Basin. Prepared for Alberta Evironment, Planning Division, Edmonton, AB. 93 pp + app.

4.0 PERSONAL COMMUNICATIONS

Uchikura, M. Riparian Resource Technician, Alberta Riparian Habitat Management Program, Lethbridge, AB.

5.0 SUMMARY OF SPECIES AT RISK WITHIN THE MILK RIVER BASIN

Brad A. Downey, Alberta Conservation Association, Lethbridge, AB

The Milk River basin contains a diversity of “At Risk,” “May Be At Risk,” and “Sensitive” species. The following data highlights 46 species that could occur in the basin and indicates the species general status in Alberta (Tables 1.1, 1.2, 1.3, and 1.4). For the species that are known to occur within the basin, the number observed and the last confirmed sightings within the basin based on surveys from 2002 and the Biodiversity/ Species Observation Database (BSOD) are provided. A map showing the general distribution of species at risk within the Milk River Basin (mammals, birds, and herptiles) is provided in Appendix T. The fish distribution map for each species listed can be found in the Fisheries section of the report (Chapter 2). The species highlighted in grey had active surveys conducted for them within the basin in 2002.

Table 1.1 Birds

Species	Species code	General status in Alberta	Number of sightings within basin	Last confirmed sighting within basin
American White Pelican	AWPE	Sensitive	4	2002
Baird’s Sparrow	BDSP	Sensitive	5	2002
Black-crowned Night Heron	BCNH	Sensitive	0	-
Black-necked Stilt	BNST	Sensitive	1	2002
Black Tern	BLTE	Sensitive	0	-
Burrowing Owl	BUOW	At Risk	133	2001
Caspian Tern	CATE	Sensitive	0	-
Ferruginous Hawk	FEHA	At Risk	188	2002
Forster’s Tern	FOTE	Sensitive	0	-
Golden Eagle	GOEA	Sensitive	310	2002
Great Blue Heron	GBLH	Sensitive	5	2002
Loggerhead Shrike	LOSH	Sensitive	79	2002
Long-billed Curlews	LBCU	May Be At Risk	349	2002
Mountain Plover	MTPL	Sensitive	22	2001
Peregrine Falcon	PEFA	At Risk	5	1984
Piping Plover	PIPL	At Risk	1	1976
Prairie Falcon	PRFA	Sensitive	169	2002
Sage Grouse	SAGR	At Risk	301	2002
Sharp-tailed Grouse	STGR	Sensitive	630	2002
Short-eared owl	SEOW	May Be At Risk	17	2001
Sprague’s Pipit	SPPI	Sensitive	147	2002
Swainson’s Hawk	SWHA	Sensitive	152	2002
Upland Sandpiper	UPSA	Sensitive	12	2002
Western Grebe	WEGR	Sensitive	0	-
White-faced Ibis	WFIB	Sensitive	0	-

Table 1.2 Fish

Species	Species code	General status in Alberta	Number of sites within the basin where the species were caught	Last confirmed sighting within basin
Brassy Minnow	BRMN	Undetermined	8	2002
Sauger	SAUG	Sensitive	17	2002
Shorthead Sculpin	SHSC	May Be At Risk	35	2002
Stonecat	STON	Undetermined	17	2002
Western Silvery Minnow	WSMN	May Be At Risk	14	2002

Table 1.3 Herptiles

Species	Species code	General status in Alberta	Number of sightings within basin	Last confirmed sighting within basin
Bullsnake	BULL	Sensitive	8	2002
Great Plains Toad	GPTO	May Be At Risk	31	2002
Northern Leopard Frog	NLFR	At Risk	201	2002
Plains Hog-nosed Snake	PHSN	May Be At Risk	2	1980
Plains Spadefoot	PLSP	May Be At Risk	302	2002
Prairie Rattlesnake	PRRA	May Be At Risk	42	2002
Red-sided Garter Snake	RSGS	Sensitive	0	-
Short-horned Lizard	ESHL	May Be At Risk	119	2002
Wandering Garter Snake	WGSN	Sensitive	2	1998
Western Plains Garter Snake	WPGS	Sensitive	1	1992
Western Painted Turtle	WPTU	Sensitive	3	1994

Table 1.4 Mammals

Species	Species code	General status in Alberta	Number of sightings within basin	Last confirmed sighting within basin
American Badger	BADG	Sensitive	22	2002
Long-tailed weasel	LTWE	May Be At Risk	4	2001
Olive-backed Pocket Mouse	OBPM	Sensitive	0	-
Swift Fox	SWFO	At Risk	498	2002
Western Small-footed Myotis (Bat)	WSFB	Sensitive	1	1988

CHAPTER 2

FISH AND WILDLIFE INVENTORIES

PART 1 - MILK RIVER BASIN FISHERIES PROJECT

Terry B. Clayton, Alberta Sustainable Resource Development, Fish and Wildlife Division, Lethbridge, AB

1.0 OVERVIEW

The Milk River Basin Fisheries Project is divided into three sections. Section one is an overview of fish distribution in the Milk River basin, based on collections made from 1979 to 2002. Section two provides the results of fish collections from Milk River tributaries in 2002 completed by Alberta Fish and Wildlife and Alberta Conservation Association staff. The third section is a report submitted by P&E Environmental Consultants Ltd. on fish collections from the mainstem Milk River in 2002.

The purpose of providing the overview is so that the reader will have, in one volume, the distribution maps for the fishes of the Milk River in Alberta. The data from fish collections undertaken from 1979 to 2002 are housed in the Fisheries Management Information System (FMIS), which is stored on computers located in Edmonton. The collections include those done by Clayton and Ash (1980), RL&L Environmental Services Ltd. (1987, 2001, 2002), and P&E Environmental Consultants Ltd. (2002). It also includes the data returns from fish research licences issued since 1990, and any collections done by Alberta Fish and Wildlife staff. A listing of fish species captured in the Milk River since 1979 is listed in Table 2.1.1.

Table 2.1.1. Common and scientific names, species codes, and status for fish species collected from the Milk River basin, 1979-2002 (from Mackay *et al.* 1990)

Common Name	Code	Scientific Name	Alberta Status[a]
Sportfish Species			
sauger	SAUG	*Stizostedion canadense*	Sensitive
stonecat	STON	*Noturus flavus*	Undetermined
northern pike	NRPK	*Esox lucius*	Secure
mountain whitefish	MNWH	*Prosopium williamsoni*	Secure
burbot	BURB	*Lota lota*	Secure
Non-sportfish Species			
shorthead sculpin	SHSC	*Cottus confusus*	May be at Risk
western silvery minnow	WSMN	*Hybognathus argyritis*	May be at Risk
brassy minnow	BRMN	*Hybognathus hankinsoni*	Undetermined
fathead minnow	FTMN	*Pimephales promelas*	Secure
flathead chub	FLCH	*Hybopsis gracilis*	Secure
lake chub	LKCH	*Couesius plumbeus*	Secure
longnose dace	LNDC	*Rhinichthys cataractae*	Secure
northern redbelly dace	NRDC	*Phoxinus eos*	Sensitive
Iowa darter	IWDR	*Etheostoma exile*	Secure
brook stickleback	BRST	*Culaea inconstans*	Secure
trout-perch	TRPR	*Percopsis omiscomaycus*	Secure

longnose sucker	LNSC	*Catostomus catostomus*	Secure
mountain sucker	MNSC	*Catostomus platyrhynchus*	Secure
white sucker	WHSC	*Catostomus commersoni*	Secure

[a] – modified from The General Status of Alberta Wild Species 2000 (Alberta Sustainable Resource Development 2001)

1.1 Fish Species Distributions

Figure 2.1.1 shows the locations of sampled waterbodies within the Milk River basin. It also includes the approximate distance upstream from the eastern International Boundary crossing (km 0). For the North Milk River, km 0 is classed as the confluence of the North Milk and Milk rivers.

1.1.1 Sauger

Nelson and Paetz (1992) list sauger as occurring in the Milk, South and North Saskatchewan, and Red Deer Rivers in Alberta. Within the Milk River basin, sauger only occur in the mainstem Milk and North Milk rivers. Sauger have been collected from the confluence area of the North Milk and Milk rivers downstream to the eastern International Boundary crossing (Figure 2.1.2).

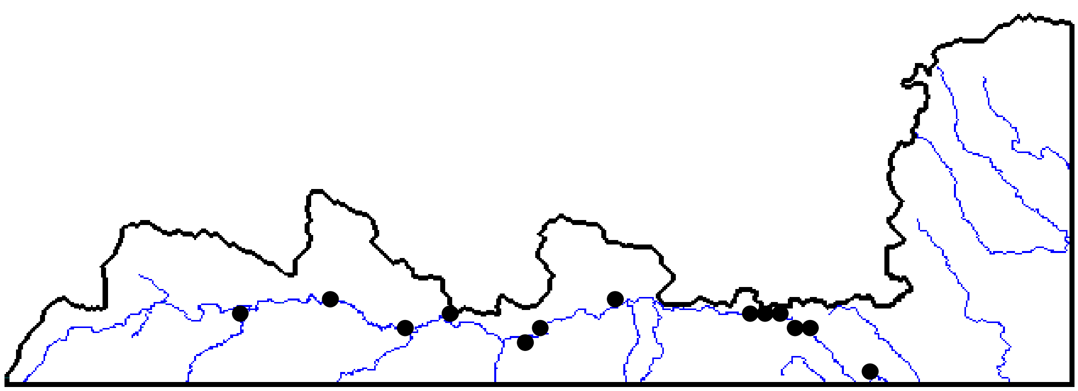

Figure 2.1.2 Sauger distribution in the Milk River basin, 1979-2002

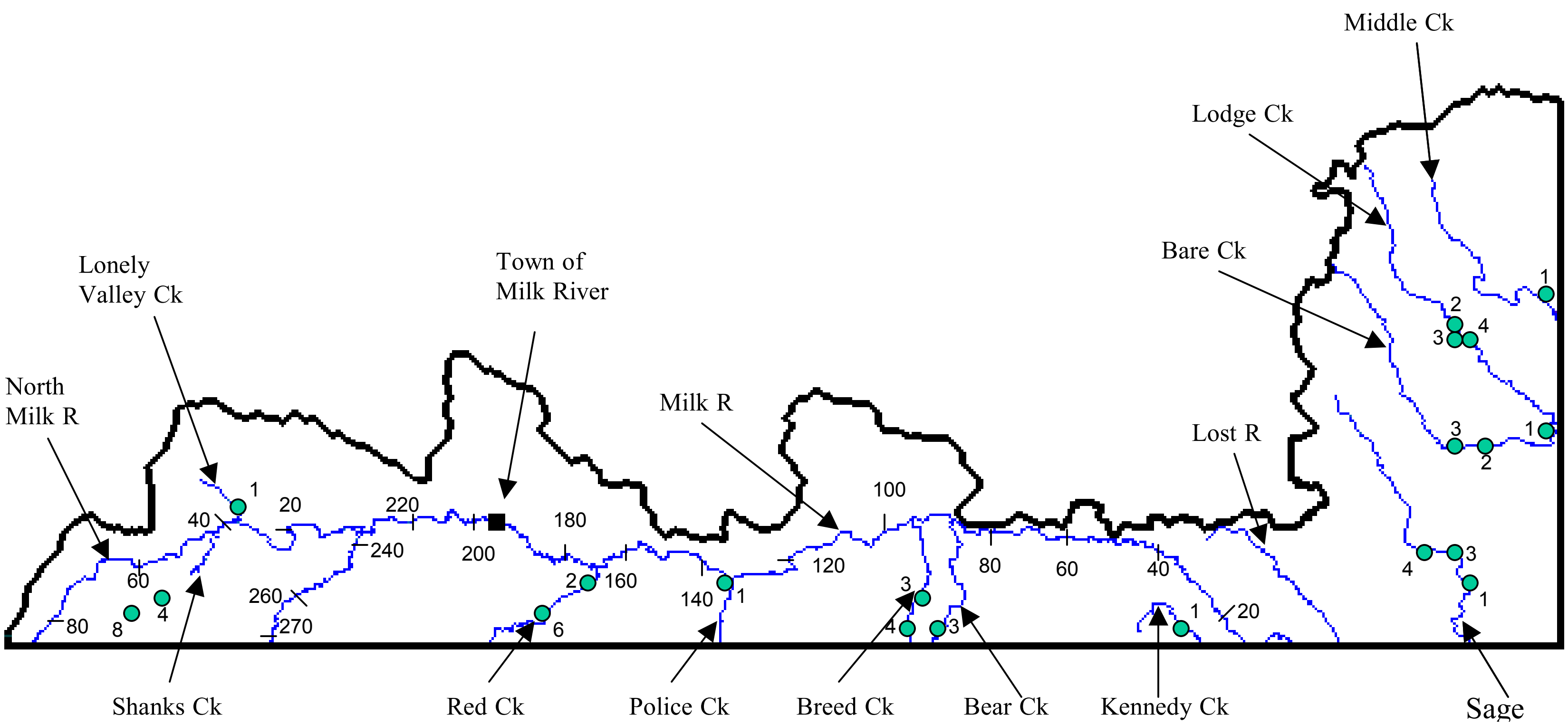

Figure 2.1.1 Location of waterbodies and sites sampled on tributaries in the Milk River basin

1.1.2 Stonecat

Stonecat are a member of the catfish family and within Alberta they only occur in the Milk River basin. Their distribution within the basin is restricted to the mainstem Milk and North Milk Rivers (Figure 2.1.3). Data records indicate that stonecat have been collected as far upstream as the Lonely Valley Creek confluence with the North Milk River, and as far downstream as the Pinhorn Ranch area (km 60). It is likely they also occur in the lowermost 60 kilometres of the Milk River in Alberta.

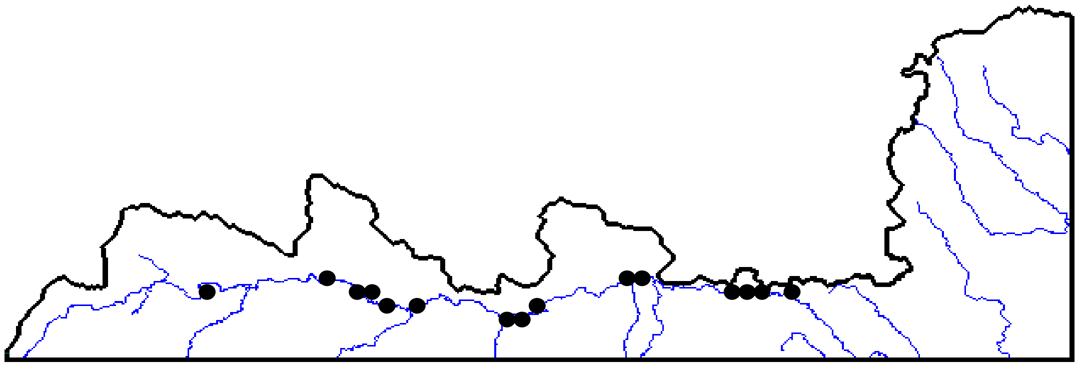

Figure 2.1.3 Stonecat distribution in the Milk River basin, 1979-2002

1.1.3 Northern Pike

Northern pike have a widespread distribution throughout Alberta. They have been captured in the Milk and North Milk rivers (Figure 2.1.4), and in lower Lonely Valley Creek. Northern pike have been stocked into Shanks Lake.

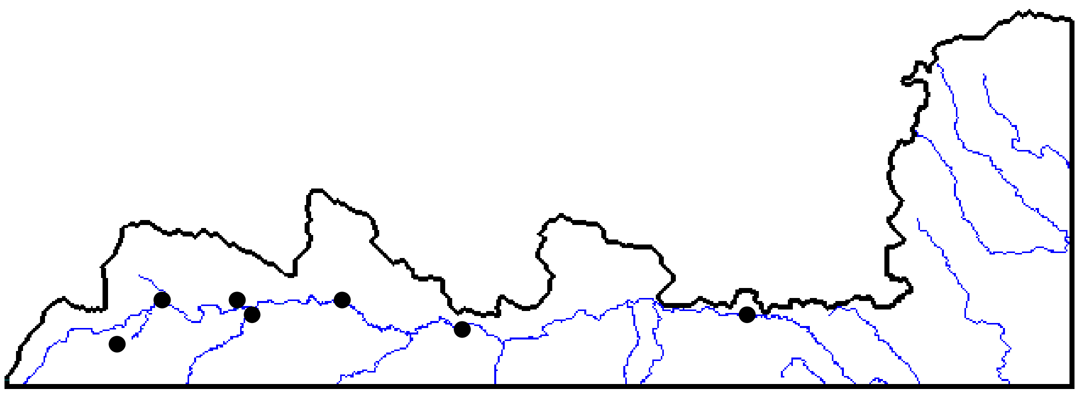

Figure 2.1.4 Northern pike distribution in the Milk River basin, 1979-2002

1.1.4 Mountain Whitefish

This species is common in eastern slope streams of Alberta. Mountain whitefish occur in the North Milk River and in the mainstem Milk River, as far downstream as the Town of Milk River (Figure 2.1.5). Summer water temperatures likely limit the downstream extent for this species in the basin.

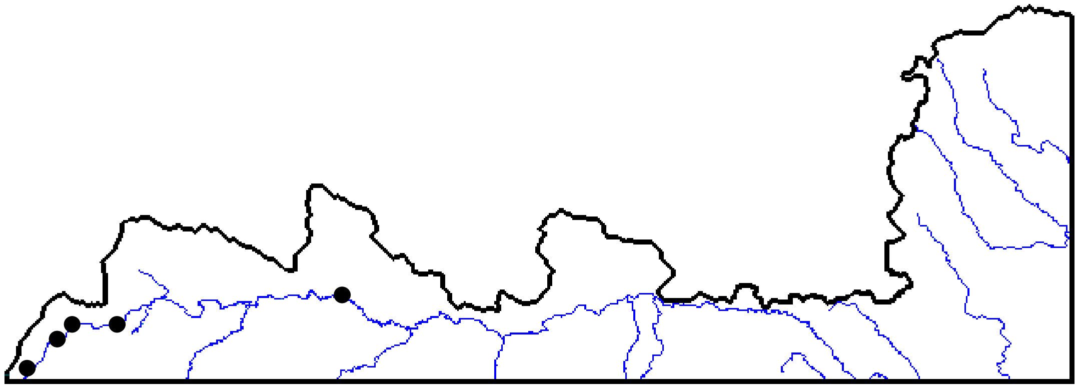

Figure 2.1.5 Mountain whitefish distribution in the Milk River basin, 1979-2002

1.1.5 Burbot

Burbot are ubiquitous in Alberta, with the exception of streams in the Rocky Mountains (Nelson and Paetz 1992). They have been collected from the mainstem Milk River (Figure 2.1.6), but have not been captured in any of the tributaries, including the North Milk River.

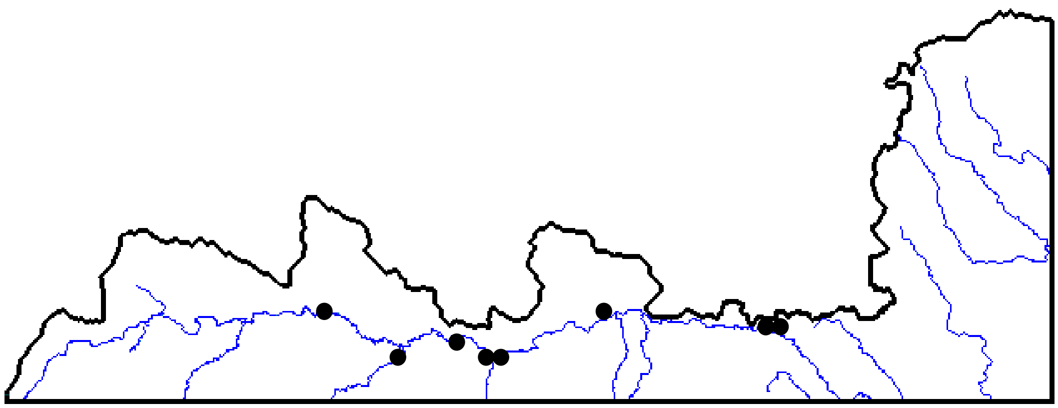

Figure 2.1.6 Burbot distribution in the Milk River basin, 1979-2002

1.1.6 Shorthead (St. Mary) Sculpin

The taxonomic status of the sculpin species inhabiting the Milk River is unresolved at this time. It has at various times been classified as the shorthead sculpin (*Cottus confusus*) or mottled sculpin (*Cottus bairdi*), although recent genetic findings suggest that it may be an unrecognized taxon (Alberta Sustainable Resource Development, in prep.). In Alberta, the shorthead sculpin occurs in the Milk River drainage and in the St. Mary River above the St. Mary Dam. Within the Milk River basin, this sculpin occurs in the North Milk River and the mainstem Milk. The downstream extent of where it has been captured since 1979 is in the Deer Creek area, which is downstream of Writing-on-Stone Provincial Park (Figure 2.1.7). The species of sculpin found in the South Saskatchewan drainage, including the St. Mary River below the dam, is the spoonhead sculpin (*Cottus ricei*).

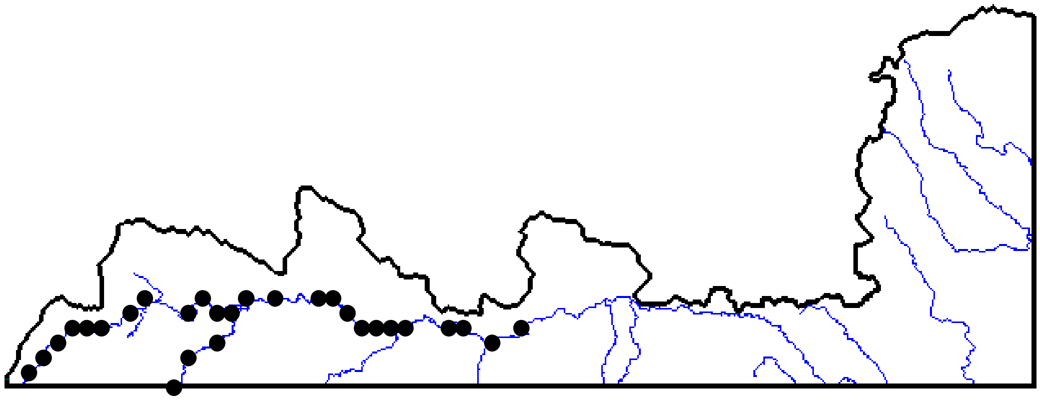

Figure 2.1.7 Shorthead sculpin distribution in the Milk River basin, 1979-2002

1.1.7 Western Silvery Minnow

This species only occurs in the mainstem Milk River in Alberta, and this is the only river system in Canada in which it occurs. The upstream extent of captures has been in the Milk River confluence with Police Creek (Figure 2.1.8), and it occurs downstream to the eastern International Border crossing. In Montana, the western silvery minnow is found in the Milk River above Fresno Reservoir (Stash 2001), but not in Fresno Reservoir itself (K. Gilge, pers. comm.).

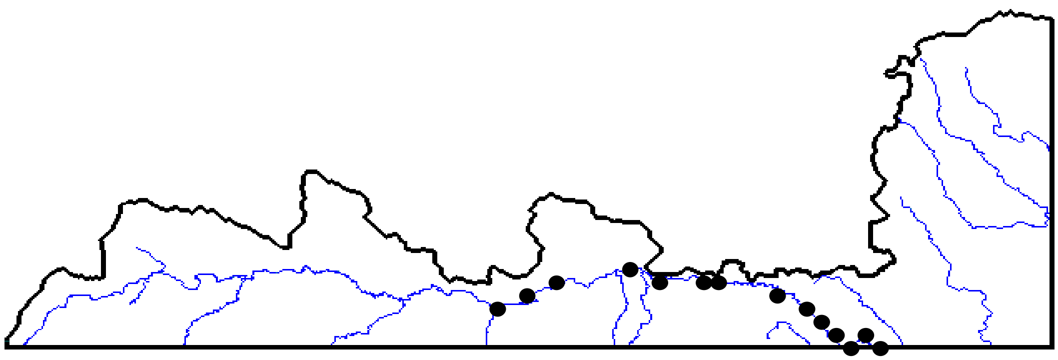

Figure 2.1.8 Western silvery minnow distribution in the Milk River basin, 1979-2002

1.1.8 Brassy Minnow

The brassy minnow has a sporadic distribution in Alberta. It occurs in Musreau Lake near Grande Prairie (T. Ripley, pers. comm.), the Athabasca River drainage in the Ft. McMurray area (L. Rhude, pers. comm.), and in the Milk River basin. Since 1979, it has been captured in the Milk River, and Lodge, Red, and Kennedy Creeks (Figure 2.1.9). Willock (1969) reported that brassy minnow occurred in the Lost River at one time.

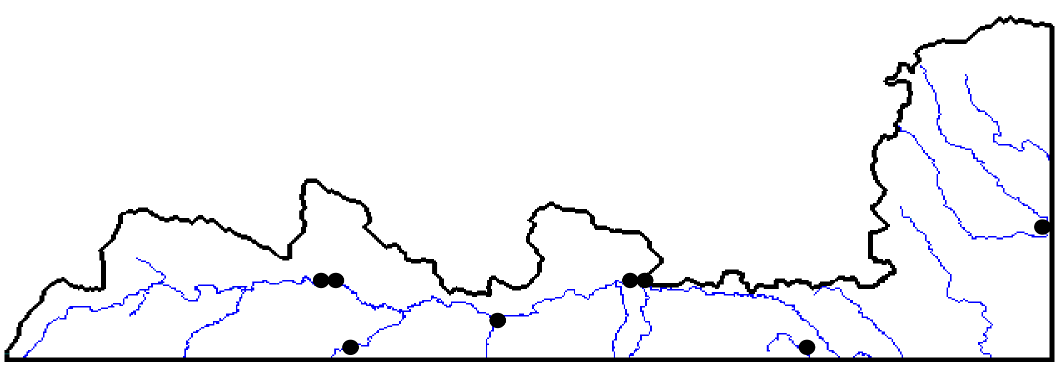

Figure 2.1.9 Brassy minnow distribution in the Milk River basin, 1979-2002

1.1.9 Fathead Minnow

The fathead minnow is a common species in most of the major drainages of Alberta; the exception to this is the Peace River basin (Nelson and Paetz 1992). Within the Milk River basin, fathead minnow have been captured in the Milk and North Milk rivers, and in Red, Kennedy, Sage, Bare, Lodge, and Middle Creeks (Figure 2.1.10).

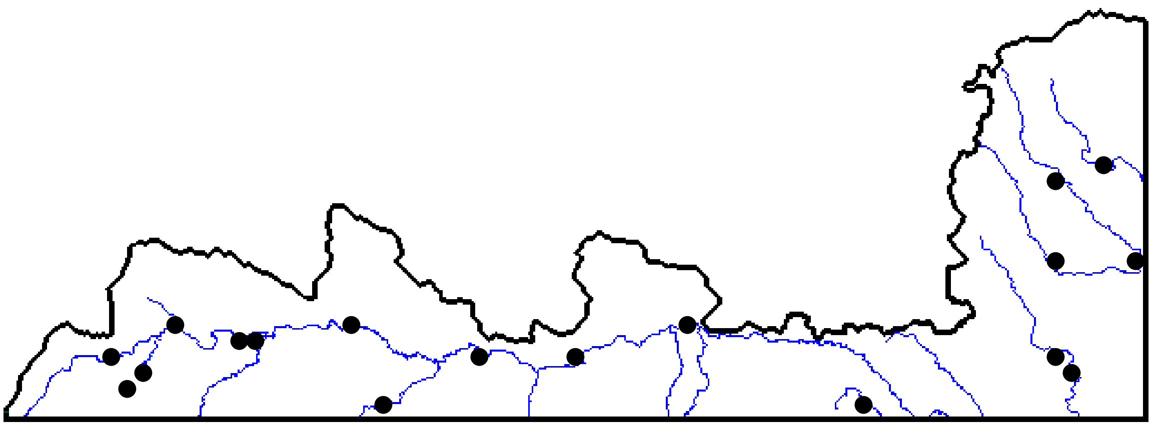

Figure 2.1.10 Fathead minnow distribution in the Milk River basin, 1979-2002

1.1.10 Flathead Chub

Flathead chub occur in the mainstems of large, usually turbid rivers. In Alberta, they are found in the Peace, Athabasca, North Saskatchewan, Red Deer, South Saskatchewan, and Milk River drainages (Nelson and Paetz 1992). Within the Milk River basin, they have been collected in the mainstem Milk and North Milk rivers (Figure 2.1.11).

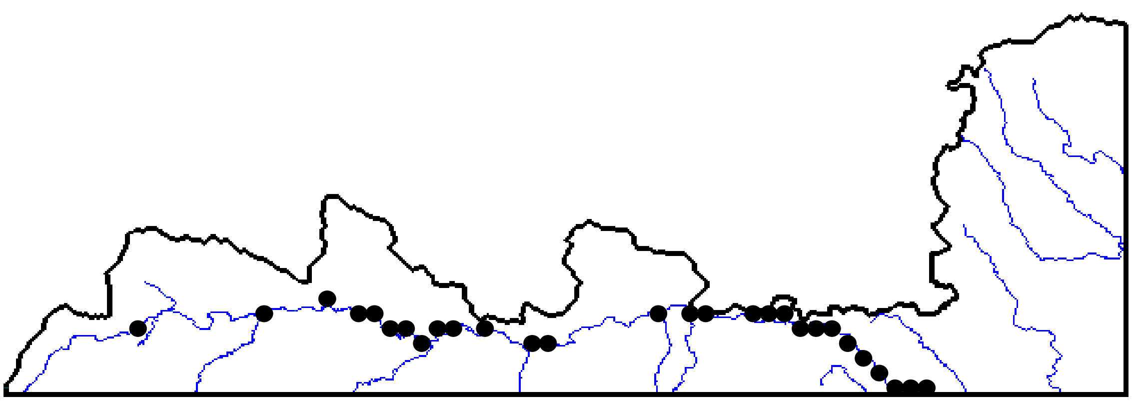

Figure 2.1.11 Flathead chub distribution in the Milk River basin, 1979-2002

1.1.11 Lake Chub

Lake chub occur in waterbodies throughout Alberta. They have been collected since 1979 in the Milk and North Milk rivers, and in Shanks, Red, Breed, Bear, Kennedy, Sage, Bare, and Lodge Creeks (Figure 2.1.12).

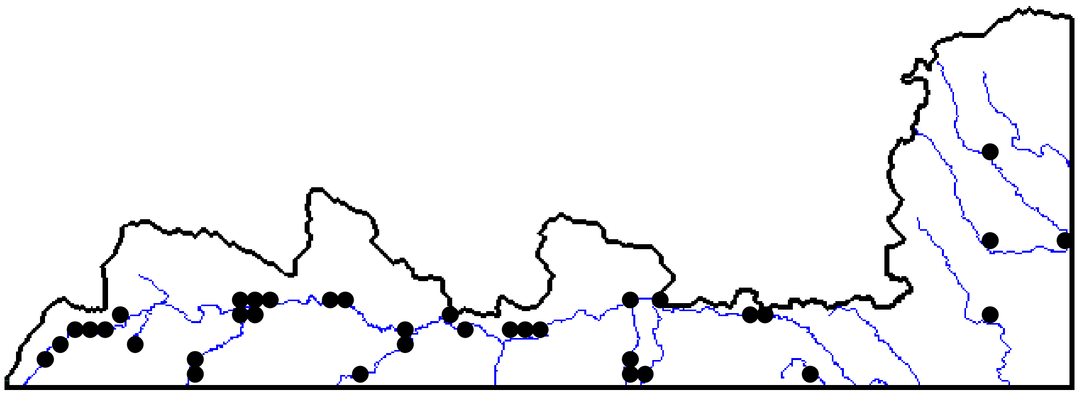

Figure 2.1.12 Lake chub distribution in the Milk River basin, 1979-2002

1.1.12 Longnose Dace

Longnose dace are a common component of the fish assemblage in many of Alberta's streams and rivers. Within the Milk River basin, they have been collected at many sites from the western International Boundary crossing on the North Milk River to the eastern International Boundary crossing on the mainstem Milk (Figure 2.1.13). They also have been collected from Breed and Lodge Creeks.

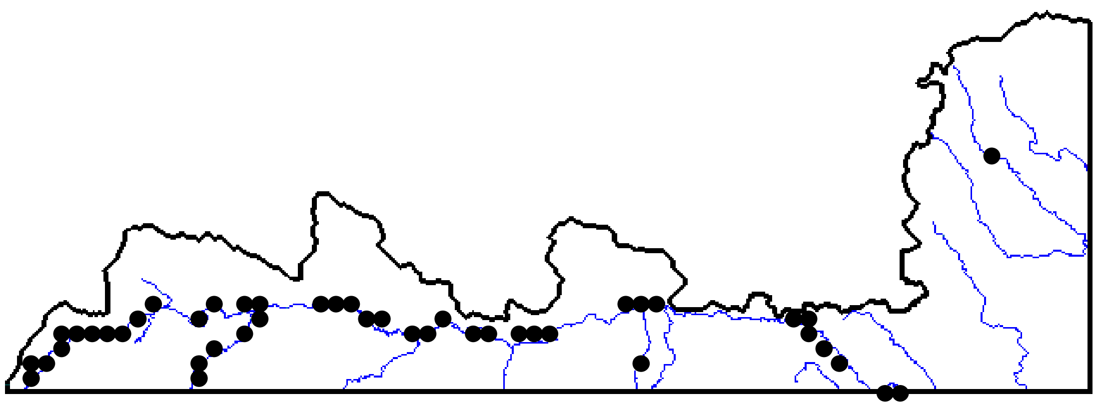

Figure 2.1.13 Longnose dace distribution in the Milk River basin, 1979-2002

1.1.13 Northern Redbelly Dace

The northern redbelly dace has a scattered distribution in Alberta. Within the Milk River basin, this species was collected in the North Milk River, and Red, Lodge and Middle Creeks (Figure 2.1.14).

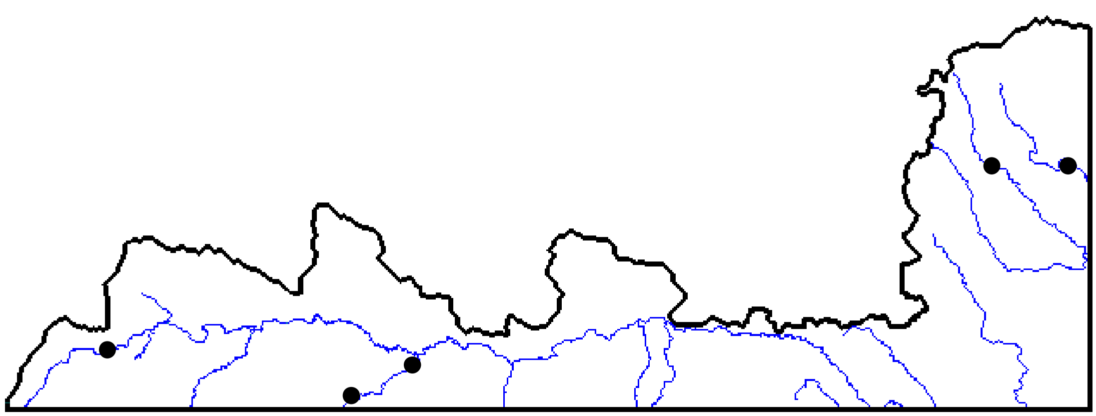

Figure 2.1.14 Northern redbelly dace distribution in the Milk River basin, 1979-2002

1.1.14 Iowa Darter

This small member of the perch family occurs in smaller streams in most of the drainages in Alberta (Nelson and Paetz 1992). Within the Milk River basin, the records since 1979 indicate Iowa darter have been collected in Kennedy and Breed Creeks (Figure 2.1.15).

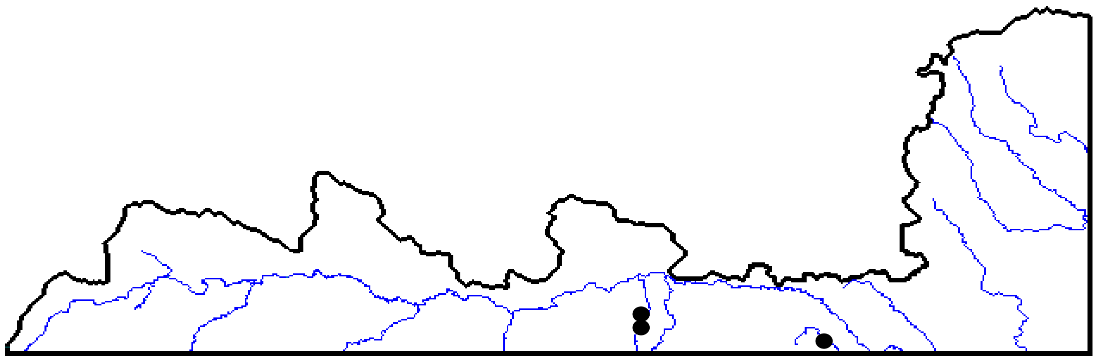

Figure 2.1.15 Iowa darter distribution in the Milk River basin, 1979-2002

1.1.15 Brook Stickleback

Brook stickleback are common throughout Alberta. Within the Milk River basin, they have been caught in the mainstem Milk River, and in Red, Lodge, Bare, and Middle Creeks (Figure 2.1.16).

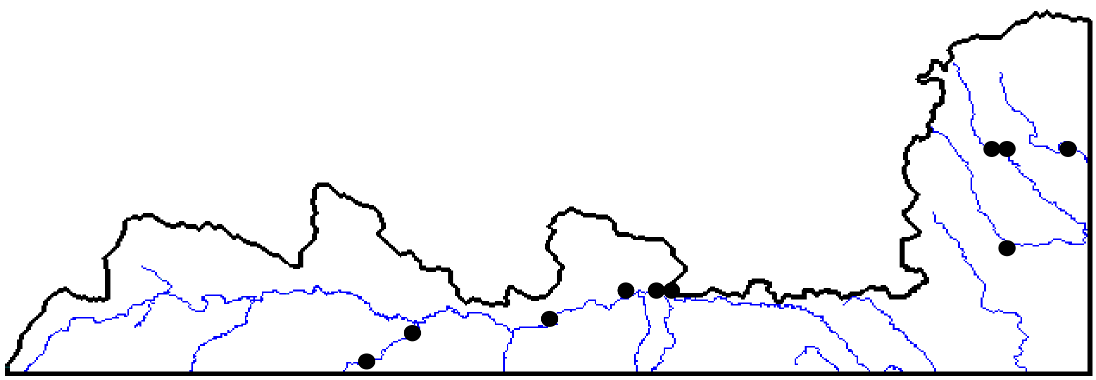

Figure 2.1.16 Brook stickleback distribution in the Milk River basin, 1979-2002

1.1.16 Trout-perch

This species is found in every drainage system in Alberta. They are, however, a very recent addition to the fish fauna of the Milk River drainage (Figure 2.1.17). Trout-perch began to appear in fisheries collections around 2000, even though extensive collections had been done prior to then. Trout-perch had been collected in the St. Mary River system in Alberta prior to 2000, although their distribution and abundance above the St. Mary Dam is unclear due to very few small fish collections being conducted. They are common in Lower St. Mary Lake and in the St. Mary River near the canal headworks near Babb, MT (Jim Mogen, pers. comm.). Therefore, it is likely that the trout-perch in the Milk River originated from St. Mary drainage stock, although it is possible they were introduced by an angler's bait bucket.

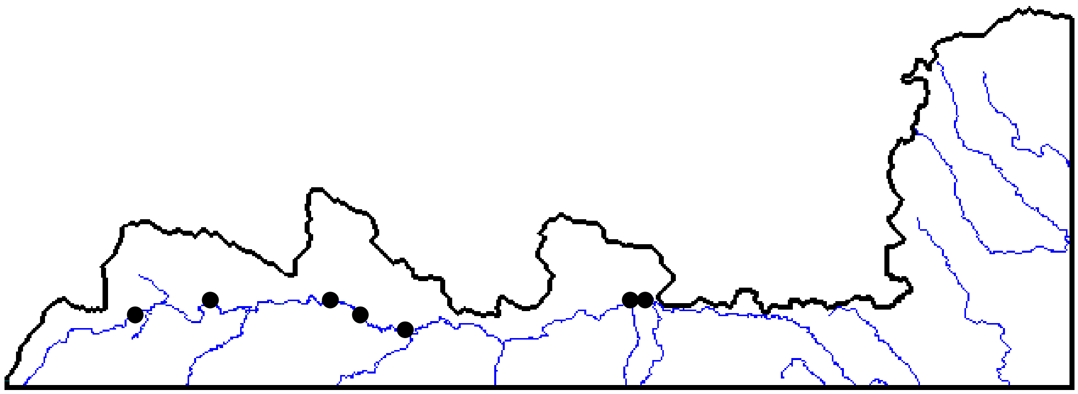

Figure 2.1.17 Trout-perch distribution in the Milk River basin, 1979-2002

1.1.17 Longnose Sucker

Longnose suckers are a common species throughout Alberta. Within the Milk River basin, they have been captured in the North Milk and Milk rivers, and in Red and Breed Creeks (Figure 2.1.18).

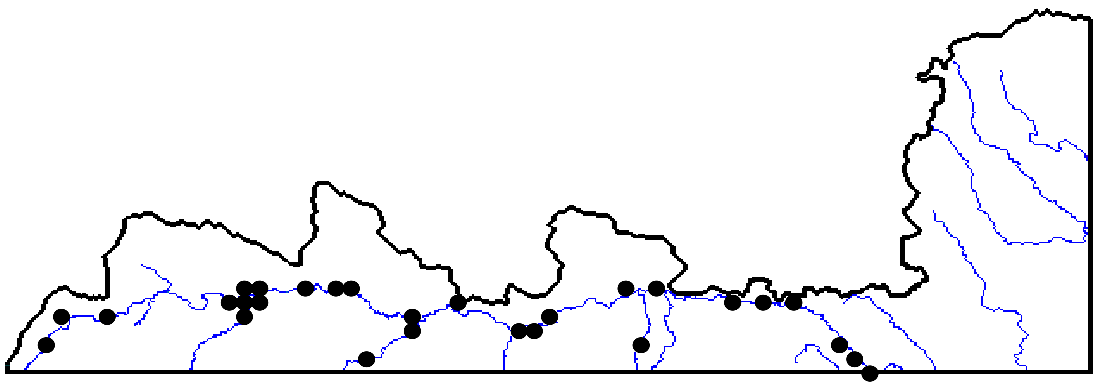

Figure 2.1.18 Longnose sucker distribution in the Milk River basin, 1979-2002

1.1.18 Mountain Sucker

In Alberta, the mountain sucker is known from drainages south of the North Saskatchewan River basin (Nelson and Paetz 1992). Within the Milk River basin, mountain sucker have been collected only from the North Milk and mainstem Milk rivers (Figure 2.1.19).

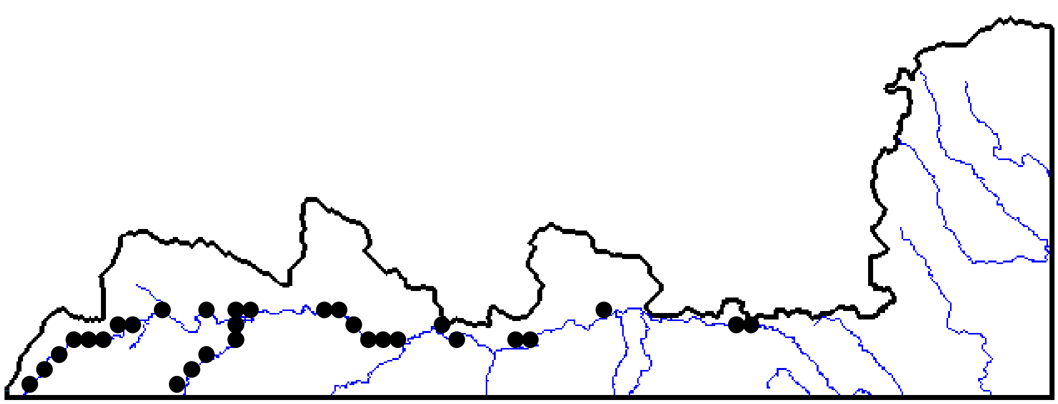

Figure 2.1.19 Mountain sucker distribution in the Milk River basin, 1979-

1.1.19 White Sucker

White suckers are a common component of the fish assemblage in many of Alberta's streams and rivers. As indicated in Figure 2.1.20, this species has been captured in the North Milk and Milk rivers, and in Red, Breed, Bear, Kennedy, Bare, and Lodge Creeks.

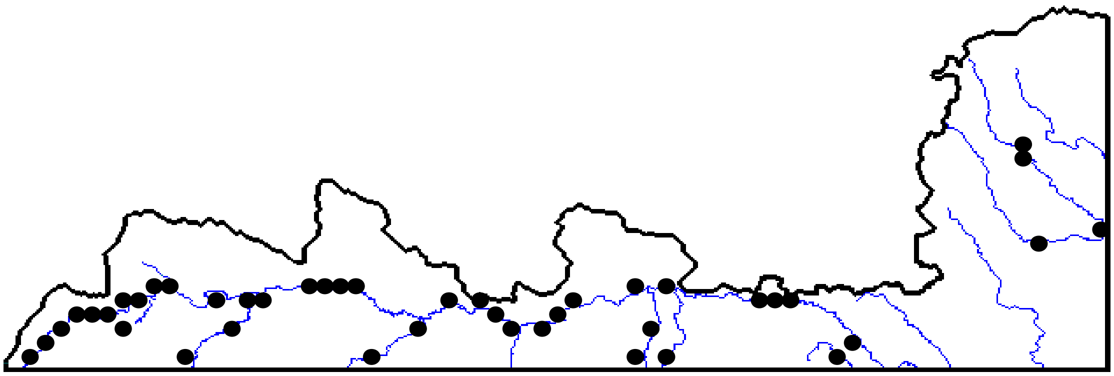

Figure 2.1.20 White sucker distribution in the Milk River basin, 1979-2002

1.1.20 Rainbow, Cutthroat, Brown, and Bull Trout

All but brown trout occur in the St. Mary River in the vicinity of the St. Mary Canal headworks near Babb, MT. None of these species has been recorded in the North Milk or Milk rivers since 1979. Willock (1969) collected a single cutthroat trout from the North Milk River during his collections. He also reported examining a brown trout in an angler's catch from the North Milk River. Neither rainbow nor bull trout were collected by Willock in the mainstem or North Milk Rivers, and neither species has been captured and entered into the database since 1979.

PART 2 - Milk River Basin Tributaries Project

Terry B. Clayton, Alberta Sustainable Resource Development, Fish and Wildlife Division, Lethbridge, AB

1.0 INTRODUCTION

The Milk River Drainage Basin has the highest diversity and density of species at risk (SAR) in Alberta, and possibly of all the prairie provinces. Periods of drought are part of the ecology of the Milk River basin. Under drought conditions, discharge in the creeks declines dramatically and portions of the streams can become dewatered. However, there are sites where fish species persist, which are referred to as refugia. Fish recolonization of streams when the stream flow returns is dependent not only on those fish that persisted in reservoirs and streams in downstream locations, but in part on fish that survived in upstream areas. The objective of the refugia project was to inventory and quantify fish and wildlife species within the Milk River Drainage as a prioritizing exercise for future (within a year) habitat stewardship activities, and to identify pools that, under drought conditions, act as refugia.

Ephemeral streams are harsh environments for fish, due to dewatering and hypoxia (lack of oxygen). The distribution of fish is spatially and temporarily variable, with some stream reaches supporting fish while others do not. The isolation of some reaches and deleterious conditions can result in simple fish communities. The fish assemblages of creeks in southeastern Alberta had not been investigated in over a decade, so this project provided the opportunity to update the database.

2.0 PROJECT GOALS AND OBJECTIVES

The primary goal of this project is to conserve and enhance the biodiversity of the Milk River Drainage. The objectives of this study are as follows:

1). To conduct inventories for select SAR within the Milk River Drainage, and
2). To identify and inventory fish refugia in the Milk River Drainage to allow for their protection.

3.0 STUDY AREA

The study area for the refugia portion of the project included 11 tributaries to the Milk River. All but four of the tributaries enter the Milk River in Alberta. Of those four, Bare and Lodge Creeks join immediately west of the Alberta-Saskatchewan border. Middle Creek joins with Lodge Creek in Saskatchewan. Both Lodge and Battle Creeks join together in Montana a few kilometres prior to entering the Milk River southeast of Fresno Reservoir.

4.0 METHODS

The initial identification of potential refugia sites in tributaries to the Milk River was accomplished by air photo interpretation, followed by onsite inspections. Forty-nine locations were identified by air photo interpretation as having potential. Site selection was based on easy access to the creeks (*i.e.* trails, roads). Landowner contact was then made either by telephone or personal contact to request permission to access sites near or along private trails. Of the 49 potential refugia sites identified, 35 sites were determined suitable for sampling. Due to inclement weather (*i.e.* wet conditions), land access problems, and time constraints, only 21 sites were sampled. The majority of the initial onsite surveys of the sites were conducted between 17 September 2002 and 15 October 2002, to determine if sufficient water was present to conduct electroshocking surveys, and to establish whether there was enough water for the site to provide refugia. Pictures, water depths, and the surrounding creek vegetation were recorded at each site.

A Smith-Root Type VII backpack electrofisher was the primary capture methodology used to collect fish. The majority of backpack electrofishing collections occurred on 25 and 26 September 2002, when Middle, Lodge, Bare and Sage Creeks were sampled. Breed, Bear, Red, Shanks, and Lonely Valley Creeks were sampled by backpack electrofishing from 8 October to 15 October 2002. Kennedy Creek was electrofished on 11 July 2002.

In most instances the electrofishing crew consisted of one operator and two netters. The electrofisher operator waded upstream, and in most cases was able to sample the complete channel; however, there were some areas, such as the outside meanders, that proved too deep to sample safely and effectively. Netters placed captured fish in a holding bucket, and at the end of the section designated for sampling, the fish were enumerated and measured. Pertinent data collected at each site included UTM coordinates, sampling effort (seconds), electrofisher settings, water temperature, and general habitat conditions. Photos were taken with a digital camera at each site visited.

Other sampling methods employed during this project included the use of commercially-available Gee minnow traps and fine mesh dip nets. Fish sampling on the mainstem Milk River utilizing minnow traps occurred at five sites between 18 June and 19 July 2002. Captured fish had fork and total lengths taken before they were released back into the river. Sampling by use of minnow traps was undertaken in conjunction with other components of this project and on an opportunistic basis (*e.g.* an amphibian monitoring crew was camped overnight along the river).

Collected fish were enumerated, and a sub-sample was measured for fork length (mm) and/or total length (mm). Weights (in grams) were taken from some larger individuals in the field. Most fish were returned to the creek, although some representative samples were preserved in whirl-packs containing 10% formalin. Samples returned to the lab were identified with the aid of a binocular microscope, using the keys provided in Nelson and Paetz (1992) and Scott and Crossman (1973). After identification, length measurements were taken under magnification and weights were determined with a beam balance.

Most of the preserved samples were forwarded to the Provincial Museum of Alberta for confirmation. Names and abbreviations for fish species follow those listed in Mackay *et al.* (1990).

The UTMs for sites where the captured fish were processed were determined using a Garmin 12 GPS unit, using the NAD 83 scale.

5.0 RESULTS

There were fish sampling sites on 11 creeks in the Milk River drainage. The number of sampled sites per creek varied from one site per creek to four sites per creek. There were more potential sampling sites identified than were actually sampled; this was due to poor accessibility to the sites or not obtaining landowner permission for access, discovering poor quality habitat at the sites, and limited sampling time available. Additionally, water levels were higher than anticipated in all of the Milk River tributaries investigated, with the high water levels obscuring identification of refugia sites.

In total, 11 species were captured in Milk River Basin tributaries in 2002. Lake chub were the species most frequently collected in the creeks surveyed (Table 2.1.2), comprising 45.6% of the fish collected. White suckers (20.1%) were second in terms of abundance, while fathead minnow (14.1%) were the third species most frequently encountered.

Table 2.1.2 Numbers per fish species captured in Milk River Drainage tributaries in 2002

Waterbody	Site	Date	BRMN	BRST	FLCH	FTMN	IWDR	LKCH	LNDC	LNSC	NRDC	NRPK	WHSC	Total
Sage Ck	1	25/9												0
Sage Ck	1	25/9				3								3
Sage Ck	3	25/9												0
Sage Ck	3	25/9				9		69						78
Sage Ck	4	26/9												0
Middle Ck	1	25/9		80		8					1			89
Bare Ck	3	26/9		1		27							10	38
Lodge Ck	1	25/9	2			16		1					1	20
Lodge Ck	2	26/9		3				15	2				1	21
Lodge Ck	3	26/9		5		11		14	2		4		5	41
Lodge Ck	4	26/9		7		2		5	3		1		12	30
Kennedy Ck	1	11/8	2			35		7					3	47
Shanks Ck	4	8/10				5							15	20
Shanks Ck	8	8/10				2		5					13	20
Red Ck	2	8/10				13		69		4	2		16	104
Red Ck	6	8/10	1	1		25		5					15	47
Police Ck	1	9/10			69				18				13	100
Breed Ck	4	9/10					2	70					56	128
Breed Ck	3	9/10					9	70	1	2			47	129
Bear Ck	3	9/10						177					13	190
Lonely Valley Ck	1	15/10				1						2	4	7
Total			**5**	**97**	**69**	**157**	**11**	**507**	**26**	**6**	**8**	**2**	**224**	**1112**

Species diversity per creek ranged from a low of two species to a high of seven species. Lodge and Red Creeks had the highest diversity of species (7), which perhaps was not surprising given that they are the largest (in terms of discharge) of the tributaries sampled. Bear and Sage Creeks were at the low end; only two species were captured in each of these creeks.

Of the species listed in Table 2.1.1 as having a status other than secure (n=6), only brassy minnow and northern redbelly dace were collected in Milk River tributaries. There were 8 northern redbelly dace captured (0.7% of overall total) and 5 brassy minnow captured (0.4% of overall total). The remaining four species (*i.e.* SAUG, STON, SHSC, WSMN) are residents of the mainstem Milk River and have never been recorded as occurring in the tributaries.

A comparison of the tributaries sampled by backpack electrofishing shows that the highest relative abundance, as measured by catch-per-unit-effort (CPUE; number of fish captured divided by effort, in minutes sampled) occurred in Bear Creek. However, Bear Creek had the lowest species diversity, with only lake chub and white sucker being collected. The creeks with the highest diversity (*i.e.* Lodge and Red Creeks) were in the middle of the range of CPUE values (Table 2.1.3.).

Table 2.1.3 Catch-per-unit-effort by electrofishing by stream for fish species captured in Milk River tributaries in 2002

Waterbody	Effort (min.)	BRMN	BRST	FLCH	FTMN	IWDR	LKCH	LNDC	LNSC	NRDC	NRPK	WHSC	Total
Bear Ck	12.88						13.74					1.01	14.75
Middle Ck	8.78		9.11		0.91					0.11			10.13
Breed Ck	25.87					0.43	5.41	0.04	0.08			3.98	9.94
Red Ck	21.60	0.05	0.05		1.76		3.43		0.19	0.09		1.44	6.99
Bare Ck	6.03		0.17		4.48							1.66	6.30
Lodge Ck	53.53	0.04	0.28		0.54		0.65	0.13		0.09		0.35	2.09
Shanks Ck	25.82				0.27		0.19					1.08	1.55
Sage Ck	57.62				0.21		1.20						1.41
Kennedy Ck	51.70	0.04			0.68		0.14					0.06	0.91
Lonely Valley Ck	27.85				0.04						0.07	0.14	0.25

White sucker and fathead minnow occurred in 8 of the 10 tributaries sampled by backpack electrofishing. Lake chub were also a common component of the fish fauna; they occurred in 7 of the 10 creeks. Northern pike were only collected from one tributary, which was Lonely Valley Creek; however, the collection site was relatively close to the confluence of this creek with the North Milk River.

5.1 Inventory Summaries

The following paragraphs are summaries of fish captures in each creek and some habitat characteristics observed at the sampling sites (Figure 2.1.1). The order they are presented in is northeast to southwest.

5.1.1 Middle Creek

Middle Creek is located south of Cypress Hills Provincial Park. Middle Creek joins Lodge Creek in Saskatchewan within 7 miles of the USA border, north of the Willow Creek border crossing. Fisheries sampling occurred on 25 September 2002 at one site (568943E, 5474967N), which was on a township road close to the Alberta-Saskatchewan border. Three fish species were collected in Middle Creek; these were brook stickleback, fathead minnow and northern redbelly dace. The second highest relative abundance values (CPUE) recorded were for Middle Creek (Table 2.1.3), due in large part to the high numbers of brook stickleback captured. The sampling site was located in a large pool underneath and upstream of the bridge crossing (Appendix A, Photo 1).

5.1.2 Lodge Creek

Lodge Creek originates near the southwest corner of Cypress Hills Provincial Park and flows southeast into Saskatchewan. Lodge Creek enters the Milk River southeast of Fresno Reservoir in Montana. Four sites were sampled; the most downstream site was located downstream of the confluence of this creek and Bare Creek, near the Saskatchewan border. The remaining three sites were downstream of the Highway 41 bridge crossing; sampling at all sites occurred on 25 and 26 September 2002. There were 112 fish captured, representing seven species. Species captured included brassy minnow, fathead minnow, lake chub, northern redbelly dace, longnose dace, white sucker and brook stickleback. The CPUE for Lodge Creek was 2.1 fish per minute, which was in the middle of the range of CPUE values (Table 2.1.3) for all tributaries electrofished.

There was a considerable range in the CPUE values for individual sites on Lodge Creek (Table 4). The CPUEs ranged from a low of 0.7 fish per minute to a high of 10.0 fish per minute. Habitat photos from Lodge Creek sampling sites are located in Appendix A, Photo 2.

5.1.3 Bare Creek

Bare Creek is the next waterbody south of Lodge Creek. It joins Lodge Creek just upstream of the Alberta-Saskatchewan border. This creek was sampled at one site on 26 September 2002, in the vicinity of the Highway 41 bridge crossing (Appendix A, Photo 3). The CPUE at this site was 6.3, which was in the middle of the range of CPUE values (Table 2.1.3). A total of 38 fish representing three species were collected. These included white sucker, fathead minnow, and brook stickleback.

5.1.4 Sage Creek

Sage Creek originates north of Onefour and flows southeast into Montana. Sampling was undertaken at five sites along Sage Creek on 25 and 26 September 2002, but fish were only collected at three of those sites. A total of 81 fish from two species were collected; these species were fathead minnow and lake chub. The combined CPUE value for Sage Creek was 1.4 fish per minute, and individual site values ranged from 0 to 7.9 fish per minute (Table 2.1.4). One of the reasons that the numbers of fish captured were relatively low and species diversity was very low (considering the size of Sage Creek) is that the substrate and interstitial spaces are covered by fine, bentonite-like clay. The turbidity levels were very high in Sage Creek (Appendix A, Photos 4 and 5), and there was little opportunity for macroinvertebrates to colonize the creek.

5.1.5 Kennedy Creek

Kennedy Creek originates in the lowlands south of the Milk River, in the Pinhorn Grazing Reserve west of the Milk River Natural Area. It flows southeast, winding through the Kennedy Creek Ecological Reserve, before entering Montana. It travels eastward through Montana before winding northward and entering the Milk River within a few metres south of the International Boundary. Since Kennedy Creek is in an Ecological Reserve, access to the creek is on foot.

One site was sampled on Kennedy Creek on 11 July 2002, within the Ecological Reserve (519837 E, 5428770 N). There were 47 fish representing four species captured. These included the brassy minnow, fathead minnow, lake chub and white sucker. In 1997, Iowa darter had been one of the species collected from Kennedy Creek by Alberta Fish and Wildlife Division staff. The CPUE for the one site sampled, at 0.9 fish per minute, was the second lowest of the ten creeks sampled. A representative habitat photo is located in Appendix A, Photo 6.

5.1.6 Bear Creek

This creek originates on the slopes of the Sweetgrass Hills in Montana, and flows north until entering the Milk River downstream of the Secondary Highway 880 bridge crossing. High numbers of individuals were caught (n=190) in Bear Creek when it was sampled on 9 October 2002. The CPUE of 14.8 fish per minute was the highest of the 10 creeks sampled by backpack electrofishing; however, species diversity was very low with only two species, lake chub and white sucker, captured. A representative habitat photo is located in Appendix A, Photo 7.

5.1.7 Breed Creek

This creek also originates on the slopes of the Sweetgrass Hills in Montana, and flows north until entering the Milk River immediately downstream of the Secondary Highway 880 bridge crossing. There was not any flowing water when the site was sampled on 9 October 2002; most of the water was contained in dugouts or depressions. Breed Creek had the third highest CPUE (9.9) of the 10 creeks sampled. A total of 257 fish were collected from two sampling sites. Five species of fish were represented: Iowa darter, lake chub, longnose dace, longnose sucker and white sucker. A representative habitat photo is located in Appendix A, Photo 8.

5.1.8 Police Creek

This creek originates on the slopes of the Sweetgrass Hills in Montana, and flows north until entering the Milk River across from Writing-on-Stone Provincial Park. Police Creek was sampled at 453451 E, 5435818 N with dip nets on 9 October 2002. This sampling site was in close proximity to the confluence of Police Creek and the Milk River. Species captured included 69 flathead chub, 18 longnose dace, and 13 white sucker (Table 2.1.2). A representative habitat photo is located in Appendix A, Photo 9.

5.1.9 Red Creek

Red Creek originates in Montana, west of the village of Sunburst. It flows north until it reaches the International Boundary, and then flows northeast until it enters the Milk River just upstream of the Coffin Bridge. Red Creek was sampled by backpack electrofishing on 8 October 2002 at two sites. The CPUE for both sites combined was 7.0, which was the fourth highest of the 10 sites sampled. The CPUE for the lower of the two Red Creek sites was three times that of the upper site (Table 2.1.4), even though there was not much distance between the two. Diversity was high in Red Creek, with 7 fish species collected there: brassy minnow, fathead minnow, lake chub, northern redbelly dace, white sucker, longnose sucker and brook stickleback. A representative habitat photo is located in Appendix A, Photos 10 and 11.

5.1.10 Lonely Valley Creek

This creek originates in the Milk River Ridge. It flows southwest before entering the North Milk River about 35 kilometres upstream of the confluence of the North Milk and Milk rivers. One site along Lonely Valley Creek was sampled by backpack electrofishing on 15 October 2002. The CPUE was 0.3, which was the lowest of the 10 creeks sampled (Table 2.1.3), and only 7 fish were collected. Species captured included northern pike, fathead minnow, and white sucker. A representative habitat photo is located in Appendix A, Photo 12.

5.1.11 Shanks Creek

Shanks Creek starts near the International Boundary and flows northeast until it enters the North Milk River approximately 5 km upstream of the Lonely Valley Creek confluence. There is a reservoir located about 5 km upstream of the North Milk – Shanks Creek confluence, called Shanks Lake, which has been stocked with northern pike on occasion by Alberta Fish and Wildlife Division. Shanks Creek was sampled on 8 October 2002 at two sites, both of which were upstream of Shanks Lake. One site was at the Highway 501 crossing, while the other was at the township road crossing immediately above the lake. The combined CPUE for Shanks Creek was 2.1, which was the seventh highest of the 10 waterbodies sampled (Table 2.1.3). There was little difference in the CPUE values between the two sampling sites. Species diversity was fairly low in the creek with only three species captured; fathead minnow, lake chub, and white sucker. A total of 40 fish were collected. A representative habitat photo is located in Appendix A, Photos 13 and 14.

Table 2.1.4. Catch-per-unit-effort by electrofishing at individual sites (Figure 2.1.1) for fish species captured in Milk River tributaries in 2002

Waterbody	Site	Effort (min.)	BRMN	BRST	FLCH	FTMN	IWDR	LKCH	LNDC	LNSC	NRDC	NRPK	WHSC	Total
Sage Ck	1	8.1												
Sage Ck	1	15.1				0.20								0.20
Sage Ck	3	15.6												
Sage Ck	3	9.9				0.91		6.98						7.89
Sage Ck	4	8.9												
Middle Ck	1	8.8		9.11		0.91					0.11			10.13
Bare Ck	3	6.0		0.17		4.48							1.66	6.30
Lodge Ck	1	28.1	0.07			0.57		0.04					0.04	0.71
Lodge Ck	2	13.7		0.22				1.10	0.15				0.07	1.54
Lodge Ck	3	4.1		1.21		2.67		3.40	0.49		0.97		1.21	9.96
Lodge Ck	4	7.7		0.91		0.26		0.65	0.39		0.13		1.57	3.91
Kennedy Ck	1	51.7	0.04			0.68		0.14					0.06	0.91
Shanks Ck	4	13.8				0.36							1.09	1.45
Shanks Ck	8	12.0				0.17		0.42					1.08	1.66
Red Ck	2	8.7				1.49		7.90		0.46	0.23		1.83	11.91
Red Ck	6	12.9	0.08	0.08		1.94		0.39					1.17	3.65
Breed Ck	4	12.6					0.16	5.56					4.44	10.16
Breed Ck	3	13.3					0.68	5.28	0.08	0.15			3.54	9.72
Bear Ck	3	12.9						13.74					1.01	14.75
Lonely Valley Ck	1	27.9				0.04						0.07	0.14	0.25

6.0 DISCUSSION

South and southeastern Alberta received substantially more precipitation than normal between the start of May and the end of August 2002. Precipitation data from Alberta Environment showed that the Medicine Hat area received 214% of normal precipitation, and the Lethbridge area received 185% of normal precipitation for that period (Alberta Environment 2002). These heavy precipitation events in 2002 recharged groundwater levels, which also contributed to increases in surface flow originating from springs. Given the amount of water in the creeks throughout the summer and fall, it was impossible to determine where refugia sites existed.

Schlosser (1987 *in* Capone and Kushlan 1991) observed that in shallow headwater streams small minnow species dominated the fish assemblage, but as temporal stability increased downstream, larger fish species such as white sucker became more prevalent. Capone and Kushlan (1991) found that the number of species increased in a downstream direction as pool depth, persistence, and channel size increased.

The 2002 study did not confirm the predictions that minnow species would dominate in upstream areas and that larger species such as sucker would be found in downstream environs. White sucker were found at 14 of the sites investigated, whereas fathead minnow and lake chub were collected at 13 and 12 sites, respectively. However, all of the white suckers captured were juveniles and most of the specimens were of the smaller juvenile size classes (*i.e*. < 150 mm). At every site where white suckers were collected, either fathead minnow or lake chub were also captured, and in most cases both species were collected. Consequently, while the species assemblage prediction was not confirmed, the size class distribution (*i.e*. smaller-sized individuals) was confirmed.

Given that south and southeast Alberta experienced three years of drought from 1999 to 2001, it was somewhat surprising that the community structure in most of these creeks, particularly those in the southeast, was fairly robust. The number of species captured per creek ranged from 2 to 7, which indicates that there are likely sufficient refugia to allow fish to survive high temperatures and low oxygen concentrations in summer while also pools deep enough to provide relief from freezing during the winter months.

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APPENDIX A

Sampling Site Photographs

Photo 1. Middle Creek

Photo 2. Lodge Creek

Photo 3. Bare Creek

Photo 4. Sage Creek

Photo 5. Sage Creek

Photo 6. Kennedy Creek

Photo 7. Bear Creek

Photo 8. Breed Creek

Photo 9. Police Creek

Photo 10. Red Creek

Photo 11. Red Creek

Photo 12. Lonely Valley Creek

Photo 13. Shanks Creek

Photo 14. Shanks Creek

PART 3 - FISH SPECIES OF CONCERN SURVEY ON THE MILK RIVER -OCTOBER 2002-

P&E Environmental Consultants Ltd., Edmonton, Alberta

1.0 INTRODUCTION

1.1 Background

Alberta Sustainable Resource Development (SRD) initiated a two-year program in 2000 to assess the status of fish species of concern in the Milk and St. Mary River drainages. The primary purpose of the inventories was to assess the distribution and relative abundance of these species and to document habitat characteristics at sites where fish were recorded. The three fish species of primary interest were the St. Mary sculpin (Cottus *spp*.), western silvery minnow (*Hybognathus argyritis*), and the stonecat (*Noturus flavus*). Other species of interest were the brassy minnow (*Hybognathus hankinsoni*) and sauger (*Stizostedion canadense*). Alberta SRD contracted P&E Environmental Consultants Ltd. (P&E) to collect additional data for these fish species in areas of the Milk River that were not sampled during the previous investigations. These data are required to allow for the development of appropriate fisheries management and habitat protection strategies.

1.2 Objectives

The objectives of the study, as outlined in the Terms of Reference dated 13 September 2002 are as follows:

1. Collect data on fish species within the primary and secondary sections required for input into the Fisheries Management Information System (FMIS) habitat load form.

2. Collect data on habitat variables required for input into the FMIS habitat load form.

3. Provide at least one photo of the habitat sampled, as well as one upstream and one downstream for each sample location.

4. Provide representative photographs of the study area during the aerial reconnaissance flight.

1.3 Study Area

There are two areas in the Milk River drainage that were sampled. The lower study area (primary section, Figure 2.2.1) was a portion of the Milk River downstream of the Pinhorn Ranch approximately 57 km in length (16-02-7-W4 to International Boundary). The upper study area (secondary section; Figure 2.2.2) was located upstream of the Town of Milk River and was approximately 40 km in length (14-02-21-W4 to 27-02-17-W4). Road access in these areas was severely restricted.

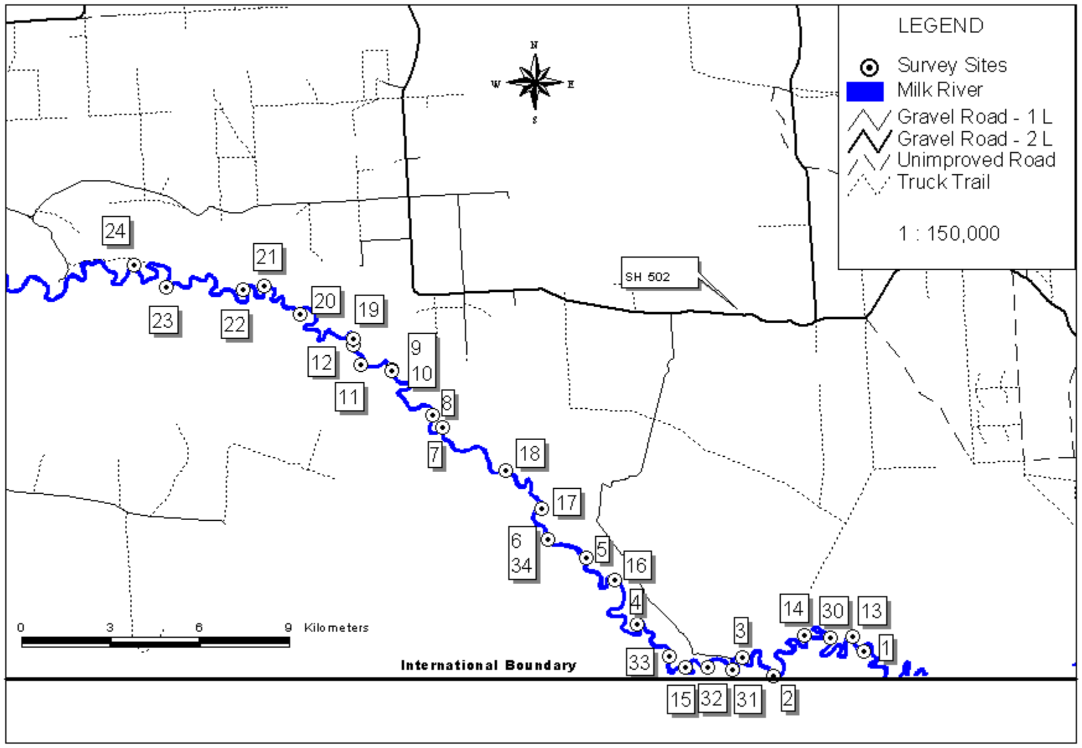

Figure 2.2.1 Primary section of the fish survey on the Milk River, 22 to 27 October 2002

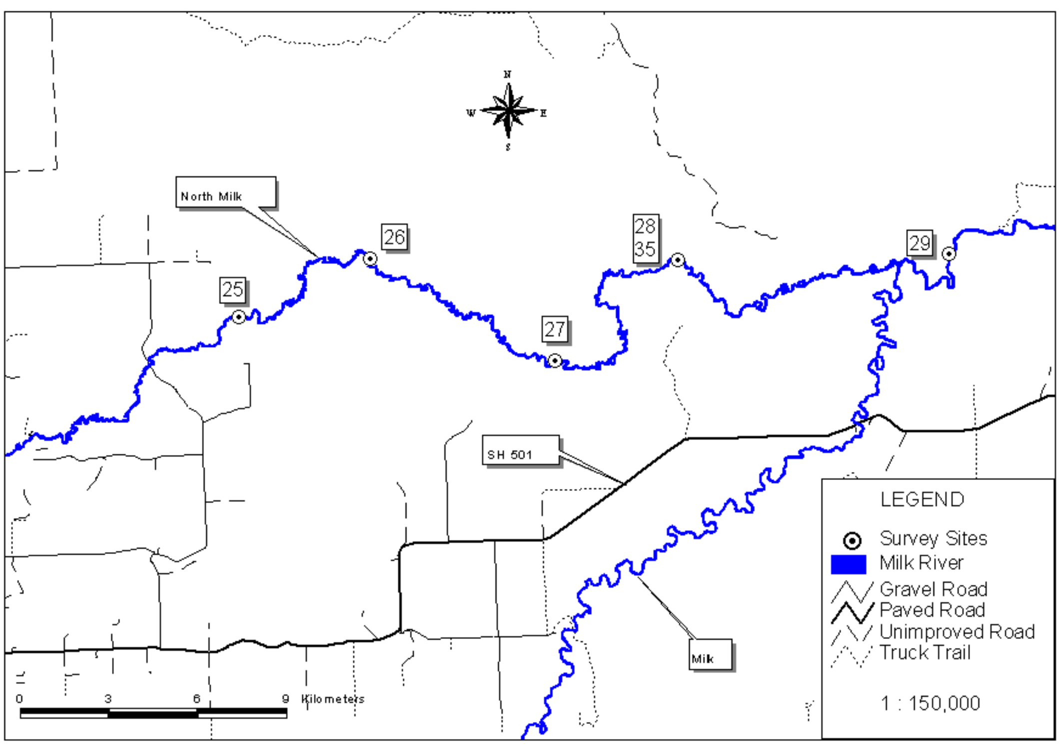

Figure 2.2.2 Secondary section of the fish survey on the Milk River, 22 to 27 October 2002

1.4 Sample Period

To maximize the effectiveness of fish sampling procedures the study was to be undertaken after the discharge in the mainstem Milk River had reached normal fall levels of approximately 2.0 m^3/s (Terry Clayton, Area Biologist, SRD, pers. comm.). Using this criterion, the delayed closure of the water diversion system on the North Milk drainage prevented initiation of sampling until 22 October when discharge was 2.21 m^3/s (Water Survey of Canada Station 11AA031). The sample period encompassed a six-day session between 22 and 27 October 2002 during which time river discharge continued to decrease.

2.0 METHODS

The general approach to sampling and the methods were similar to those employed by R.L.&L. Environmental Services Ltd. (2001 and 2002). To ensure continuity, the senior technician responsible for all field sampling during these previous investigations was the crew leader for P&E during the present study.

2.1 Logistics

The Terms of Reference for the proposed work program included a primary sampling program that utilized a helicopter to access isolated sites and a secondary sampling program that used all terrain vehicles (ATV) for sites that could be accessed from the ground. Based on information collected during the aerial reconnaissance and discussions with the client, it was decided that all sampling would be completed by helicopter. This decision was made for two reasons. First, ground access to potential sites by ATV was limited by steep terrain adjacent to the riverbanks and the absence of travel routes within the active river channel. Second, sub-zero air temperatures at the time of the study indicated that river freeze-up was imminent; therefore, the window of opportunity to complete the program was severely restricted. Helicopter was the preferred option because it eliminated access issues and allowed the largest number of sites to be sampled in a short period of time.

Bighorn Helicopters of Fernie, British Columbia provided helicopter support. A Bell 206 based in Lethbridge was used to ferry a two-person crew to sample sites (Table 2.2.1). To sample in the primary section, the field crew was located in the Town of Foremost during the first four days (22 to 25 October). The crew was based in Lethbridge during the last two days of sampling. The 26th October was used to sample the secondary section, while the 27th October was used to sample additional sites in the primary section. Three hours of helicopter time per day were required to complete the work. An aerial reconnaissance undertaken in the primary section on the 22nd October was used to establish potential sites and to obtain an overview of habitat characteristics. A brief aerial reconnaissance was completed in the secondary section on the 26th October.

Table 2.2.1 Number of sites sampled in each study section during the fish species of concern survey on the Milk River, 22 to 27 October 2002

Section[a]	Dates Sampled	Number of Sites		
		Beach Seine	Backpack Electrofisher	Total
Primary	22 to 25 Oct.; 27 Oct.	24	5	29
Secondary	26 October	1	5	6
Total		25	10	35

[a] See Section 1.3 for description.

2.2 Data Collection

At each site, data were collected for entry into the FMIS fish load form and the habitat load form. Sample methods followed standard, accepted practices (Platts *et al.* 1983, Bain and Stevenson 1999).

2.2.1 Fish

Fish capture methods included beach seining and backpack electrofishing where appropriate. Beach seining was used to sample habitats exhibiting low water velocities (<0.3 m/s) and/or low visibility. The seine was 1.5 m high x 6.0 m wide with a mesh size of 6 mm and was equipped with a weighted lead line and collection bag. The collection bag had the following dimensions: 1.5 high x 2.5 m wide x 1.5 m deep. Samplers first deployed the seine across the sample area and then moved downstream at a rapid and constant pace. At the downstream end of the site, the seine was turned into shore. Contact with the bottom was maintained at all times and if the seine snagged during the sweep the sample was abandoned.

A Smith-Root Type XII high output backpack electrofisher equipped with a 28 cm anode ring was used to capture fish in areas containing large rock substrate not effectively sampled by beach seining. The electrofisher operator waded in an upstream direction, while the netter who was equipped with a dip net having a mesh size of 5 mm, collected the immobilized fish.

In general, each beach seine and backpack electrofisher sample was at least 25 m in length and was restricted to a specific habitat type. Where possible, three beach seine hauls were completed per site. Recorded fish sampling information included location (UTM coordinates), equipment settings, and sampling effort (length [m] and/or time [s]).

Captured fish were identified to species, enumerated and measured for fork length, total pinched length, and weight. A limited number of some specimens were preserved to confirm cyprinid species identification (n=9).

2.2.2 Habitat

Photographs were taken at each site to depict the habitat type sampled, upstream conditions, and downstream conditions. In addition, habitat conditions were characterized at each site. Measurements were collected along transects (typically three) placed within the sampled zone. Parameters measured at each site were as follows:

- Habitat type using classification developed by O'Neil and Hildebrand (1986).
- Wetted and channel widths (m) using a Bushnell Yardage Pro Range Finder (±2% full scale).
- Water depth (m) and water velocity (m/s) using a Swoffer Model 2100 flow meter.
- Substrate composition using the modified Wentworth scale (Cummins 1962).
- Percent available instream cover.
- D90 (m).
- Silt depth (m).
- Percent area exhibiting water depths greater than 1 m.
- Dissolved oxygen and temperature using an Oakton DO 300 meter (±1.5% full scale).
- Conductivity (Oakton TDS Testr3) (±1.0 µS/cm) and pH (Oakton pH Testr2) (±0.1).
- Water clarity (m) by visual assessment.
- Turbidity (NTU) measured with a Hach 2100P Turbidty meter (±1% full scale).

The quality of fish habitat at each site also was characterized. The rating system was specific to each target species and life-requisite (*i.e.*, egg incubation/spawning, rearing, overwintering, and movement) expected to occur in the area. Rating categories corresponded to guidelines specified by DFO (1998) as follows:

Category	Description
Low	Habitat contributes marginally to production of the species life stage.
Moderate	Habitat is used by the species life stage, but is present in large amounts.
High	Habitat is unique and is critical to the well being of the species life stage.

2.3 Data Entry and Summary

Standard data entry and quality control procedures were used to process collected information. All collected data were entered into Microsoft Access data files. Once checked for errors, data required for FMIS were entered into the appropriate load form. The fish and habitat data were summarized in tabular form for presentation in the report.

3.0 RESULTS

Sampling conditions during the survey were suboptimal. Sub-zero water temperatures promoted the formation of frazil ice and shore-fast ice over much of the study area one day after the commencement of the study. The presence of ice cover along the river margin precluded sampling calm-water habitats typically preferred by most of the target species. Frazil ice also hampered the effectiveness of fish sampling due to clogging of the beach seine and the dip net used during electrofishing. The cold air temperatures also prevented proper operation of some equipment. As such, the information collected during this study should be interpreted with caution. The catch data provides a suitable representation of fish distribution in the study area, but fish catch rates are likely biased downward. The measured habitat variables accurately describe the areas sampled, but they may not be representative of the habitats preferred by the target species.

The following provides a concise summary of the study results. In addition to this hard copy report, electronic data files have been submitted as part of the deliverables for this study (Appendices B and C).

3.1 Fish Assessment

In total, 303 fish were captured or observed at 35 sampled sites on the Milk River (Table 2.2.2). The catch was comprised of ten species; however, brassy minnow (*Hybognathus hankinsoni*) was not encountered during the study. In the primary section, flathead chub (*Platygobio gracilis*) and western silvery minnow were the most numerous fish. In the secondary section, longnose dace (*Rhinichthys cataractae*) and St. Mary sculpin were the most numerous species encountered. Of the target species, sauger and western silvery minnow were only found in the primary section, while St. Mary sculpin and stonecat were recorded only in the secondary section (Table 2.2.3).

Table 2.2.2 Percent composition of fish species encountered in the Milk River, 22 to 27 October 2002

Species		Section			
Common Name	Latin Name	Primary		Secondary	
		Number	Percent	Number	Percent
Flathead chub	*Platygobio gracilis*	66	45.8		
Lake chub	*Couesius plumbeus*			14	8.8
Longnose dace	*Rhinichthys cataractae*	6	4.2	47	29.6
Longnose sucker	*Catostomus catostomus*	3	2.1	1	0.6
Mountain sucker	*Catostomus platyrhynchus*			2	1.2
Sauger	*Stizostedion canadense*	6	4.2		
St. Mary sculpin	*Cottus spp.*			59	37.1
Stonecat	*Noturus flavus*			1	0.6
Trout-perch	*Percopsis omiscomaycus*			35	22.1
Western silvery minnow	*Hybognathus argyritis*	63	43.7		
Total		144	100.0	159	100.0

Table 2.2.3 Percent occurrence of fish species encountered at 35 sites in the Milk River, 22 to 27 October 2002

Species		Section			
		Primary		Secondary	
Common Name	Latin Name	Occurrence	Percent	Occurrence	Percent
Flathead chub	*Platygobio gracilis*	17	58.6		
Lake chub	*Couesius plumbeus*			3	50.0
Longnose dace	*Rhinichthys cataractae*	3	10.3	4	66.7
Longnose sucker	*Catostomus catostomus*	2	6.9	1	16.7
Mountain sucker	*Catostomus platyrhynchus*			2	33.3
Sauger	*Stizostedion canadense*	5	17.2		
St. Mary sculpin	*Cottus spp.*			5	83.3
Stonecat	*Noturus flavus*			1	16.7
Trout-perch	*Percopsis omiscomaycus*			2	33.3
Western silvery minnow	*Hybognathus argyritis*	9	31.0		
Number of Sites		29		6	

Catch rates were generally low for all species (Table 2.2.4). In the primary section, flathead chub was the most abundant species during backpack electrofishing (1.90 fish/100 m). One sauger was encountered during backpack electrofishing in the primary section (0.27 fish/100 m). During beach seining, western silvery minnow was one of the more numerous species in the primary section (0.62 fish/100 m^2) followed closely by flathead chub (0.58 fish/100 m^2).

Catch rates were higher in the secondary section. Longnose dace (13.06 fish/100 m), St. Mary sculpin (16.39 fish/100 m), and trout-perch (9.72 fish/100 m) were the most abundant species during backpack electrofishing. One stonecat was also recorded in this study section (0.28 fish/100 m).

Table 2.2.5 presents a summary of the biological characteristics of sampled fish from the Milk River. In general a wide side range of sizes were encountered for most species.

Table 2.2.4 Catch rate summaries for fish species encountered in the Milk River, 22 to 27 October 2002

Section	Method	Species	Fish Recorded			Catch Rate[a]
			Captured	Observed	Total	
Primary	Electrofishing (*n*=5)	Flathead chub	6	1	7	1.90
		Longnose dace	6		6	1.63
		Sauger	1		1	0.27
		Total	*13*	*1*	*14*	*1.27*
	Seining (*n*=24)	Flathead chub	58	1	59	0.58
		Longnose sucker	3		3	0.03
		Sauger	5		5	0.05
		Western silvery minnow	63		63	0.62
		Total	*129*	*1*	*130*	*0.32*
Secondary	Electrofishing (*n*=5)	Lake chub	10		10	2.78
		Longnose dace	9	38	47	13.06
		Longnose sucker	1		1	0.28
		Mountain sucker	2		2	0.56
		St. Mary sculpin	37	22	59	16.39
		Stonecat	1		1	0.28
		Trout-perch	10	25	35	9.72
		Total	*70*	*85*	*155*	*5.42*
	Seining (*n*=1)	Lake chub	4		4	1.33
		Total	*4*		*4*	*1.33*

[a] Electrofishing catch rate calculation = no. fish/distance sampled in metres * 100.
Beach seining catch rate calculation = no. fish/area sampled in m^2 * 100.

Table 2.2.5 Summary of biological characteristics of fish species sampled from the Milk River, 22 to 27 October 2002

Section	Species	Fork Length (mm)			Weight (g)		
		Mean	Range	*n*	Mean	Range	*n*
Primary	Flathead chub	99.0	31 - 147	64	17.4	4 - 40	49
	Longnose dace	70.0	31 - 133	6	26	-	1
	Longnose sucker	146.7	115 - 185	3	38.7	16 - 68	3
	Sauger	93.8	73 - 143	6	9.5	4 - 143	4
	Western silvery minnow	88.3	35 - 122	63	10.5	2 - 24	53
Secondary	Lake chub	48.1	37 - 81	14	-	-	0
	Longnose dace	44.8	25 - 77	9	-	-	0
	Longnose sucker	251	-	1	152	-	1
	Mountain sucker	108.0	74 - 142	2	44	-	1
	St. Mary sculpin	64.8[a]	35 - 92	37	5.1	2 - 10	20
	Stonecat	165[a]	-	1	44	-	1
	Trout-perch	43.0	32 - 50	10	-	-	0

[a] Total length.

3.2 Habitat Characteristics

Water temperatures were near or below 0^{0}C at all sites during the sampling program (Table 2.2.6). Dissolved oxygen concentrations were close to saturation and ranged from 13.1 to 15.0 ppm. Measurements of pH also produced consistent results (8.6).

Conductivity, water clarity, and turbidity differed between the primary and secondary sections. The primary section exhibited a higher conductivity than the secondary section (363 µS/cm versus 238 µS/cm, respectively) and water clarity was lower (0.21 m versus 1.50 m, respectively). As expected, single turbidity measurements in each section reflected the difference in water clarity (16.2 NTU versus 1.5 NTU, respectively).

Table 2.2.6 Summary of the water quality characteristics at sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

Parameter	Primary Section (*n*=29)		Secondary Section (*n*=6)	
	Average	Range	Average	Range
Water temperature (C^{0})	-1.0	-3.1 to 0.90	-2.2	-2.8 to -1.8
Dissolved Oxygen (ppm)[a]	13.3	12.9 - 14.6	15.0	15.0 - 15.0
Conductivity (µS/cm)	363	80 - 560	238	110 - 370
pH	8.6	8.6 - 8.6	8.6	8.6 - 8.6
Water Clarity (m)	0.21	0.10 - 0.33	1.50	1.50 - 1.50
Water Turbidity (NTU)[b]	16.2	-	1.5	-

[a] Sample size for Primary Section was 27.
[b] Sample size of one for each section.

The Milk River at sampled sites exhibited a U-shaped channel profile at all sample locations. In general the primary section exhibited wider channel widths than the secondary section and in all cases wetted channel widths were much narrower than active channel widths (Table 2.2.7). Sand was the dominant substrate in the primary section (81% average substrate composition) with much lower amounts of rock substrates such as gravels and cobbles. These characteristics differed from the secondary section, which contained a greater percentage of large rock substrates. In this area boulders (28%), cobbles (24%), and gravels (31%) were important. Sand substrates accounted for only 11% of the substrates in the secondary section. As expected D90 also was higher in this area: 0.50 m in the secondary section compared to 0.14 m in the primary section. The depth of silt was negligible at most sites (range of 0.00 to 0.05 m).

Dominant habitats at sampled sites in both sections consisted primarily of shallow RUN (Table 2.2.7). Percent occurrence of R3 was 80% in the primary section and 67% in the secondary section. Other habitat types that were relatively common, but only in the secondary section, included R3BG (11%) and RF (17%). The percent area of sampled sites containing water >1.0m depth was very restricted. In the primary section the average was only 0.8%, while in the secondary section it was 0.3%.

Table 2.2.7 Summary of the habitat characteristics at sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

Parameter[a]		Primary Section (n=86)[b]		Secondary Section (n=18)[b]	
		Average	**Range**	**Average**	**Range**
Wetted width (m)		24.3	3 - 64	19.7	12 - 27
Channel width (m)		77.8	41 - 184	30.8	26 - 40
Water depth at capture (m)		0.35	0.10 - 1.40	0.33	0.14 - 0.77
Water velocity at capture (m/s)		0.21	0.00 - 0.66	0.20	0.01 - 0.51
Maximum water depth (m)		0.46	0.15 - 1.40	0.49	0.19 - 0.90
Maximum water velocity (m/s)		0.29	0.00 - 0.82	0.29	0.11 - 0.52
Silt depth (m)		0.01	0.00 - 0.05	0.01	0.00 - 0.05
Maximum substrate size - D90 (m)		0.14	0.02 - 1.01	0.50	0.02 - 0.98
Area of site > 1.0 m water depth (%)		0.8	0 - 15	0.3	0 - 5
Average Substrate Composition (%)	Organic	0.5	0 - 5	0.3	0 - 5
	Silt	7.2	0 - 30	6.9	5 - 10
	Sand	80.9	0 - 100	10.6	0 - 95
	Gravel	2.7	0 - 65	30.8	0 - 85
	Cobble	4.2	0 - 65	23.9	0 - 70
	Boulder	4.6	0 - 75	27.5	0 - 75
Habitat	*Type*	*Occurrence*	*Percent*	*Occurrence*	*Percent*
	Backwater	5	5.8	1	5.6
	Flat (F3)	1	1.2		
	Pool (P3)	1	1.2		
	Run (R3)	69	80.2	12	66.7
	Run (R3BG)	4	4.7	2	11.1
	Riffle (RF)	3	3.5	3	16.7
	Riffle (RFBG)	3	3.5		

[a] With the exception of wetted and channel widths, values represent habitat conditions within the sampled area rather than the entire river channel.

[b] Sample size reflects number of habitat transects measured at each site (typically three) times the number of sites.

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APPENDIX B

Sampling and Fish Data

Appendix B1. Sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

			Location (NAD 83, Zone 12)			Sampling Effort	
Section	Method	Site	Easting	Northing	Date	Second	Metres
Primary							
	Backpack Electrofish						
		2	529942	5427309	22-Oct-02	463	83
		6	522847	5432163	23-Oct-02	333	15
		9	518085	5438001	23-Oct-02	218	40
		11	517108	5438204	23-Oct-02	276	55
		19	516915	5439037	25-Oct-02	451	90
		21	514085	5440913	25-Oct-02	369	60
	Beach Seine						
		1	532906	5427972	22-Oct-02		75
		3	528961	5427967	22-Oct-02		75
		4	525578	5429242	22-Oct-02		75
		5	524038	5431519	22-Oct-02		75
		7	519671	5436039	23-Oct-02		75
		8	519341	5436441	23-Oct-02		75
		10	518088	5437967	23-Oct-02		75
		12	516901	5438856	23-Oct-02		75
		13	532568	5428491	24-Oct-02		75
		14	531008	5428609	24-Oct-02		50
		15	527084	5427756	24-Oct-02		75
		16	524930	5430753	24-Oct-02		110
		17	522712	5433202	24-Oct-02		75
		18	521647	5434490	25-Oct-02		100
		20	515205	5439946	25-Oct-02		75
		22	513412	5440856	25-Oct-02		75
		23	510897	5441034	25-Oct-02		75
		24	509890	5441841	25-Oct-02		75
		30	531844	5428464	27-Oct-02		75
		31	528600	5427617	27-Oct-02		80
		32	527829	5427721	27-Oct-02		75
		33	526581	5428154	27-Oct-02		75
		34	522847	5432163	23-Oct-02		42
Secondary							
	Backpack Electrofish						
		25	377398	5443006	26-Oct-02	743	90
		26	381913	5444735	26-Oct-02	517	75
		27	387900	5441022	26-Oct-02	478	50
		28	392216	5444141	26-Oct-02	678	65
		29	401343	5443856	26-Oct-02	565	55
	Beach Seine						
		35	392216	5444141	26-Oct-02		75

Appendix B2. Catch rate information for fish species recorded at sites sampled during the fish Survey on the Milk River, 22 to 27 October 2002

Section	Method	Site	Species	Number Recorded Observed	Captured	Total	Catch Rate*
Primary							
	Backpack Electrofish						
		2					
			Longnose dace	1		1	1.20
		6					
			None			0	
		9					
			Longnose dace	1		1	2.50
		11					
			Flathead chub	2	1	3	3.75
		19					
			Flathead chub	2	1	3	0.56
			Sauger	1		1	0.19
		21					
			Flathead chub	4		4	6.67
			Longnose dace	4		4	6.67
			Sauger	1		1	1.67
	Beach Seine						
		1					
			Flathead chub	2		2	0.44
			Western silvery minnow	4		4	0.89
		3					
			Flathead chub	2		2	0.44
			Western silvery minnow	11		11	2.44
		4					
			Flathead chub	4		4	0.89
		5					
			Flathead chub	7		7	1.56
			Longnose sucker	1		1	0.22
			Western silvery minnow	26		26	5.78
		7					
			Western silvery minnow	1		1	0.22
		8					
			Sauger	2		2	0.44
			Western silvery minnow	3		3	0.67
		10					
			Sauger	1		1	0.22
			Western silvery minnow	1		1	0.22
		12					
			None			0	0.00
		13					
			Flathead chub	11		11	2.44
			Western silvery minnow	4		4	0.89
		14					
			Flathead chub	1		1	0.33
		15					
			Flathead chub	1		1	0.22

Section	Method	Site	Species	Number Recorded Observed	Captured	Total	Catch Rate*
		16					
			Flathead chub	4		4	0.89
		17					
			Flathead chub	6		6	1.33
		18					
			Flathead chub	3		3	0.50
			Longnose sucker	2		2	0.33
			Western silvery minnow	1		1	0.17
		20					
			None			0	
		22					
			Flathead chub	1		1	0.22
		23					
			None			0	
		24					
			None			0	
		30					
			None			0	
		31					
			Flathead chub	2		2	0.44
		32					
			Flathead chub	11		11	2.44
			Sauger	1		1	0.22
			Western silvery minnow	12		12	2.67
		33					
			Flathead chub	1		1	0.22
		34					
			None			0	
Secondary							
	Backpack Electrofish						
		25					
			Longnose dace	4	1	5	5.56
			St Mary sculpin	7	1	8	8.89
			Trout-perch	1		1	1.11
		26					
			Longnose dace	2	12	14	18.67
			Mountain sucker	1	0	1	1.33
			St Mary sculpin	13	8	21	28.00
		27					
			St Mary sculpin	3	1	4	8.00
		28					
			Lake chub	9		9	10.00
			Longnose dace	2	25	27	30.00
			St Mary sculpin	7	10	17	18.89
			Stonecat	1		1	1.11
			Trout-perch	9	25	34	37.78
		29					

Section	Method	Site	Species	Number Recorded Observed	Captured	Total	Catch Rate*
			Lake chub	1		1	1.82
			Longnose dace	1		1	1.82
			Longnose sucker	1		1	1.82
			Mountain sucker	1		1	1.82
			St Mary sculpin	7	2	9	16.36
	Beach Seine						
		35					
			Lake chub	4		4	1.33

Appendix B3. Biological characteristics of fish measured during the fish survey on the Milk River, 22 to 27 October 2002

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
Primary					
	1				
		Flathead chub	142	155	30
		Flathead chub	143	157	36
		Western silvery minnow	62	68	2
		Western silvery minnow	101	110	12
		Western silvery minnow	95	104	10
		Western silvery minnow	103	114	14
	2				
		Longnose dace	54	57	
	3				
		Flathead chub	113	127	16
		Flathead chub	73	79	4
		Western silvery minnow	106	114	14
		Western silvery minnow	83	89	2
		Western silvery minnow	91	100	8
		Western silvery minnow	90	98	6
		Western silvery minnow	100	108	12
		Western silvery minnow	100	110	12
		Western silvery minnow	110	122	16
		Western silvery minnow	92	101	8
		Western silvery minnow	105	111	10
		Western silvery minnow	35	41	
		Western silvery minnow	102	108	10
	4				
		Flathead chub	91	102	8
		Flathead chub	115	122	18
		Flathead chub	82	87	6
		Flathead chub	80	89	6
	5				
		Flathead chub	93	103	12
		Flathead chub	106	117	16
		Flathead chub	118	130	22
		Flathead chub	87	95	6
		Flathead chub	114	125	16
		Flathead chub	102	112	12
		Flathead chub	74	81	
		Longnose sucker	140	148	32
		Western silvery minnow	99	109	12
		Western silvery minnow	115	124	16
		Western silvery minnow	99	109	10
		Western silvery minnow	90	100	8
		Western silvery minnow	104	114	14

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
		Western silvery minnow	95	104	6
		Western silvery minnow	92	102	8
		Western silvery minnow	62	67	
		Western silvery minnow	51	55	
		Western silvery minnow	91	100	6
		Western silvery minnow	94	104	10
		Western silvery minnow	40	42	
		Western silvery minnow	96	105	14
		Western silvery minnow	86	95	8
		Western silvery minnow	94	102	10
		Western silvery minnow	97	106	12
		Western silvery minnow	97	108	12
		Western silvery minnow	92	100	6
		Western silvery minnow	102	112	12
		Western silvery minnow	105	116	16
		Western silvery minnow	122	133	24
		Western silvery minnow	102	112	10
		Western silvery minnow	104	115	16
		Western silvery minnow	92	102	8
		Western silvery minnow	90	97	8
		Western silvery minnow	48	51	
	7				
		Western silvery minnow	51	56	
	8				
		Sauger	94	100	6
		Sauger	73	77	
		Western silvery minnow	43	47	
		Western silvery minnow	35	38	
		Western silvery minnow	36	39	
	9				
		Longnose dace	55	56	
	10				
		Sauger	143	151	22
		Western silvery minnow	55	61	
	11				
		Flathead chub	145	160	36
		Flathead chub	79	87	8
	13				
		Flathead chub	110	122	18
		Flathead chub	86	94	10
		Flathead chub	103	116	14
		Flathead chub	88	98	10
		Flathead chub	84	96	8

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
		Flathead chub	137	152	30
		Flathead chub	121	135	22
		Flathead chub	145	162	
		Flathead chub	130	145	28
		Flathead chub	114	128	18
		Flathead chub	91	98	8
		Western silvery minnow	95	104	12
		Western silvery minnow	90	99	10
		Western silvery minnow	91	100	8
		Western silvery minnow	107	114	16
	14				
		Flathead chub	147	161	40
	15				
		Flathead chub	45	47	
	16				
		Flathead chub	77	87	
		Flathead chub	77	86	
		Flathead chub	44	47	
		Flathead chub	31	33	
	17				
		Flathead chub	135	149	30
		Flathead chub	45	48	
		Flathead chub	85	94	6
		Flathead chub	86	92	6
		Flathead chub	121	136	22
		Flathead chub	105	118	14
	18				
		Flathead chub	88	97	
		Flathead chub	132	148	30
		Flathead chub	129	142	28
		Longnose sucker	115	124	16
		Longnose sucker	185	197	68
		Western silvery minnow	95	103	8
	19				
		Flathead chub	42	46	
		Flathead chub	39	41	
		Sauger	76	81	
	21				
		Flathead chub	81	90	6
		Flathead chub	128	142	26
		Flathead chub	41	44	
		Flathead chub	46	50	
		Longnose dace	92	99	

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
		Longnose dace	55	61	
		Longnose dace	31	32	
		Longnose dace	133	141	26
		Sauger	85	92	6
	22				
		Flathead chub	81	92	
	31				
		Flathead chub	120	134	
		Flathead chub	126	140	24
	32				
		Flathead chub	89	98	8
		Flathead chub	82	92	6
		Flathead chub	119	127	20
		Flathead chub	92	101	8
		Flathead chub	104	116	14
		Flathead chub	88	108	8
		Flathead chub	135	151	32
		Flathead chub	116	129	18
		Flathead chub	130	144	26
		Flathead chub	122	137	20
		Flathead chub	122	132	18
		Sauger	92	99	4
		Western silvery minnow	98	109	10
		Western silvery minnow	96	107	12
		Western silvery minnow	92	103	10
		Western silvery minnow	98	109	12
		Western silvery minnow	92	102	10
		Western silvery minnow	91	100	8
		Western silvery minnow	95	104	10
		Western silvery minnow	105	116	12
		Western silvery minnow	97	106	12
		Western silvery minnow	89	99	6
		Western silvery minnow	91	100	10
		Western silvery minnow	88	97	10
	33				
		Flathead chub	122	135	24
Secondary					
	25				
		Longnose dace	55	57	
		Longnose dace	55	58	
		Longnose dace	53	55	
		Longnose dace	35	36	
		St Mary sculpin		63	4

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
		St Mary sculpin		61	2
		St Mary sculpin		63	
		St Mary sculpin		56	
		St Mary sculpin		57	4
		St Mary sculpin		55	
		St Mary sculpin		65	4
		Trout-perch	49	52	
	26				
		Longnose dace	25	27	
		Longnose dace	27	29	
		Mountain sucker	74	79	
		St Mary sculpin		35	
		St Mary sculpin		63	
		St Mary sculpin		92	10
		St Mary sculpin		85	8
		St Mary sculpin		85	8
		St Mary sculpin		84	8
		St Mary sculpin		60	2
		St Mary sculpin		67	4
		St Mary sculpin		64	
		St Mary sculpin		55	
		St Mary sculpin		56	
		St Mary sculpin		37	
		St Mary sculpin		68	4
	27				
		St Mary sculpin		55	
		St Mary sculpin		79	6
		St Mary sculpin		63	
	28				
		Lake chub	79	86	
		Lake chub	42	45	
		Lake chub	41	43	
		Lake chub	48	50	
		Lake chub	48	51	
		Lake chub	44	47	
		Lake chub	38	41	
		Lake chub	81	87	
		Lake chub	44	48	
		Longnose dace	35	37	
		Longnose dace	41	43	
		St Mary sculpin		46	
		St Mary sculpin		71	2
		St Mary sculpin		81	10
		St Mary sculpin		75	6

Zone	Site	Species	Fork Length (mm)	Total Length (mm)	Weight (gm)
		St Mary sculpin		65	2
		St Mary sculpin		63	
		St Mary sculpin		42	
		Stonecat		165	44
		Trout-perch	43	47	
		Trout-perch	37	41	
		Trout-perch	43	48	
		Trout-perch	39	43	
		Trout-perch	50	56	
		Trout-perch	39	42	
		Trout-perch	32	35	
		Trout-perch	50	55	
		Trout-perch	48	54	
	29				
		Lake chub	44	47	
		Longnose dace	77	83	
		Longnose sucker	251	262	152
		Mountain sucker	142	155	44
		St Mary sculpin		72	4
		St Mary sculpin		74	
		St Mary sculpin		60	
		St Mary sculpin		67	4
		St Mary sculpin		74	6
		St Mary sculpin		69	
		St Mary sculpin		70	4
	35				
		Lake chub	38	40	
		Lake chub	41	43	
		Lake chub	48	50	
		Lake chub	37	38	

APPENDIX C

Habitat Data

Appendix C1. General habitat characteristics at sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

Section	Site	River Stage	WaterTemp. (C deg.)	Conductivity (microsiemns)	pH	DO (ppm)	Clarity (m)	Turbidity (NTU)	Dominant Habitat
Primary									
	1	Low	0.4	530	8.6	14.1	0.10		R3
	2	Low	0.4	540	8.6	14.3	0.15		R3
	3	Low	0.9	550	8.6	13.9	0.13		R3
	4	Low	0.8	560	8.6	13.9	0.23		R3
	5	Low	0.3	550	8.6	14.3	0.15		R3
	6	Low	-3.1	80	8.6		0.20		RFBG
	7	Low	-3.0	140	8.6		0.20		R3
	8	Low	-2.5	180	8.6	13.1	0.16		R3
	9	Low	-1.7	90	8.6	13.1	0.33		RFBG
	10	Low	-1.7	90	8.6	13.1	0.25		R3
	11	Low	-1.3	140	8.6	13.5	0.24		R3BG
	12	Low	-1.4	140	8.6	13.5	0.22		R3
	13	Low	-2.5	400	8.6	13.1	0.17		R3
	14	Low	-2.0	400	8.6	12.9	0.18		R3
	15	Low	-1.9	410	8.6	12.9	0.18		R3
	16	Low	-1.5	400	8.6	13.4	0.19		R3
	17	Low	-0.8	380	8.6	13.5	0.19		R3
	18	Low	-2.2	430	8.6	13.5	0.18		R3
	19	Low	-1.4	410	8.6	13.6	0.19		RF
	20	Low	-0.4	450	8.6	14.1	0.25		R3
	21	Low	-0.6	440	8.6	13.7	0.26		RF
	22	Low	0.0	410	8.6	14.6	0.26		R3
	23	Low	0.0	440	8.6	14.5	0.26		R3
	24	Low	-0.2	460	8.6	14.1	0.28		R3
	30	Low	-0.7	450	8.6	13.6	0.21		R3
	31	Low	-0.3	450	8.6	13.9	0.18	16.2	R3
	32	Low	0.2	450	8.6	14.0	0.22		R3
	33	Low	0.1	460	8.6	13.9	0.19		R3
	34	Low	-3.1	80	8.6		0.20		R3
Secondary									
	25	Low	-2.5	360	8.6	15.0	1.50		R3BG
	26	Low	-2.8	370	8.6	15.0	1.50		R3
	27	Low	-2.3	350	8.6	15.0	1.50		R3
	28	Low	-1.8	110	8.6	15.0	1.50		R3BG
	29	Low	-1.8	130	8.6	15.0	1.50	1.5	RF
	35	Low	-1.8	110	8.6	15.0	1.50		R3

Appendix C2 – Habitat characteristics at sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

Section	Site	Trans.	Channel	Chan. Width (m) Wetted	Chan. Width (m) Active	Habitat	Area >1.0 m (%)	Capture Depth (m)	Capture Vel. (m/s)	Maximum Depth (m)	Maximum Vel. (m/s)	Silt Depth (m)	D90 (m)	Substrate (%) Org.	Substrate (%) Si.	Substrate (%) Sa.	Substrate (%) Gr.	Substrate (%) Co	Substrate (%) Bo.	Cover (%) Bo.	Cover (%) Ov.	Cover (%) Dp./Tr.	Cover (%) LOD
Primary																							
	1	2	U-shaped	10.0	106.0	R3	0	0.70	0.01	1.14	0.01	0.01	0.02		10	90						90	
	1	3	U-shaped	5.5	106.0	R3	0	0.46	0.08	0.51	0.08	0.01	0.02		10	90						90	
	1	1	U-shaped	8.0	106.0	BW	15	1.40	0.01	1.40	0.01	0.02	0.02		10	90						90	
	2	1	U-shaped	25.0	43.0	RFBG	0	0.13	0.33	0.33	0.65	0.00	0.28	5	5	50	5	10	25	15		10	
	2	2	U-shaped	22.0	41.0	R3	0	0.25	0.22	0.72	0.35	0.01	0.24		5	45	20	15	15	5		10	
	2	3	U-shaped	22.0	41.0	R3	0	0.60	0.18	0.60	0.18	0.01	0.21	5	5	45	15	15	15	10		10	
	3	1	U-shaped	10.0	82.0	R3	5	0.28	0.12	0.98	0.20	0.01	0.02		10	90						85	
	3	2	U-shaped	10.0	82.0	R3	0	0.25	0.16	0.25	0.09	0.01	0.02		10	90						85	
	3	3	U-shaped	10.0	82.0	R3	0	0.16	0.16	0.24	0.14	0.01	0.02		10	90						85	
	4	1	U-shaped	5.0	66.0	R3	0	0.19	0.28	0.39	0.34	0.00	0.02		10	90						65	
	4	2	U-shaped	5.0	66.0	R3	0	0.43	0.21	0.43	0.21	0.00	0.02	5	10	85						65	
	4	3	U-shaped	8.5	66.0	R3	0	0.14	0.21	0.25	0.30	0.00	0.02		10	90						65	
	5	1	U-shaped	64.0	100.0	R3	0	0.48	0.13	0.48	0.13	0.01	0.02	5	10	85						80	5
	5	2	U-shaped	64.0	100.0	R3	0	0.42	0.30	0.42	0.30	0.01	0.02	5	10	85						80	5
	5	3	U-shaped	64.0	100.0	R3	0	0.86	0.32	0.86	0.32	0.01	0.02	5	10	85						80	
	6	1	U-shaped	24.0	57.0	R3	0	0.34	0.27	0.47	0.36	0.00	0.02		5	95						10	
	6	2	U-shaped	24.0	57.0	R3	0	0.38	0.10	0.55	0.01	0.00	0.80		10	50		10	30	25		10	
	6	3	U-shaped	24.0	57.0	R3	0	0.39	0.25	0.36	0.07	0.00	0.02		5	95						10	
	7	1	U-shaped	23.0	57.0	R3	0	0.20		0.35		0.00	0.02		5	95						10	

Section	Site	Trans.	Channel	Chan. Width (m) Wetted	Chan. Width (m) Active	Habitat	Area >1.0 m (%)	Capture Depth (m)	Capture Vel. (m/s)	Maximum Depth (m)	Maximum Vel. (m/s)	Silt Depth (m)	D90 (m)	Substrate (%) Org.	Si.	Sa.	Gr.	Co	Bo.	Cover (%) Bo.	Ov.	Dp./Tr.	LOD
	14	3	U-shaped	8.0	62.0	R3	0	0.14	0.12	0.44	0.27	0.01	0.02		5	95						50	
	14	1	U-shaped	8.0	62.0	R3	0	0.41	0.27	0.61	0.25	0.01	0.02		5	95						50	
	14	2	U-shaped	8.0	62.0	R3	0	0.56	0.19	0.56	0.19	0.01	0.02		5	95						50	
	15	1	U-shaped	19.0	72.0	R3	0	0.29	0.31	0.52	0.42	0.00	0.02		5	95						70	
	15	2	U-shaped	19.0	72.0	R3	0	0.37	0.25	0.51	0.40	0.00	0.02		5	95						70	
	15	3	U-shaped	19.0	72.0	R3	0	0.40	0.39	0.41	0.51	0.00	0.02		5	95						70	
	16	1	U-shaped	36.0	106.0	R3	0	0.51	0.24	0.61	0.55	0.00	0.02		5	95						15	
	16	2	U-shaped	36.0	106.0	R3	0	0.41	0.29	0.22	0.33	0.00	0.02		5	95						15	
	16	3	U-shaped	36.0	106.0	R3	0	0.52	0.45	0.21	0.31	0.00	0.02		5	95						15	
	17	3	U-shaped	15.0	95.0	R3	0	0.17	0.26	0.29	0.35	0.01	0.02		10	90						75	
	17	1	U-shaped	6.0	93.0	R3	0	0.16	0.23	0.42	0.36	0.00	0.02		5	95						75	
	17	2	U-shaped	16.0	95.0	R3	0	0.29	0.31	0.18	0.24	0.01	0.02		10	90						75	
	18	2	U-shaped	29.0	106.0	BW	0	0.27	0.01	0.27	0.01	0.00	0.02		5	95						30	
	18	3	U-shaped	29.0	106.0	R3	0	0.21	0.01	0.38	0.24	0.00	0.02		5	95						20	
	18	1	U-shaped	29.0	106.0	R3	0	0.24	0.13	0.36	0.18	0.00	0.02		5	95						50	
	19	1	U-shaped	26.0	57.0	RF	0	0.10	0.22	0.20	0.67	0.00	0.39		5	5	65	25	10	5			
	19	2	U-shaped	26.0	57.0	R3BG	0	0.38	0.35	0.24	0.82	0.00	0.93		5	10	15	20	50	30		40	
	19	3	U-shaped	26.0	57.0	BW	10	0.40	0.01	0.70	0.02	0.01	0.98	5	10	85				5		75	
	19	4	U-shaped	26.0	57.0	BW	10	0.61	0.01	1.00		0.01	1.01		5	85			10	10		75	
	20	3	U-shaped	41.0	98.0	R3	0	0.21	0.20	0.30	0.26	0.01	0.02		5	95						35	

Section	Site	Trans.	Channel	Chan. Width (m) Wetted	Chan. Width (m) Active	Habitat	Area >1.0 m (%)	Capture Depth (m)	Capture Vel. (m/s)	Maximum Depth (m)	Maximum Vel. (m/s)	Silt Depth (m)	D90 (m)	Substrate (%) Org.	Substrate (%) Si.	Substrate (%) Sa.	Substrate (%) Gr.	Substrate (%) Co	Substrate (%) Bo.	Cover (%) Bo.	Cover (%) Ov.	Cover (%) Dp./Tr.	Cover (%) LOD
	20	1	U-shaped	41.0	98.0	R3	5	0.70	0.40	1.17	0.17	0.01	0.02		5	95						35	
	20	2	U-shaped	41.0	98.0	R3	0	0.42	0.35	0.54	0.35	0.01	0.02		5	95						35	
	21	3	U-shaped	24.0	51.0	R3BG	5	0.43	0.01	0.65	0.15	0.05	0.83		15	80			5	10			
	21	1	U-shaped	24.0	51.0	RF	0	0.13	0.66	0.15	0.74	0.00	0.09		10	5	40	45		10			
	21	2	U-shaped	24.0	51.0	RF	0	0.21	0.22	0.38	0.28	0.00	0.18		5	5	25	60	5	10			
	22	1	U-shaped	34.0	67.0	R3	0	0.39	0.38	0.50	0.37	0.01	0.02		5	95					10		
	22	2	U-shaped	34.0	67.0	R3	0	0.37	0.34	0.64	0.48	0.01	0.02		5	95					10		
	22	3	U-shaped	34.0	67.0	R3	0	0.41	0.23	0.53	0.28	0.01	0.02		5	95					10		
	23	1	U-shaped	10.0	184.0	F3	15	0.35	0.09	0.66	0.12	0.00	0.02		5	95					5	50	
	23	2	U-shaped	11.0	184.0	R3	0	0.14	0.21	0.29	0.33	0.00	0.02		5	95						30	
	23	3	U-shaped	26.0	66.0	R3	0	0.22	0.29	0.50	0.62	0.00	0.02		5	95						30	
	24	1	U-shaped	21.0	72.0	R3	0	0.33	0.26	0.50	0.29	0.00	0.02		5	95						40	
	24	2	U-shaped	21.0	72.0	R3	0	0.33	0.21	0.58	0.23	0.00	0.02		5	95						40	
	24	3	U-shaped	21.0	72.0	R3	0	0.29	0.15	0.56	0.22	0.00	0.02		5	95						40	
	30	2	U-shaped	26.0	71.0	R3	0	0.31	0.38	0.33	0.48	0.00	0.02		5	95						55	
	30	1	U-shaped	26.0	71.0	R3	0	0.30	0.17	0.37	0.32	0.00	0.02		5	95						55	
	30	3	U-shaped	26.0	71.0	R3	0	0.25	0.29	0.41	0.32	0.00	0.02		5	95						55	
	31	1	U-shaped	35.0	102.0	R3	0	0.16	0.13	0.46	0.06	0.00	0.02		5	95						40	
	31	2	U-shaped	35.0	102.0	R3	0	0.14	0.30	0.18	0.35	0.00	0.02		5	95						40	
	31	3	U-shaped	35.0	102.0	R3	0	0.21	0.29	0.27	0.45	0.00	0.02		5	95						40	

Section	Site	Trans.	Channel	Chan. Width (m) Wetted	Active	Habitat	Area >1.0 m (%)	Capture Depth (m)	Vel. (m/s)	Maximum Depth (m)	Vel. (m/s)	Silt Depth (m)	D90 (m)	Org.	Substrate (%) Si.	Sa.	Gr.	Co	Bo.	Cover (%) Bo.	Ov.	Dp./Tr.	LOD
	32	3	U-shaped	34.0	57.0	R3	0	0.31	0.09	0.21	0.27	0.00	0.02		5	95						60	
	32	1	U-shaped	34.0	57.0	R3	0	0.28	0.01	0.46	0.09	0.00	0.02		5	95						60	
	32	2	U-shaped	34.0	57.0	R3	0	0.30	0.02	0.22	0.29	0.00	0.02		5	95						60	
	33	1	U-shaped	21.0	91.0	R3	0	0.48	0.29	0.63	0.43	0.00	0.02		5	95						55	
	33	2	U-shaped	21.0	91.0	R3	0	0.45	0.16	0.67	0.50	0.00	0.02		5	95						55	
	33	3	U-shaped	21.0	91.0	R3	0	0.37	0.22	0.54	0.45	0.00	0.02		5	95						55	
	34	1	U-shaped	24.0	57.0	R3	0	0.28	0.17	0.39	0.28	0.00	0.02		5	95						10	
Secondary																							
	25	3	U-shaped	12.0	39.0	R3BG	0	0.30		0.55		0.00	0.64		5		15	35	45	45			
	25	2	U-shaped	12.0	39.0	R3BG	0	0.25		0.47		0.00	0.80		10		5	40	50	55			
	25	1	U-shaped	17.0	39.0	RF	0	0.14		0.20		0.00	0.30		5	5	75	15		30			
	26	2	U-shaped	27.0	27.0	BW	5	0.54		0.55		0.05	0.02		5	95							
	26	3	U-shaped	14.0	27.0	RF	0	0.19		0.19		0.00	0.20		5	5	85	5		5			
	26	1	U-shaped	14.0	27.0	R3	0	0.25		0.43		0.00	0.35	5	5		15	70	5	40			
	27	3	U-shaped	21.0	27.0	R3	0	0.77		0.79		0.01	0.81		5		15	30	50	40			
	27	2	U-shaped	21.0	27.0	R3	0	0.48		0.90		0.01	0.98		5	10	5	25	55	45			
	27	1	U-shaped	21.0	27.0	R3	0	0.37		0.47		0.00	0.60		5		40	40	25	45			
	28	3	U-shaped	19.0	26.0	R3	0	0.27	0.01	0.29	0.24	0.01	0.44		10		20	30	40	55			
	28	2	U-shaped	19.0	26.0	R3	0	0.20	0.33	0.46	0.13	0.01	0.76		10		5	10	75	75			
	28	1	U-shaped	19.0	26.0	R3	0	0.31	0.01	0.44	0.11	0.01	0.51		10		15	35	40	60			

Section	Site	Trans.	Channel	Chan. Width (m) Wetted	Chan. Width (m) Active	Habitat	Area >1.0 m (%)	Capture Depth (m)	Capture Vel. (m/s)	Maximum Depth (m)	Maximum Vel. (m/s)	Silt Depth (m)	D90 (m)	Org.	Substrate (%) Si.	Substrate (%) Sa.	Substrate (%) Gr.	Substrate (%) Co	Substrate (%) Bo.	Cover (%) Bo.	Cover (%) Ov.	Cover (%) Dp./Tr.	Cover (%) LOD
	29	3	U-shaped	27.0	40.0	R3	0	0.43	0.11	0.63	0.29	0.01	0.76		10	5	10	30	45	50			
	29	2	U-shaped	27.0	40.0	R3	0	0.46	0.51	0.55	0.46	0.01	0.94		10	5	5	20	60	55			
	29	1	U-shaped	27.0	40.0	RF	0	0.14	0.01	0.36	0.34	0.01	0.65		10		60	45	5	30			
	35	3	U-shaped	19.0	26.0	R3	0	0.29	0.22	0.58	0.22	0.00	0.06		5	20	70						
	35	1	U-shaped	19.0	26.0	R3	0	0.39	0.46	0.55	0.52	0.00	0.06		5	20	70						
	35	2	U-shaped	19.0	26.0	R3	0	0.24	0.16	0.48	0.31	0.01	0.05		5	25	70						

Appendix C3. Fish habitat quality ratings for sites sampled during the fish survey on the Milk River, 22 to 27 October 2002

			Habitat Quality Rating			
Section	**Site**	**Species**	**Spawn**	**Rear**	**Overwinter**	**Movement**
Primary						
	1					
		Sauger	Low	Moderate	Low	High
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Moderate	Moderate	Low	High
		Brassy minnow	Moderate	Moderate	Low	Moderate
	2					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	3					
		Brassy minnow	Low	Moderate	Low	Moderate
		Western silvery minnow	Low	Moderate	Low	Moderate
		Stonecat	Low	Low	Low	Low
		Sauger	Low	Moderate	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
	4					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	5					
		Stonecat	Low	Low	Low	Low
		Brassy minnow	Moderate	Moderate	Low	Moderate
		Western silvery minnow	Moderate	Moderate	Low	Moderate
		Sauger	Low	Moderate	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
	6					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Moderate	Low	Moderate
		Western silvery minnow	Low	Low	Low	Low

			Habitat Quality Rating			
Section	**Site**	**Species**	**Spawn**	**Rear**	**Overwinter**	**Movement**
	7					
		Sauger	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
	8					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	9					
		Stonecat	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	10					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	11					
		Sauger	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
	12					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	13					

Section	Site	Species	Habitat Quality Rating Spawn	Rear	Overwinter	Movement
		Western silvery minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
	14					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Moderate	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Moderate
	15					
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Sauger	Low	Low	Low	Moderate
		Brassy minnow	Low	Low	Low	Low
	16					
		Sauger	Low	Moderate	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Moderate
		Brassy minnow	Low	Low	Low	Low
	17					
		Brassy minnow	Low	Moderate	Low	Moderate
		Sauger	Low	Moderate	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Moderate	Low	Moderate
	18					
		Stonecat	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
	19					
		Brassy minnow	Low	Low	Low	Low

Section	Site	Species	Habitat Quality Rating Spawn	Rear	Overwinter	Movement
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	20					
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	21					
		Sauger	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Moderate	Low	Moderate
	22					
		Western silvery minnow	Low	Low	Low	Moderate
		Brassy minnow	Low	Low	Low	Moderate
		Sauger	Low	Low	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
	23					
		Western silvery minnow	Low	Moderate	Moderate	Moderate
		Stonecat	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Brassy minnow	Low	Moderate	Moderate	Moderate
		Sauger	Low	Moderate	Moderate	Moderate
	24					
		Brassy minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
	30					
		St. Mary sculpin	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low

Section	Site	Species	Spawn	Rear	Overwinter	Movement
			Habitat Quality Rating			
		Sauger	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
	31					
		Western silvery minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
	32					
		Western silvery minnow	Low	Low	Low	Moderate
		Sauger	Low	Low	Low	Moderate
		St. Mary sculpin	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Moderate
		Stonecat	Low	Low	Low	Low
	33					
		Brassy minnow	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
	34					
		Stonecat	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
Secondary						
	25					
		Brassy minnow	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		Stonecat	High	High	High	High
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	High	High	High	High
	26					
		Western silvery minnow	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low

			Habitat Quality Rating			
Section	**Site**	**Species**	**Spawn**	**Rear**	**Overwinter**	**Movement**
		St. Mary sculpin	High	High	High	High
		Sauger	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
	27					
		Brassy minnow	Low	Low	Low	Low
		Western silvery minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		Stonecat	High	High	High	High
		St. Mary sculpin	Moderate	Moderate	High	High
	28					
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	High	High	High	High
		Stonecat	High	High	High	High
		Western silvery minnow	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
	29					
		Western silvery minnow	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	High	High	High	High
		Stonecat	High	High	High	High
	35					
		Western silvery minnow	Low	Low	Low	Low
		Brassy minnow	Low	Low	Low	Low
		Sauger	Low	Low	Low	Low
		St. Mary sculpin	Low	Low	Low	Low
		Stonecat	Low	Low	Low	Low

MILK RIVER 2002 AERIAL RAPTOR SURVEY

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1.0 INTRODUCTION

The primary objective of the Milk River 2002 Aerial Raptor Survey was to survey all potential raptor nesting habitat along the Milk River and associated coulees. The survey was designed as part of the Milk River Basin Species at Risk Conservation project, and fell within one of the overall project objectives of identifying and prioritizing areas of the landscape of importance to species at risk. The results of this survey will assist in the designation of priority areas for conservation and stewardship activities.

Prior to this survey, a similar aerial inventory was carried out in 2000 as part of the provincial peregrine falcon survey (Corrigan 2000, Erickson 2000). In 2000, the survey included the Milk and North Milk River valleys from the point where the rivers enter Alberta downstream to a point approximately 15 km below Writing-on-Stone Provincial Park. This represented about 60% of the drainage. In 2002 the same portion was surveyed, plus the remainder of the river valley downstream to the outflow point into Montana.

The Milk River Aerial Raptor Survey provided the opportunity to inventory all raptors and associated species along the Milk River within a short period of time (3 days). During spring 2002 there were also ground surveys of previously established ferruginous hawk quadrats within the Milk River Basin. These were established in 1982 and resurveyed in 1987, 1992, and 2000 (Stepnisky *et al.* 2002). The quadrats are used to determine population trends and have recently been redesigned to more accurately estimate size of the provincial ferruginous hawk population (Taylor 2003).

2.0 METHODS

Intensive surveys were conducted using a Bell 206 Jet Ranger helicopter along the entire Alberta portion of the Milk River plus associated coulees that contained suitable raptor habitat (cliffs, hoodoos, trees).

Cliffs suitable for nesting were thoroughly searched by flying the helicopter along the face of the cliff and watching for birds flushing from the cliff or for adults, young, eggs, or nests on the cliff. Observations of all birds of prey nests and individuals were recorded. Young and eggs were only recorded where seen, as it was not possible to thoroughly search nest sites. Canada goose nests were recorded, however total numbers of geese not associated with nests were not recorded.

Location co-ordinates for observations were determined using Garmin 12XL GPS primary and backup units. Specific co-ordinates are not displayed in this report, but rather stored in the

Lethbridge wildlife database and Alberta's Biodiversity Species Observation Database (BSOD). Requests for specific locations should be made to the Alberta Fish and Wildlife Division Lethbridge Area Wildlife Biologist. The locations represent the position of the helicopter at the time of the observation, not the location of the nest or individual observed, however, most nest co-ordinate locations are within 50 meters of the actual nest location.

Two observers participated in the survey. The observers were situated in the left front seat and right rear seat of the helicopter. The front seat observer also navigated and recorded sightings.

Surveys were conducted from 0730-1337 hours on May 29, 0707-1725 hours on May 30, and 0700-0915 hours on May 31. Conditions were clear and sunny, with excellent visibility. Wind was from the west and southwest, and generally varied from 15 km/hr to 30 km/hr throughout the survey, but up to 65 km/hr by mid-day on May 30. This resulted in a temporary suspension of the May 30 survey near Writing-on-Stone Provincial Park due to the high risk of low level flying in strong winds.

Fuel drums were hauled by truck to strategic locations along the survey route. This reduced the total flying time required for the survey.

3.0 RESULTS

A total of 17.3 hours helicopter time was required to complete the Milk River aerial raptor survey. Forty-two active raptor nests were recorded (Table 2.3.1). This included nests of 18 prairie falcon, 15 ferruginous hawk, 3 golden eagle, 3 Swainson's hawk, and 3 red-tailed hawk. In addition, there were 12 Canada goose nests and there was 1 raven nest (Table 2.3.2). Approximate locations of active raptor nests are shown in Appendix D.

Table 2.3.1 Numbers of raptors observed on the Milk River 2002 aerial raptor survey

SPECIES	# ADULTS	# NESTS	# YOUNG	# EGGS
Ferruginous Hawk	30	15	0	0
Prairie Falcon	37	18	0	6
Golden Eagle	13	3	1	0
Red-tailed Hawk	16	3	2	0
Swainson's Hawk	20	3	0	0
American Kestrel	45	0	0	0
Merlin	5	0	0	0
Northern Harrier	9	0	0	0
Rough-legged Hawk	1	0	0	0
Great Horned Owl	6	0	0	0
TOTAL	182	42	3	6

Table 2.3.2 Numbers of non-raptorial birds observed on the 2002 Milk River aerial raptor survey

SPECIES	# ADULTS	# NESTS	# YOUNG	# EGGS
American White Pelican	4	0	0	0
Canada Goose	10	12	0	28
Great Blue Heron	3	0	0	0
Long-billed Curlew	6	0	0	0
Raven	1	1	0	0

Many empty and inactive nests were observed (Appendix E). These observations were categorized as stick nests in trees (17), stick nests on ground, including cliff ledges and hoodoos (74), or hole nests (7). Some of these nests may have been active, but were not occupied during the short period available for observation during the aerial survey. Some nests may have been abandoned during nesting, or may have been predated upon earlier in the season. Some, but not all, of the nests were clearly inactive as evidenced by various states of disrepair.

A total of 182 individual raptors were sighted on the survey (Table 2.3.1, Appendix F). The most numerous were American kestrel (45), followed by prairie falcon (37), ferruginous hawk (30), Swainson's hawk (20), red-tailed hawk (16), golden eagle (13), northern harrier (9), great horned owl (6), merlin (5), and rough-legged hawk (1). There were not any peregrine falcon observed on this survey. In addition to the raptors, one raven was observed, plus 6 long-billed curlew, 3 great blue heron, 4 American white pelican, and 12 Canada goose (Table 2.3.2). Only Canada geese in association with nests were recorded.

4.0 DISCUSSION

A survey done of most of the area in 2000 found a high density of ferruginous hawk nests along the upper portion of the Milk and St.Mary Rivers (Erickson 2000). Erickson identified this area as a provincial stronghold for ferruginous hawk. In this area a high proportion of the ferruginous hawk nests occur on the ground, usually in association with valley slope ledges and hoodoos (Appendix D).

The number of ferruginous hawks observed in the 2002 aerial survey was similar to that in 2000 (Table 2.3.3). However, the number of active nests in the survey area covered in both surveys dropped from 23 in 2000 to just 15 in 2002 (Table 2.3.3). One probable cause of this reduction was the occurrence of two major snowstorms, with strong north winds, two weeks prior to the survey. These storms resulted in heavy snow drifting into south-facing coulees during the period of ferruginous hawk nest establishment. Several known ground nest locations were covered with snowdrifts during the 2002 survey. This likely resulted in reduced nesting success, or territory shifts within and outside the survey area. The 2002 decrease in ground nests in the North Milk River was coincident with an increase in ferruginous hawk nests in floodplain cottonwoods approximately 10 km further downstream. This may have been a displacement of some of the unsuccessful ground nesters to this area of greater availability of trees.

Based upon the 2002 survey it cannot be concluded that the documented decrease of nesting ferruginous hawks is indicative of a continuing downward trend, but rather a result of some unusually severe weather events. Similar results were gathered from ground surveys conducted in 2000 and 2002 indicating a decline of ferruginous hawk nests from five to two (unpubl. data.). However, three of the nests found in 2000 were located near the North Milk River, which was subject to these weather events that could have affected nesting. Trend can only be confirmed with continued monitoring of the project area.

Table 2.3.3 Comparison between observations on 2000 survey and same portion of 2002 survey (Milk and North Milk River upstream of Aden Bridge)

SPECIES	# Adults 2000	# Adults 2002	# Nests 2000	# Nests 2002
Ferruginous Hawk	29	30	23	15
Prairie Falcon	32	27	25	15
Golden Eagle	1	10	1	2
Swainson's Hawk	3	19	2	3
Red-tailed Hawk	4	12	0	2
American Kestrel	6	15	0	0
Merlin	0	3	0	0
Great Horned Owl	1	6	0	0
Raven	0	1	0	1
Canada Goose	N/A	10	0	12
Great Blue Heron	1	3	0	0
Long-billed Curlew	0	5	0	0

This survey demonstrated some differential use of the Milk River valley by raptors. All of the ferruginous hawk nests were located in the upper Milk River, including the North Milk River. The majority of these nests were located on the ground, generally on cliff ledges and on the tops of hoodoos (Figures 2.3.1 and 2.3.2). This area requires particular attention for ferruginous hawk conservation and stewardship activities.

The middle portion of the survey, Milk River town to Writing-on-Stone Provincial Park, had the highest density of prairie falcons and prairie falcon nests. Most observations were in sandstone cliffs and hoodoos along the river and in Police Coulee.

Figure 2.3.1 Ferruginous hawk nest on ledge, North Milk River

Figure 2.3.2 Ferruginous hawk nest on hoodoo, North Milk River

A second location that produced surprising results was the Milk River Natural Area and the surrounding badlands at the eastern end of the project area (Figure 2.3.3). This area had never been subjected to a thorough aerial survey for raptors, but due to the availability of cliffs and hoodoos, it was anticipated that there would be numerous ferruginous hawk and golden eagle nest sites. This was not the case; several hours flying resulted in very few active or inactive nests observed. One possible clue to this absence was the observation of many areas that had actively slumped in spring 2002. Following the 2002 spring rain and snow events, almost all areas had been subjected to active flow of the bentonitic clay, engulfing rocks and vegetation downslope. At one location, a very large stick nest, most likely constructed by golden eagles, had been almost completely enveloped by the onslaught of flowing clay. The few locations where stable stick nests occurred were in isolated stable rock outcrops.

Figure 2.3.3 Badlands of Milk River Natural Area

While the clay badlands of the Lower Milk River coulees were generally unsuitable for ground stick nests of ferruginous hawk and golden eagle, they were noted to often have a narrow top layer of firm sandstone, located high up on these very deep coulees at the valley breaks. At many locations the sandstone contained numerous holes of various sizes and shapes. Prairie falcons and large numbers of American kestrel occupied these areas.

The Milk River valley supported nesting peregrine falcons until the 1960's, when the widespread use of DDT and other organochloride pesticides severely affected breeding success and resulted in a well-documented species decline in Alberta and elsewhere (Rowell and Stepnisky 1997). Management initiatives during the 1980's and 1990's resulted in increased breeding success and this stimulated down listing of the peregrine falcon in Alberta's Wildlife Act from Endangered to Threatened (Endangered Species Conservation Committee 2000). Stepnisky (1998) predicted positive growth of the peregrine falcon population in southern Alberta. While recolonization of historic range has occurred along the Red Deer and Bow Rivers, the species has yet to be confirmed breeding again in the Milk River Basin (Corrigan 2000). This led to the 2000 Prairie Region Peregrine Falcon Survey (Erickson 2000), and was part of the justification for the Milk River 2000 Aerial Raptor Survey, but neither survey discovered peregrine falcon nests or birds. The Milk River valley does provide suitable habitat for peregrine falcon, and it is anticipated that, if current provincial population trends continue, the species will repopulate this area.

5.0 RECOMMENDATIONS

There are several recommendations resulting from this survey:

- The provincially significant ferruginous hawk population along the North Milk and Milk Rivers from the US - Canada border downstream to the town of Milk River requires continued monitoring to determine whether the population recovers from the poor nesting success of 2002.
- Known ferruginous hawk nest sites require protection from destruction and increased human disturbance.
- For proposed developments, Alberta Fish and Wildlife Guidelines (http://www3.gov.ab.ca/srd/fw/landuse/) should be followed for setback distances and timing constraints around all known raptor nest sites.
- Throughout the Milk River Basin, maintenance of native grasslands should be encouraged through implementation of education, conservation, and stewardship measures to ensure continuation of traditional ranching practices, as opposed to conversion to cultivation.
- Monitoring of raptors along the Milk River should be continued in order to document the expected return of peregrine falcon to this historic and suitable habitat.

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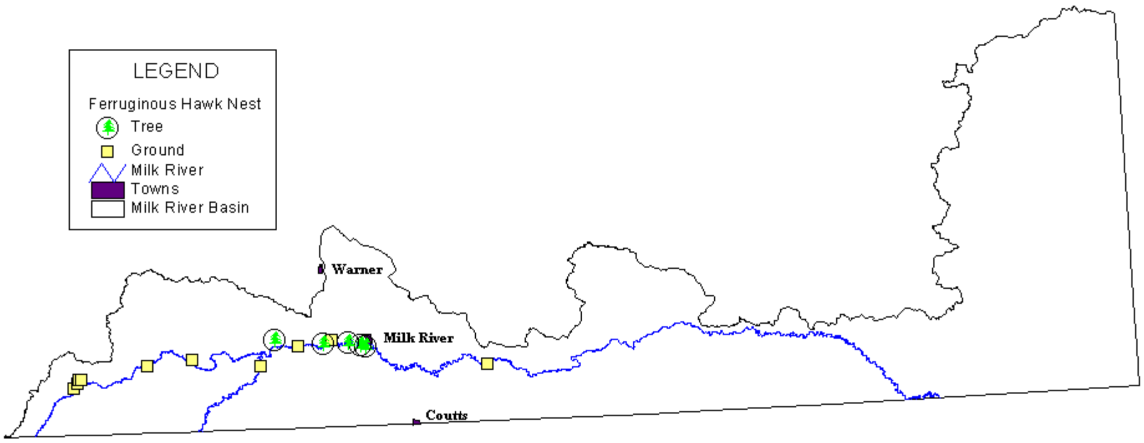
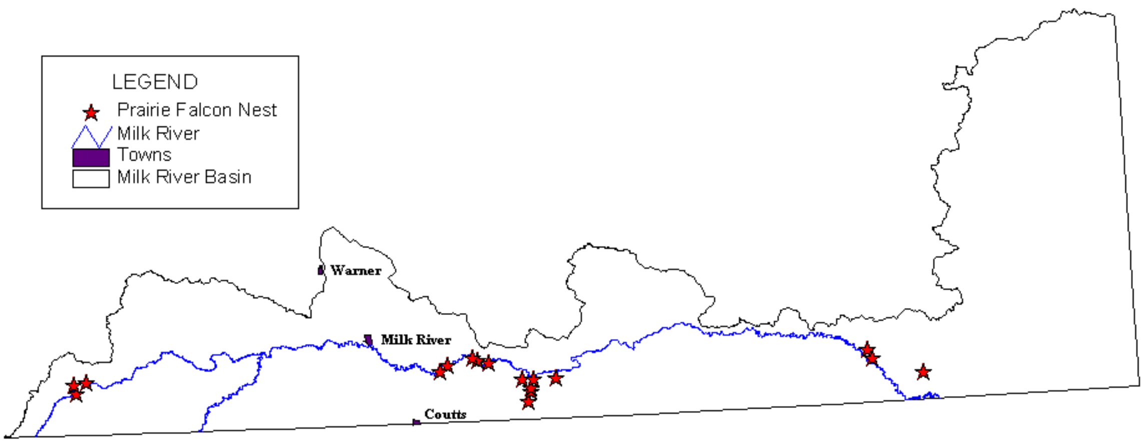
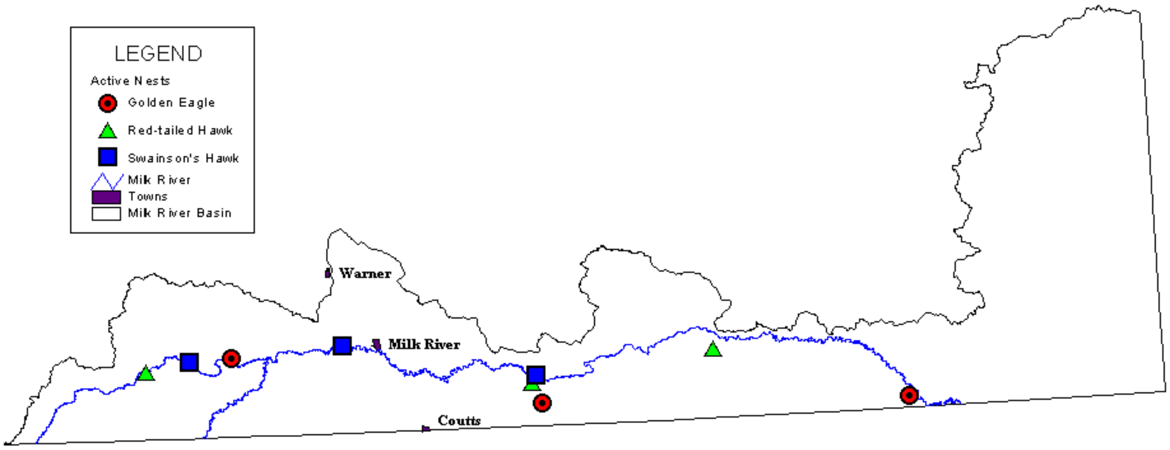
7.0 APPENDICES

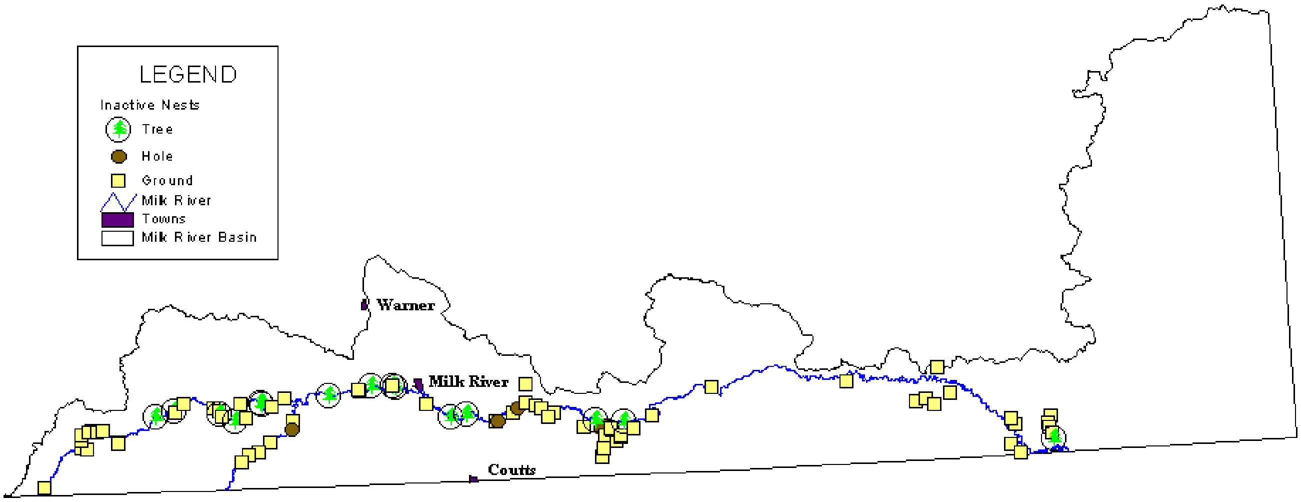
Appendix D – Active Raptor Nests



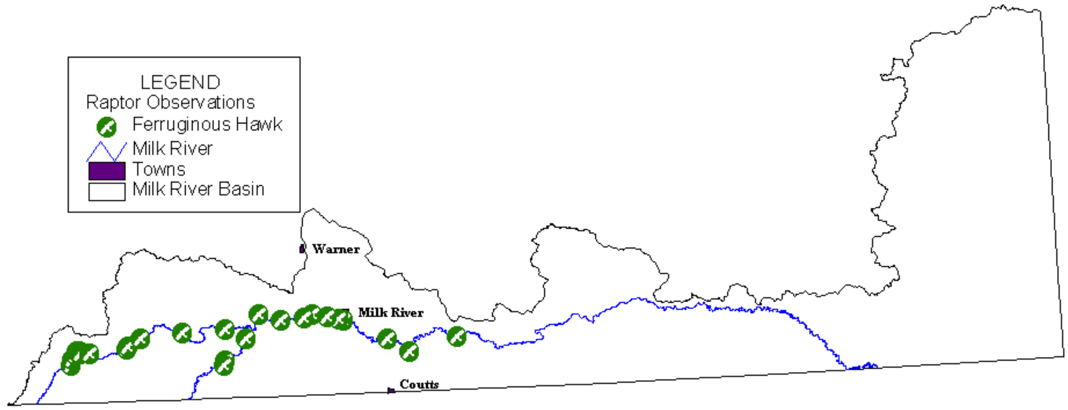


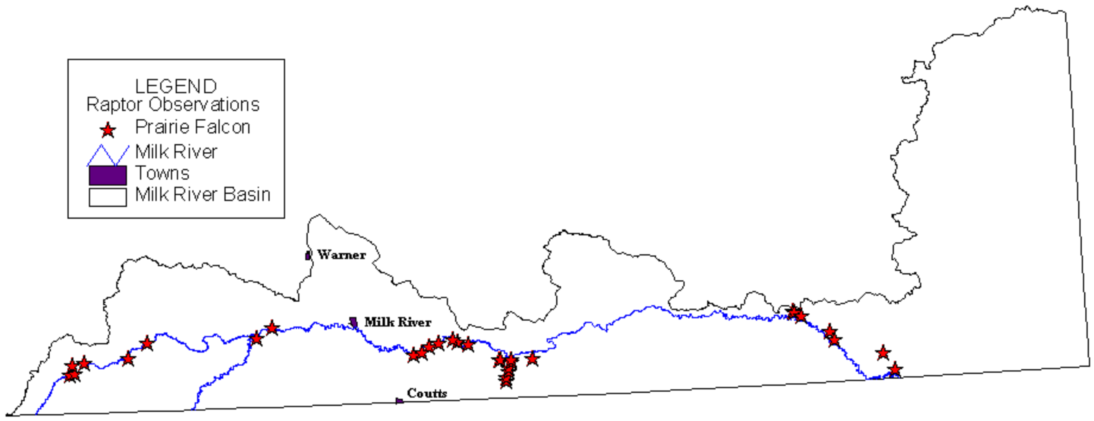


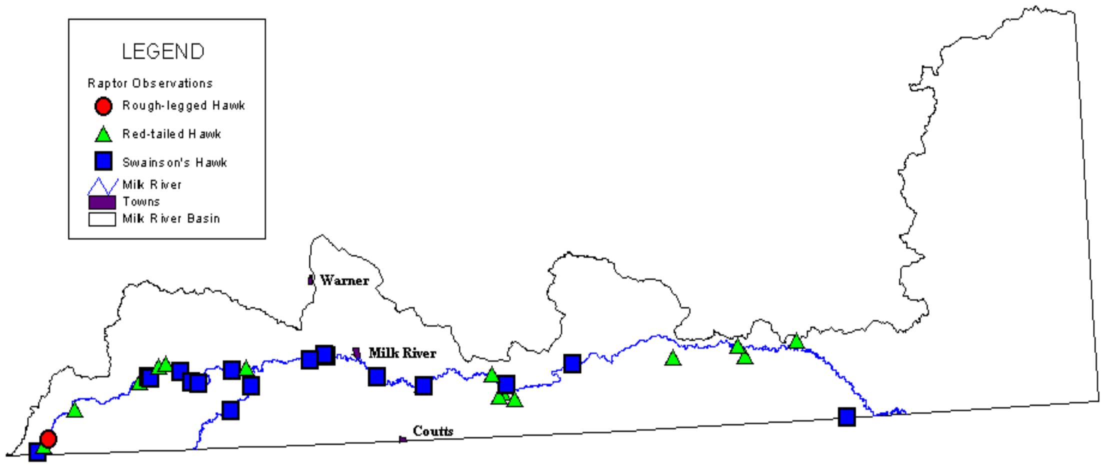
Appendix E – Inactive Raptor Nests

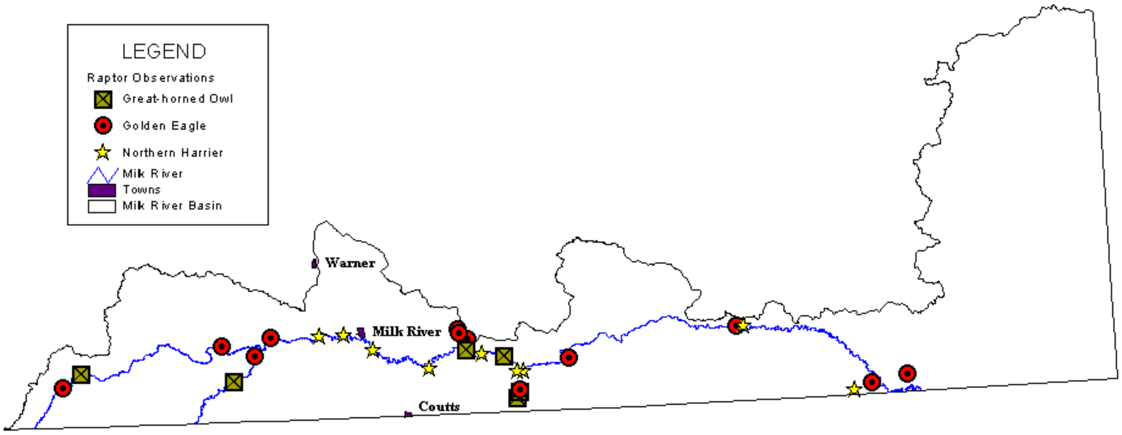


Appendix F – Raptor Observations





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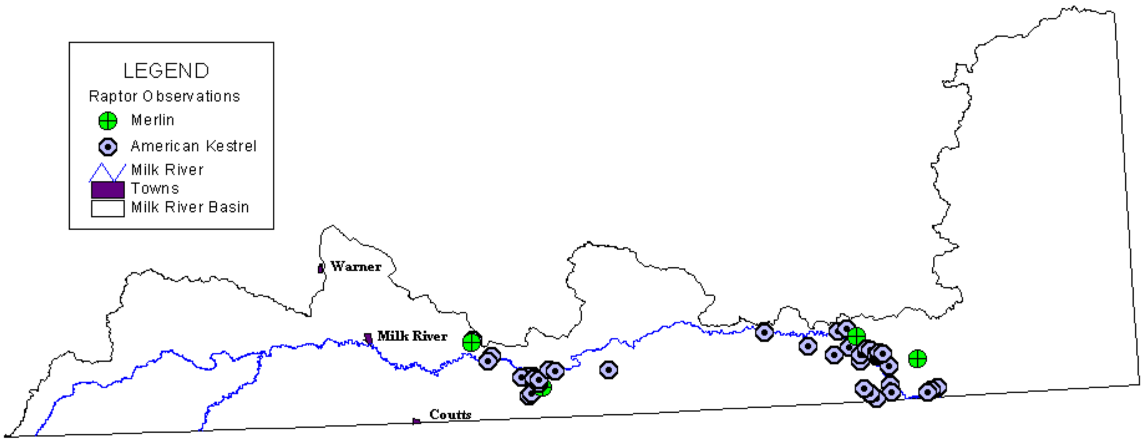
Raptor Observations
Great-horned Owl
Golden Eagle
Northern Harrier
Milk River
Towns
Milk River Basin
Warner
Milk River
Coutts


LEGEND
Raptor Observations
Merlin
American Kestrel
Milk River
Towns
Milk River Basin
Warner
Milk River
Coutts

LOGGERHEAD SHRIKE SURVEYS OF THE MILK RIVER BASIN

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1.0 INTRODUCTION

The loggerhead shrike (*Lanius ludovicianus excubitorides*) is a predatory songbird of the open grasslands and is currently ranked as a "Sensitive" species and a species of "Special Concern" in Alberta (Alberta Sustainable Resource Development 2001). Shrike populations have been declining over the past few decades throughout their range, including Alberta (Collister 1994). The Milk River Basin contains a small population of loggerhead shrikes, with 58 occurrences in the Biodiversity/Species Observation Database (BSOD). Most sightings were recorded around Onefour and Writing-on-Stone Provincial Park. Loggerhead shrike surveys were conducted in 1986, 1987, 1988, and yearly since 1998 by road transects. The road transects were conducted in the west part of the basin around Whiskey Gap and Del Bonita, and the central part of the basin around Writing-on- Stone Provincial Park, Coutts, and Milk River. Studies by Bjorge and Prescott (1996) found that within their east central Alberta study area, around Hanna and Oyen, 42.6% of shrikes would have been missed by road transects. The objectives of the Milk River Basin surveys were to develop a more intensive survey method for shrikes, identify new sites, and determine habitat use of the species to enable habitat mapping. Incidental sightings were also noted while conducting other surveys, including the traditional road transects.

2.0 METHODS

2.1 Block Surveys

Sites to be surveyed were randomly selected by assigning numbers to each of the townships within the basin. A random numbers table was generated, and the first 20 numbers were used. Then, a second random numbers table was created to determine which sections' south-east corner would be the start of the 6.4km by 6.4km survey block for each township. If overlapping occurred between blocks, the next number on the table was selected as the starting point. The size of the blocks was chosen to correspond with similar loggerhead shrike studies conducted by Bjorge and Prescott (1996) on existing ferruginous hawk blocks (6.4km by 6.4km). All twenty blocks (Figure 2.4.1) were highlighted on a 1: 250,000 map for future surveys to occur.

Blocks were surveyed by the observer driving (~ 40kph) around the 6.4km by 6.4km block in search of shrikes or potential habitat. When potential habitat was found, the observer stopped and intensively scanned the area for shrikes. Landowner permission was gained to access prospective sites, as well as sites where shrikes were seen, so that more intensive surveys could be conducted. These intensive surveys involved the observer bicycling or walking the area in search of nests or signs (*e.g.* impaled prey) that indicated a shrike occupied the area. When shrikes were seen, the observer filled out the data sheets (Appendix G) consisting of habitat information for the area, any nest information when available, GPS locations (Garmin II Plus), date, band information, and number seen. In 2002, sites were surveyed between mid to late July, however the preferred survey period would be mid-May, when nesting is initiated, to early July. In Alberta, peak hatching occurs between the 2-10 of June with the young remaining in the nest for ~16 days (Collister 1994).

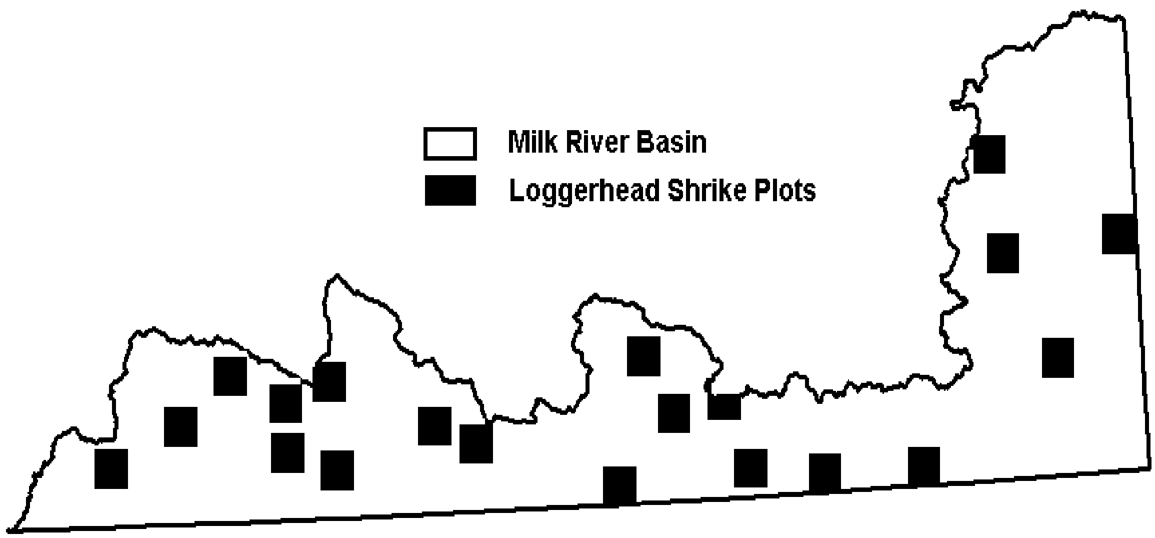


Figure 2.4.1 Loggerhead shrike survey blocks within the Milk River Basin

<u>2.2 Road Transects</u>

Two of the yearly loggerhead shrike road transects intercept part of the Milk River Basin. Surveys were conducted with two observers; one followed a predetermined route driving between 50kph and 70kph while the second observer scanned the area for shrikes. Surveys were started at 0700 hours and were completed by 1500 hours. When suitable habitat was spotted, the driver stopped the vehicle and both observers scanned the area with binoculars and spotting scopes from the truck. When loggerhead shrikes were seen, habitat characteristics and GPS (Garmin II Plus) locations were recorded. Additional avian species were also counted while conducting the survey (Erickson 1998).

3.0 RESULTS

<u>3.1 Block Surveys</u>

Four survey blocks were searched in 2002 with one shrike seen. The lone shrike was observed on July 24, perched on a fence post in a landscape dominated by cultivation with scattered shrubs; an abandoned farmyard was within 800m (Site number 10 in Table 2.4.1; Figure 2.4.2). Timing of the surveys was delayed until July due to amphibian surveys taking priority resulting from high amounts of rainfall received in the study area. The surveys were still conducted based upon the possibility that the poor weather may have delayed nesting attempts. Shrikes in Alberta usually nest around mid-May, with young hatching in early to mid-June and remaining in the nest for ~16 days (Collister 1994). Consequently, surveys conducted in July may have missed some early nesting shrikes or shrikes with failed nests.

<u>3.2 Road Transects</u>

No loggerhead shrikes were observed within the Milk River Basin while conducting road transects. One pair was located north of the basin perched in a hedgerow surrounded by cropland (Site number 9 in Table 2.4.1; see * Figure 2.4.2).

3.3 Incidental Sightings

Nine sightings and a total of 17 shrikes were seen while conducting other surveys within or near the Milk River Basin (Figure 2.4.2). Five of the nine sightings occurred along hedgerows surrounded by an array of land types (e.g. cultivation, tamed pasture, native pasture, farmyards). One lone shrike was heard on July 5 calling from a tree surrounded by native pasture. A pair was spotted on July 12 in native pasture, which was void of shrubs and trees, and another pair was observed on July 25 in native prairie with scattered clumps of thorny buffaloberry (*Shepherdia argentea*). The last group of four (possibly two adults and two young) were seen on August 13 within a small valley with a dried up creek dominated by native grassland. Two trees and a small shrub present at the site were searched with no nest found, and the group departed after being observed for five minutes.

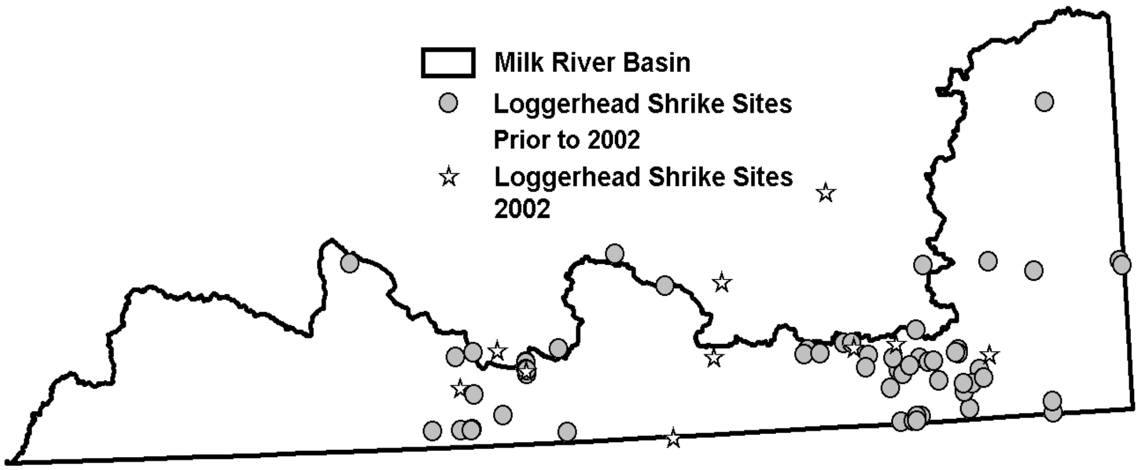
3.4 Survey Summary

Out of the eleven sites in 2002 containing one or more shrikes, native grassland was the most abundant habitat averaging 43.2%. Dry land cultivation was found to compose 34.1% and tame pasture made up 7.3% of the surrounding habitat (Table 2.4.1).

Table 2.4.1 Loggerhead shrike habitat within 400 meters of initial sightings

	Shrike Site											
Habitat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Average**
%Cultivation (Dry land)	45	50		30	50		30		80	90		**34.1%**
%Tame Pasture		20		25	25				10			**7.3%**
%Native Pasture	40		100			95	60	85			95	**43.2%**
%Riparian						4						**0.4%**
Shrubs (1-5)								10		5		**1.4%**
%Shrubs (Hedgerows)	5	5		20	10		5		5			**4.5%**
%Shrubs (Bluffs 5+)	5											**0.5%**
%Farmyard (*Abandoned)	***5**	15		15	***15**					***5**		**3.6%**
%Trees		5		10		1		5	5		5	**2.8%**
% Other Wetland, Dirt Piles, etc.		5					5					**2.3%**

Seven of the sightings occurred close to where shrikes had previously been seen, and four new sites were discovered. Of the new sites, one pair was located north of Foremost within a hedgerow surrounded by cultivation, and a second pair was located near the Aden border crossing using the hedgerows on the Canadian and American sides for perching. Another pair of shrikes was detected along a quad trail in native pasture while conducting Ferruginous hawk (*Buteo regalis*) surveys. The last pair of shrikes was observed south of Etzikom in a hedgerow within an old farm site surrounded by native pasture and cultivation. A later nest check on the Etzikom site revealed that seven eggs had been laid, however, it was evident the nest was depredated, with holes poked in several of the now rotting eggs. The shrikes had been noticed chasing Brewer's blackbirds (*Euphagus cyanocephalus)* away a few weeks prior to the nest check. The blackbirds, heavy rainfall (~173.2 mm on June 8- June 10), or both could have led to the abandonment and subsequent depredation of the nest.



*** Site located too far outside Milk River Basin**

Figure 2.4.2 Known loggerhead shrike locations within the Milk River Basin prior to 2002 and ten locations from 2002.

4.0 DISCUSSION

Shrike surveys, although conducted late in the season, still produced some preliminary information on habitat requirements of shrikes based upon a small number of observations. Six shrikes out of the eleven supported Collister's (1994) findings that hedgerows/shelterbelts were used more often than single shrubs in the Milk River region. Findings also suggest that shrikes tend to have site fidelity, with six of the eleven shrikes located in or adjacent to previously known shrike territories. This number could be a lot higher, but due to the late start of the surveys most historic shrike locations were not checked. Shrikes preferred open areas, with no sites containing >30% shrub cover. Within the Milk River Basin there are relatively few areas which would contain >30% shrub cover on a quarter section. One attempt at surveying using call playback (Kiliaan and Prescott. 2002) was successfully accomplished, with shrikes flying up from behind shrubs and perching on top of dead branches allowing us to easily see them. No shrikes were detected while conducting road transects within the Milk River Basin this year.

The cold and wet weather in spring of 2002 likely impacted the nesting success of many songbirds within the Milk River Basin, and it is believed this may have resulted in lower sighting of shrikes. The total accumulation of 45.9mm of wet snow on May 22 and 173.2mm of heavy rain occurring between June 8 to June 10 probably caused several nests to be abandoned. Yearly surveys for shrikes could be beneficial in determining population trends within the basin, with adult shrikes showing high site fidelity to specific areas or within 4 km of their original nest location year after year (Collister 1994). Yearly monitoring of these sites would allow observation of any land changes or other factors and provide valuable information for management purposes. This project will be continued in 2003 and will include 20 blocks being surveyed to gather more intensive habitat information.

5.0 MANAGEMENT AND RECOMMENDATIONS

- Loggerhead shrike surveys should be continued in 2003, preferably starting in mid- May using the identified survey protocol on the randomly selected blocks.

- Call playback should also be implemented to determine the viability and effectiveness of such a survey method in conjunction with block surveys.

- More intensive habitat information gathering: grass height, species of grass, etc.

- Yearly loggerhead shrike block surveys should be initiated within the drainage.

- Land management practices to maintain current shrike habitat should be implemented because shrikes tend to occupy the same area year after year or are found relatively close by.

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7.0 APPENDICES

Appendix G -Loggerhead Shrike Habitat Data Sheet

Observer: Date: Time:
Wind Speed (Beaufort Scale): 1 2 3 4 5 6 7 8 9 10 11 12
Location: Northing Easting

Northing	Easting

Bird Data

How Many Seen			
Were any Birds Banded:	Y N	**Colour of band (left leg):**	
Birds Activity:		**Colour of band (right leg):**	
Perching location: (If more then one bird is seen, indicate both perching locations)	Fence post Power line Barb wire *Shrub:* top middle bottom	**Height from the ground to perching location:**	

Micro Habitat (within 200m) (%)

Cultivation Dryland		**Tame Pasture**		**Riparian Lentic**	
Cultivation Irrigation		**Native Pasture**		**Riparian Lotic**	
Shrubs (1-5)		**Shrubs (hedgerows)**		**Shrubs (Bluff 5+)**	
Farmyard		**Trees**		**Other**	

Species of shrubs/trees within 200m of sighting or nest <u>(Indicate the percent composition of each species within the area.)</u>	**Thorny Buffaloberry**	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Willow	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Caragana	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Populus: Plains,	1-10%	11-20%	21-30%	31-40%	41-50%
	Balsam, Narrowleaf	51-60%	61-70%	71-80%	81-90%	91-100%
	Manitoba Maple	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Siberian Elm	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Sagebrush	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Snowberry	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Saskatoon	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Chokecherry	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Other	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%

Barb Wire Fence	**Y** **N**	Distance from shrike 0-50m, 50-100m, 100-150m, 150-200m, 200m+

Power Lines	**Y** **N**	Distance from shrike(m): 0-50m, 50-100m, 100-150m, 150-200m, 200m+
Buildings	**Y** **N**	Distance from shrike (m): 0-50m, 50-100m, 100-150m, 150-200m, 200m+
Other	Distance from shrike (m): 0-50m, 50-100m, 100-150m, 150-200m, 200m+	

Macro Habitat (within 400m) (%)

Cultivation Dryland		**Tame Pasture**		**Riparian Lentic**	
Cultivation Irrigation		**Native Pasture**		**Riparian Lotic**	
Shrubs (1-5)		**Shrubs (hedgerows)**		**Shrubs (Bluff 5+)**	
Farmyard		**Trees**		**Other**	

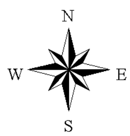
Species of shrubs/trees within 400m of sighting or nest. <u>(Indicate the percent composition of each species within the area.)</u>	**Thorny Buffaloberry**	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Willow	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Caragana	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Populus: Plains, Balsam, Narrowleaf	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
Topography: Rolling Hills Flat Plains Coulee or Valley Other	**Manitoba Maple**	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Siberian Elm	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Sagebrush	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Snowberry	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Saskatoon	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Chokecherry	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%
	Other	1-10%	11-20%	21-30%	31-40%	41-50%
		51-60%	61-70%	71-80%	81-90%	91-100%

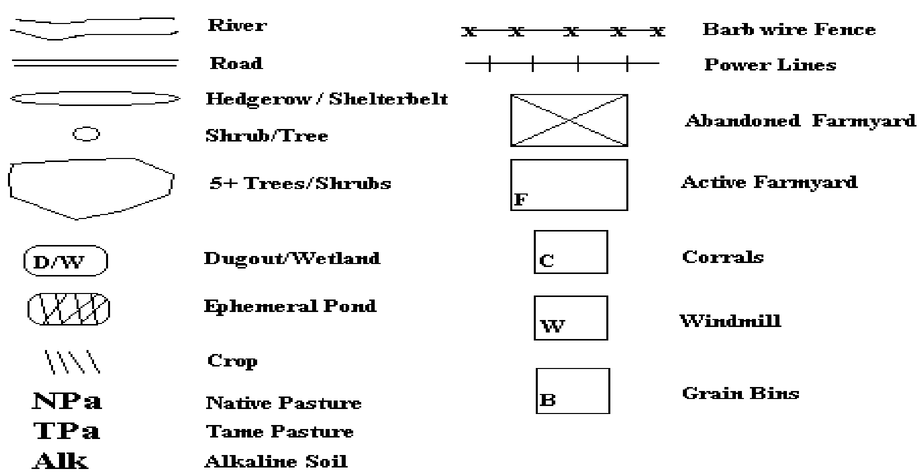
Other Species Observed:	

Nest Data

Species of Shrub/ Tree		**Height of Shrub/Tree**	
Nest Material (Mark from 1-3 with 1 being the most abundant)	Grasses Forbs Feathers Fur/Hair Twigs Other:-------	**Width of Shrub/ Tree**	
Number of Eggs		**Height of Nest**	
Number of Young		**Age of Young**	

Site Map (within 400m)





AMPHIBIAN SURVEYS OF THE MILK RIVER BASIN

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1.0 INTRODUCTION

This project was conducted as part of the overall objectives of the Milk River Species at Risk Project. Limited data on the great plains toad and plains spadefoot within the Milk River Basin resulted in a need to conduct surveys on these two "May Be At Risk" species (Alberta Sustainable Resource Development 2001). Both species have rarely been found in the area, particularly in the past three years. Drought was believed to be the main factor behind their apparent absence.

Great plains toads are explosive spring breeders, and breeding activities are strongly associated with rainfall (Bragg and Smith 1943; Krupa 1994). A. Didiuk noticed toads calling from more than three weeks to more than six weeks (James 1998). Eggs hatch in one to five days (Krupa 1994) and tadpoles take anywhere from 18 to 49 days to metamorphose [in the United States](Bragg and Smith 1943, Bragg 1946, Krupa 1994).

Great plains toads primarily occur throughout the grasslands of central North America (Krupa 1990). In Alberta, great plains toads are found in the dry mixed grass of the southeastern corner of the province (James 1998). Wershler and Smith (1992, cited by James 1998) identified six general population areas in Alberta: Empress/Bindloss, South Saskatchewan River/Hilda, Medicine Hat, Lost River/Milk River, Lake Newell/Little Rolling Hills, and Hays/Purple Springs. James (1998) notes that additional populations have been recorded in and near the Canadian Forces Base (CFB) Suffield. Typical breeding habitat for great plains toads in Alberta is shallow ponds with relatively fresh, clear water in sandy soil (Wershler and Smith 1992, cited by James 1998).

The plains spadefoot is a plump anuran with short limbs and a pronounced spade-shaped tubercle on the inner surface of the hind feet (Seburn 1993). They undergo explosive breeding in the spring following heavy precipitation events (Lauzon 1999). Lauzon noted single plains spadefoot could be heard calling from 1 km away and a large chorus could be heard from distances greater than 2 km (Lauzon 1999). Females lay up to 2000 eggs in masses of 10 to 250 eggs each (Bragg 1965 and Collins 1982, cited by Lauzon 1999). Spadefoot toads have the fastest larval development rate known among amphibians (Bragg 1965, cited by Lauzon 1999). In Alberta, tadpoles require 21 to 34 days after hatching to metamorphose with some taking up to 60 days (Klassen 1998). There are no published accounts of hibernation depths in Canada (Lauzon 1999); however, in the United States, plains spadefoot have been noted to burrow 60 to 90 cm below the surface (Bragg 1965, cited by Lauzon 1999).

Plains spadefoot have been strongly correlated with sandy soils in Alberta (Lauzon 1999). Lauzon (1999) noted that plains spadefoot in Alberta were found in wetlands 15-40 cm deep. Areas identified as plains spadefoot breeding habitat are sloughs with little vegetation, marshy depressions, flooded cultivated fields, temporary wetlands in pastures, river backwaters, and ditches (Klassen 1998). Plains spadefoot also breed in the shallow water of vernal pools on uplands and along streams, semi-permanent ponds, oxbow lakes, and stream meander channels (Cottonwood Consultants 1986).

The objectives of this study were to determine the distribution of all anurans and the habitat characteristics of the great plains toad and plains spadefoot throughout the Milk River Basin.

2.0 METHODS

2.1. Survey Protocol

Amphibian sites were identified using the Biodiversity Species Observations Database (BSOD), Alberta Natural Heritage Information Centre (ANHIC), and the Lethbridge Area Critical Wildlife Database. Sites that were not surveyed since 1998, or sites that were unsuccessfully surveyed since 1998, were given the highest priority to be surveyed in 2002. Aerial photographs of the basin were also examined in order to identify other potential sites for great plains toads, plains spadefoot, and northern leopard frogs.

Transects were established along roadways to cover as much of the basin as possible. Roadside surveys involved a five-minute call survey at least every 800m along the variable length transect. The number of stops per transect varied based on the amount of potential habitat (*i.e.* ephemeral or permanent wetlands within 400m of the road) present along the transect. The five-minute survey included a two-minute waiting period (to offset effects of disturbance) prior to the three-minute listening period. During this period, the observer recorded the air temperature, weather, moonlight, time, date, wind speed, species calling, relative abundance (Table 2.5.1), and general direction of call (Appendix H).

Table 2.5.1 Relative abundance classification[1]

Abundance Class	Description
I	Individual counted or heard (1)*
II	Two or more calling but without overlapping calls (2-5)
III	Several individuals with overlapping calls but still distinguishable (5-10)
IV	Calls are overlapping and indistinguishable (10+)
V	None heard

[1] Adapted from Kendell (2002)

* Numbers in brackets represent an approximate numerical breakdown of the classes and should be used with caution

Individual point call surveys (Takats and Priestley 2002, Kendell 2002) were to be conducted at sites located greater than four hundred meters from a road. The observer ground truthed the point survey sites the morning prior to the evening call survey. At this time, the observer recorded the water temperature, percent emergent vegetation, primary substrate, water depth, description of waterbody, origin, drainage, turbidity of the water, flow, location, any disturbances, any species encountered, and drew a site map or took a photograph (Johnson and Batie 1995, Kendell 2002). Northern leopard frog data sheets (Kendell 2002) were modified to record the information. In the evening, the observer would approach the pond downwind to minimize disturbance (Kendell 2002). When within a hundred meters of the pond, the observer would begin the five-minute call survey. Landowner contact was made prior to the surveys, and the sites were accessed either on foot or on a bike.

Almost all of the surveys were conducted from May 26 until June 26, 2002 from 30-minutes after sunset until 3:00 A.M. If great plains toads and plains spadefoot were still active, the survey was continued until 4:00 A.M. As suggested by Kendell (2002), surveys were conducted when wind speeds were lower than level 3 on the Beaufort wind scale (gentle breeze, leaves and small twigs in constant motion), there was light or no rain, and temperatures were close to the average for the season (*i.e.* above 10^{o} C). Two surveys conducted prior to May 26th were incomplete due to unfavourable weather conditions and lack of amphibians.

For road surveys, the observer recorded general land use habitat data (adapted from Saunders 2001) for each of the stops by determining the percentages of native prairie, cultivation, tame pasture, lentic, lotic, or other land use within a 400m radius (Appendix I).

One site was selected for rudimentary investigations into plains spadefoot development. After calling activity had ceased, the pond was visited weekly in order to follow tadpole development rates. A dip net was used to sweep through the pond in order to capture plains spadefoot tadpoles. Tadpoles were photographed and relative development was noted.

2.2 Analysis

Native prairie classifications used were consistent with the classifications used in the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment (Prairie Conservation Forum 2000) (Table 2.5.2). Data from the native prairie vegetation database was used in ArcView 3.2 to determine the native prairie class of each plains spadefoot site.

Native prairie data from plains spadefoot sites was analyzed using the utilization-availability method described by Neu et al. (1974) at the 95% confidence level. Only sites within the drainage boundaries were used.

Table 2.5.2 Native prairie classifications

Class	Native Prairie Components (%)
1	> 75
2	51 – 75
3	26 – 50
4	1 – 25
5	0

3.0 RESULTS

3.1. General

During the summer of 2002, the Milk River Basin was subject to precipitation levels that were approximately 80-100% more than the 30-year average for the area (Alberta Environment 2002). Both great plains toads and plains spadefoot began calling shortly after major precipitation events in May and June, respectively (Figure 2.5.1).

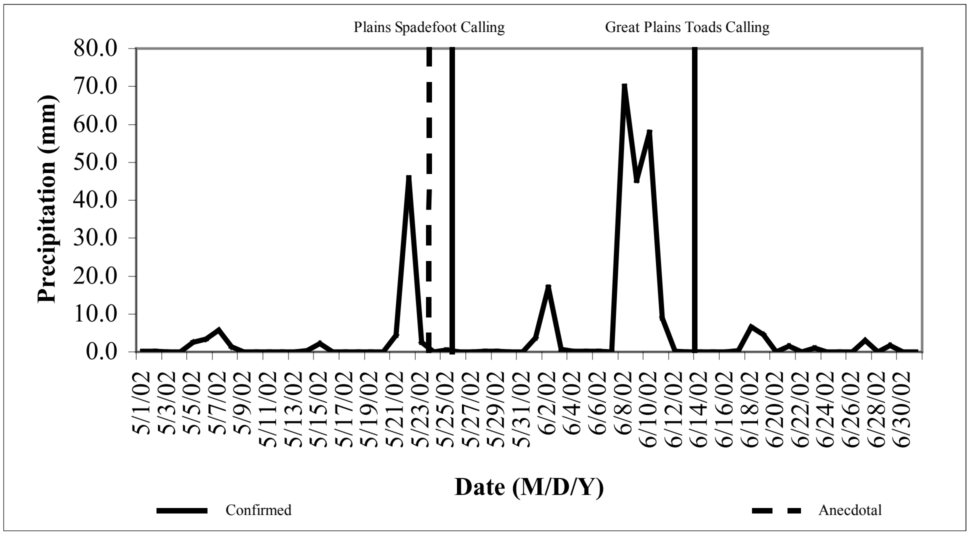

Figure 2.5.1 Milk River Basin average daily precipitation

Five hundred and twenty nine stops were surveyed across the basin (Figure 2.5.2). Great plains toads were present at 19 stops, and plains spadefoot at 192 stops (Table 2.5.3). Although the precipitation levels in the Milk River Basin were conducive for the emergence and breeding activity of great plains toads and plains spadefoot, it also caused delays in the surveys (*i.e.* wet and impassable roads). Given the shorter time frame in which to complete the surveys, roadside transects were given the highest priority and no point site surveys were conducted.

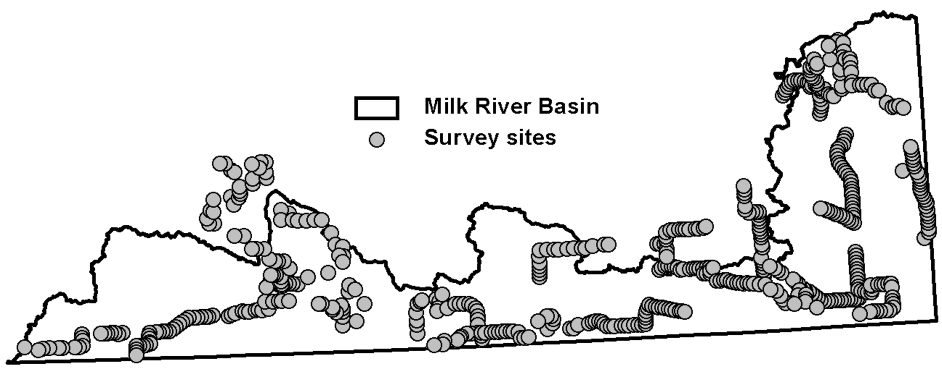

Figure 2.5.2 Amphibian survey sites

Table 2.5.3 Relative abundance of amphibians at survey sites

Species	Relative Abundance Class					
	I	**II**	**III**	**IV**	**V**	**Totals**
Plains Spadefoot	16	63	38	75	337	36%
Great Plains Toad	7	10	2	0	510	4%
Northern Leopard Frog	4	1	0	0	524	1%
Boreal Chorus Frog	45	107	29	47	301	43%

3.2. Great Plains Toad

At the 19 stops, 21 breeding sites were present for great plains toads, all of which were concentrated in the southeast corner of the province (Figure 2.5.3). General habitat conditions at the breeding sites were ephemeral ponds with clear water, approximately one meter deep, with little to no aquatic vegetation, however toads were observed calling from clumps of grasses and sedges emerging from the water. Chi-square and use-availability were not used for statistical analysis due to the small sample size.

Incidental observations of 25 toadlets on August 12, 2002 in the Lost River area led to some opportunistic measurements. The mean snout-vent length was 26.2 ± 1.5 mm and mean weight was 2.9 ± 0.7 g.

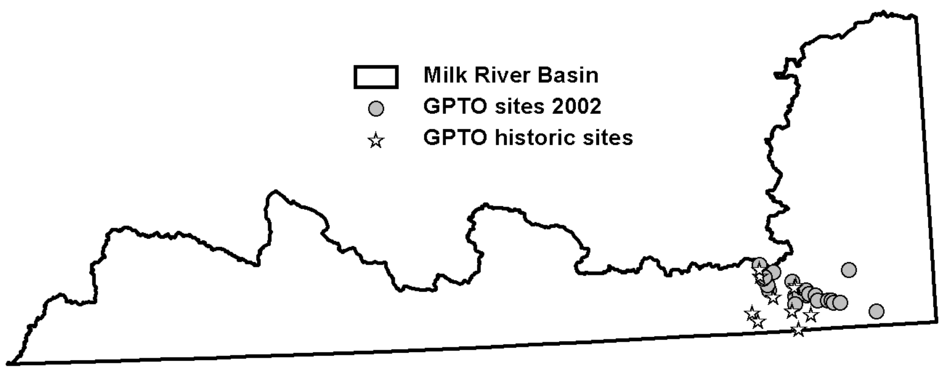

Figure 2.5.3 Great plains toad sites

3.3. Plains Spadefoot

Plains spadefoot sites were widely distributed across the Milk River Basin, but were not detected in the Milk River Ridge area or immediately south of Cypress Hills (Figure 2.5.4). There were 253 breeding sites present at the 192 stops where plains spadefoot were heard. General habitat conditions at the breeding sites were ephemeral ponds approximately 50 cm deep with little to no aquatic vegetation. Water clarity was variable, with plains spadefoot being observed in tea colored, clay colored, and clear water. Plains spadefoot selected for habitat comprised of more than 75% native prairie components (Class 1) and selected against Class 5 habitat, which contained no native prairie (χ^2 = 12.4, ρ=0.015; Table 2.5.4).

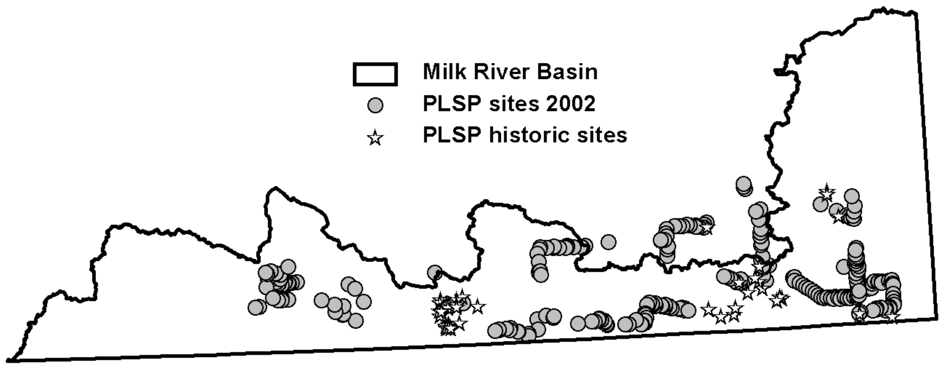

Figure 2.5.4 Plains spadefoot sites

Table 2.5.4 Plains spadefoot native prairie analysis

Native Prairie Class	Observed Plains Spadefoot	Expected Plains Spadefoot	Proportion Available	% Available	Category
1	192	169	0.683	$0.706 \le p_1 \le 0.842$	Selected For
2	6	7	0.027	$0.0 \le p_2 \le 0.049$	No Difference
3	9	9	0.037	$0.005 \le p_3 \le 0.067$	No Difference
4	18	20	0.082	$0.031 \le p_4 \le 0.115$	No Difference
5	23	43	0.172	$0.046 \le p_5 \le 0.14$	Selected Against

3.4. Other Species

Boreal chorus frogs were found at 228 stops, and resulted in 267 identified breeding sites. Northern leopard frogs were only detected at five stops, with five confirmed breeding sites. One tiger salamander (*Ambystoma tigrinum*) was found during a site inspection. No analysis was conducted on these species.

4.0 DISCUSSION

4.1 General

Roadside surveys were an effective tool for assessing the distribution of the great plains toad and plains spadefoot in the Milk River Basin. They allowed for extensive coverage of the basin in a relatively short period of time. Provided weather conditions were agreeable, low numbers of great plains toads could be heard 800m to 1.6 km away, and large choruses of plains spadefoot were usually heard 800m away. Roadside call surveys may not be as effective in areas with greater densities of farmyards or oil and gas development. Also, northern leopard frogs were difficult to hear, particularly amidst large choruses of boreal chorus frogs.

Another noteworthy aspect of the call surveys was the temporal delay between the emergence and subsequent calling of plains spadefoot and great plains toads. The great plains toads required more precipitation to begin breeding activity and were not heard for at least two weeks after plains spadefoot were detected. This delay may not be evident if a rain event of at least 100mm occurs early in the spring.

4.2 Great Plains Toad

The number of great plains toad sites increased, with additional sightings north of Wildhorse. Although new sites were found, the majority of the sites only had 1-5 toads calling. Great plains toads could be heard over the chorus of many plains spadefoot. Great plains toads were only heard east of Lost River, but while conducting surveys in August, several young of the year were spotted within and on the west side of Lost River. This provides a promising outlook for the future, and surveys should be conducted again in three years. This is how long the young take to reach breeding age, in order to see how productive the years breeding event was.

Preliminary analysis of great plains toad soils data appeared to indicate an association with soil order in the Milk River Basin. Great plains toads were only found in the extreme southeast corner of Alberta. The primary soil order in the Milk River Basin is chernozemic, which covers most of southern Alberta. However, when solonetzic soils were examined as the secondary soil order, the only area covered by both soil orders overlapped the known distribution of great plains toads in the basin. Perhaps, due to the dry climate of the area and the characteristics of solonetzic soils *(i.e.* very slow water drainage), and given the breeding requirements of great plains toads (4 – 6 weeks of development, clear and deep water), this is the only suitable habitat in the basin.

4.3 Plains Spadefoot

The known distribution of plains spadefoot increased by 50km, to the west from Writing- on-Stone Provincial Park and east to the Saskatchewan border. Gaps in their range were also filled in, and historic sites reconfirmed. The increase of plains spadefoot sites demonstrates the hardiness and opportunistic qualities of this species that used everything from ephemeral ponds in native prairie to ditches adjacent to cultivation. Even though plains spadefoot breeding ponds were widely dispersed, the only sites that allowed complete development of tadpoles were the ephemeral ponds within high quality native prairie. Ditches and other poor quality sites (*i.e.* sites adjacent to cultivation) failed to retain enough water for complete metamorphosis to occur.

An interesting observation of plains spadefoot occurred at one of the sites near Writing- on-Stone. One investigation of the site took place before sunset on May 28, 2002, with the intention of observing the emergence of the toads prior to them calling. No spadefoot were observed within the vicinity of the pond or around the perimeter of the pond prior to the toads suddenly appearing within the pond itself. It was assumed that the toads buried themselves at the bottom of the pond or at the extreme edge of the pond. The first spadefoot was heard approximately 30 minutes after sunset, and within a few minutes several hundred spadefoot were heard calling.

Throughout this study, several samples of spadefoot tadpoles were taken to determine the various stages of development. Upon examination of two samples taken in mid-June, it was noted that most of the tadpoles that were not fully metamorphosed had algae developing on their backs and tails. At the time the samples were taken, the water in the pond was getting shallower and algae had started to spread. The exact fate of these tadpoles is unknown; however, any growth on the tadpoles was expected to be detrimental.

5.0 FUTURE MANAGEMENT AND RECOMMENDATIONS

- Some baseline information on distribution and habitat has been collected, so continued monitoring of plains spadefoot and great plains toads sites is important
- Establishment of a RANA site near Writing on Stone
- Re-survey the basin in 3 to 5 years to determine recruitment to the breeding population, as well as relative survivorship, of great plains toads
- Because of the availability of prey in 2002, western hog-nosed snake surveys should be conducted in 2003
- Create and distribute information in the form of pamphlets, posters, and tapes to residents in the Milk River Basin to create awareness of amphibians and their habitat needs

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7.0 APPENDICES

APPENDIX H – Route Call Survey Data Sheet

Route	
Observer	
Date	
Start Time	
End Time	

Amphibian Inventory

Route Call Survey Data Sheet

Weather at the start of the route	
Wind	
Cloud	
Moonlight	
Precipitation	
Weather at the end of the route	
Wind	
Cloud	
Moonlight	
Precipitation	
# of stops	

Start Coordinates	Northing	Easting
End Coordinates	Northing	Easting

Coordinates							
Northing	Easting	Stop #	Species	Distance	Direction	Number calling	Comments

APPENDIX I – Habitat Data Entry Form

Amphibian Inventory

Habitat Data Entry Form

Route	Date	Observer

GPS INFO		Stop	Native Grassland		Tame Pasture		Cultivated		Riparian		Other	Other
Easting	Northing		Ungrazed	Grazed	Irrigated	Dryland	Irrigated	Dryland	Lentic	Lotic		description
		1										
		2										
		3										
		4										
		5										
		6										
		7										
		8										
		9										
		10										
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		40										

REPTILE SURVEYS OF THE MILK RIVER BASIN

Brad A. Downey and Brad N. Taylor, Alberta Conservation Association, Lethbridge, AB

1.0 INTRODUCTION

Reptile surveys were conducted for prairie rattlesnakes (*Crotalus viridis viridis*), bullsnakes (*Pituophis catenifer*), short-horned lizards (*Phrynosoma hernandesi*), and western painted turtles (*Chrysemys picta*) in the Milk River Basin. The prairie rattlesnake and short-horned lizard are considered "May be at Risk" while bullsnakes and western painted turtles are considered "Sensitive" (Alberta Sustainable Resource Development 2001). Surveys had been conducted in 2001 for short-horned lizards and rattlesnake hibernacula, however time constraints left seven short-horned lizard and a few rattlesnake hibernacula sites in the Milk River Basin to be done in 2002. Native populations of western painted turtles within the basin were last recorded in 1994 (Biodiversity/ Species Observation Database [BSOD] 2000).

2.0 METHODS

Surveys for prairie rattlesnake and bullsnake hibernacula took place in mid to late May, and road mortality data sheets were filled out throughout the field season. Short-horned lizard surveys took place in late July and early August, when the females were giving birth (James 2003), and a western painted turtle survey was conducted in late July at the only location within the basin where native populations were known to occur.

Information obtained from the Biodiversity/ Species Observation Database (BSOD) and personal contacts were used to determine historic snake hibernacula sites. These areas, especially the south facing slopes, were intensively searched for any signs of snake activity (*i.e.* sheds) or snakes themselves. When snakes were found, the observer recorded the location with a Garmin II Plus GPS unit (NAD 83), the number of snakes present, species of snake, and whether there was any indication of a hibernacula within the vicinity. If a possible hibernacula was found, the observer recorded the time of day, air temperature (C^o), aspect, general habitat the snake was found in, and the number of holes leading into the hibernacula. The data sheet used is found in Appendix J. The observer also drew a site map and took photographs of the site. Incidental sightings of snakes along roadways were also recorded during the field season. When roadkilled snakes were found, a data sheet from the Provincial Roadkill Snake Monitoring Program (Appendix K) was filled out, indicating the snake's location, date, species, total length, apparent time of death, and in the case of a rattlesnake, the number of rattles on its tail.

Areas searched for short-horned lizards were historical locations obtained from BSOD and locations from earlier work done by Powell and Russell highlighted by James (2002). Short-horned lizard surveys were conducted along the perimeter of coulees, hummocky terrain containing greasewood (*Sarcobatus vermiculatus*), or the spurs of valleys (James 2002). Two or more observers walked slowly back and forth and probed clumps of vegetation with walking sticks. If short-horned lizards were sighted a data sheet developed by James (Appendix L) was filled out containing their location, time of day, air temperature, sex, snout-vent length, weight, and surrounding microhabitat (1 m² and 100 m²) (James 2002). They were also marked with non-toxic permanent markers on their belly to prevent recounting the same individual. These marks fade within a few months or when they shed their skin (James 2002). Habitat characteristics of the entire quarter section, landowner information, start and end time of the search, photograph information, and weather conditions were recorded on a second data sheet developed by James (Appendix M).

Western painted turtles were surveyed for on July 25, 2002 at the lone location where native populations were known to exist. This survey involved two observers walking around the perimeter of the oxbow lake observing any movements in the water or any turtles basking on logs.

3.0 RESULTS

Two hibernacula and two possible rookeries were found, all of which were located within Writing-on-Stone Provincial Park (Table 2.6.1). The first hibernaculum, containing three rattlesnakes and three bullsnakes, was located on a south-facing slope overlooking the Milk River. Two other large bullsnakes, > 1.5 m long, were also seen near the hibernaculum and were assumed to use it as well. The second hibernaculum, containing one rattlesnake, was located south of the Milk River within Davis Coulee; it was also located on a south-facing slope and had six sheds nearby. Both rookeries, one containing a large bullsnake and the other a large rattlesnake, were located on south-facing slopes with a few shrubs and flat rocks for basking just outside the entrance.

Table 2.6.1 Bullsnake and prairie rattlesnake observations within the Milk River Basin

Species	Aspect	Slope (degrees)	Alive	Date	Temperature C°	Abundance	Activity	Habitat
BULL	S	25	Y	16-May-02	10	1	Basking near Entrance	Hibernacula/Rookery, 80%Shrubs, 10% Native Grass, and 10% Dirt/Rocks
BULL/PRRA	S	15-20	Y	16-May-02	10	3 of Each	Basking near Entrance	Hibernacula, 60% Shrubs, 35% Native Grass, and 5% Dirt/Rocks
PRRA	S	20	Y	16-May-02	10	1	Basking near Entrance	Hibernacula/Rookery, 75% Shrubs, 20% Native Grass, and 5% Dirt/Rocks
PRRA	S	25	Y	1-Aug-02	17	1	Basking near Entrance	Hibernacula, 20% Shrubs, 40% Native Grass, and 40% Dirt/Rock
PRRA	SE	20	Y	25-Jul-02	30	1	Hiding in only shade	
PRRA	N/A	N/A	N	31-Jul-02	N/A	1	Roadkill	
PRRA	N/A	N/A	N	12-Aug-02	N/A	1	Roadkill	
BULL	N/A	N/A	N	8-Jul-02	N/A	1	Roadkill	
BULL	N/A	N/A	N	8-Jul-02	N/A	1	Roadkill	

Five other individual snakes were seen in 2002, four of which were found dead along the sides of roads (Table 2.6.1); two bullsnakes (70 cm and 124 cm) and two prairie rattlesnakes (109 cm and 110 cm). The fifth snake, a prairie rattlesnake, was spotted in the shade of a depression adjacent to an east-facing cliff (Table 2.6.1) while conducting the western painted turtle survey. Temperature at the time was greater than 30^{o}C.

Seven historical short-horned lizard sites within the Milk River Basin were searched with no lizards being found, however, 25 great plains toad (*Bufo cognatus*) young of the year were encountered hopping up the sides of a coulee while at one site. The western painted turtle survey resulted in no turtles being found in the lone oxbow lake. On the day of the survey there was sufficient water in the lake and the temperature was near 30^{o}C.

4.0 DISCUSSION

The weather severely hampered most of the reptile surveys conducted in 2002. Snake observations, although limited to Writing-on-Stone Provincial Park, did provide some valuable habitat information, and continued monitoring of the sites is expected. Other hibernacula within the basin will be inspected in 2003. Four road killed snakes out of the nine sightings highlights the hazards of roads near hibernacula.

Surveys conducted for eastern short-horned lizards were severely affected by the unprecedented amount of rainfall (~173.2 mm) and cool temperatures received in southern Alberta this year. The impact of the rainfall and subsequent flooding of the river valley and oxbow lake in the spring may have affected the western painted turtle site this year.

5.0 MANAGEMENT AND RECOMMENDATIONS

- Continued monitoring should be done of known snake hibernacula, preferably in early spring and fall, to get an estimated minimum population size for each hibernacula.

- Conduct western hog-nosed (*Heterodon nasicus*) and yellow-bellied racer (*Coluber constrictor*) snake surveys within the extreme southeast corner of the Basin around Onefour using snake fences and live traps. Both species are rarely seen, with yellow-bellied racer's remains only recently discovered in a burrowing owl's hole.

- Re-survey the eastern short-horned lizard sites.

- Re-survey the western painted turtle site in the spring of 2003.

- Development and dispersal of brochures within the local communities on the identification and benefits of reptiles.

6.0 LITERATURE CITED

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7.0 APPENDICES
APPENDIX J: Snake Den Survey Data Sheet

SURVEYOR INFORMATION

Name:____________________________ Affiliation: ☐Volunteer ☐NRS ☐ACA ☐ Other __________

Address: ____
Street Address / Box # / City / Postal Code

Phone Number: (___) ________________ E-mail (optional): _______________________________

DEN INFORMATION

Den Name ___________________________________

Location (choose one)

MAP DATUM: NAD 27 NAD 83

UTM:

REFERENCE MERIDIAN: _________ **NORTHING:** _____________ **EASTING:** ______________

ATS:

QUARTER: NE NW SW SE **SECTION:** _____ **TOWNSHIP:** _____ **RANGE:** ____ **WEST OF:** 4 5 6

HISTORIC INFORMATION:

Species of Snake(s) ____

Years Den is Known to Have Been Occupied:

☐ 2000 ☐ 1999 ☐ 1998 ☐ 1997 ☐ 1996 ☐ 1995 ☐ 1994 ☐ 1993 ☐ 1992 ☐ 1991 ☐ 1990 ☐ 1989 ☐ 1988 ☐ 1987 ☐ 1986 ☐ 1985 ☐ Known since ______
YEAR

DEN DESCRIPTION:

Location of den: ☐ Natural ☐ Artificial ☐ Unknown

☐ Rock crevice ☐ Roadside bank ☐ Bank along water ☐ Mammal hole(s)
☐ Gravel Pit ☐ Building foundation ☐ Other ________________

Approximate Number of Holes: ____________ **Average Diameter of Holes:** ________________

Percent Vegetative Cover at immediate den site:

_______% None _______% Grass (native) _______% Grass (introduced)

_______% Shrubs (Species___________________)

_______% Trees (Species_____________________)

_______% Other ____________________________

SNAKE SURVEY **Den Name______________________________**

Percent Vegetative Cover within 100 metre radius of den site:

_______% None _______% Grass (native) _______% Grass (introduced)

_______% Shrubs (Species____________________)

_______% Trees (Species____________________)

_______% Other ___________________________

Slope: ☐ flat 0-15 degrees ☐ gentle 16-30 degrees ☐ moderate 31-45 degrees ☐ steep 46-60 degrees ☐ very steep 61-90 degrees

Slope Angle: _________ degrees

Slope Stability: Y N Explain____________________

Aspect: N NE E SE S SW W NW __________ degrees

Position on Slope: ☐ Bottom ☐ Middle ☐ Top

Exposure to Direct Sunlight: Y N

Distance to Water: _________ meters ☐ Lake ☐ Pond ☐ Stream ☐ River ☐ Marsh/bog

Distance to Coulee: __________ meters

Distance to Road: __________ meters **Road Name**: ________________________________

Distance to Disturbance: _________ meters ☐ Agriculture ☐ Ranchland ☐ Oil and Gas ☐ Other____

Distance to Disturbance: _________ meters ☐ Agriculture ☐ Ranchland ☐ Oil and Gas ☐ Other____

Distance to Disturbance: _________ meters ☐ Agriculture ☐ Ranchland ☐ Oil and Gas ☐ Other____

How much area does the total den cover? ___________________________________

ENVIRONMENTAL CONDITIONS

Date: __________________ Time: _________ Temperature: ______^{o}C Cloud Cover _________%

Wind: ☐ None ☐ Light ☐ Medium ☐ Strong

Precipitation: ☐ None ☐ Light ☐ Medium ☐ Heavy Type: ☐ Rain ☐ Snow

SNAKE SURVEY **Den Name**______________________________________

SNAKE COUNT

Is there evidence of breeding? ☐ Yes ☐ No

Number of Breeding Balls of Snakes and Size Observed

Small (2-5 snakes)		**Medium** (softball-sized)		**Large** (volleyball-sized)		**Very Large** (basketball-sized)	

Is there a pit(s) of snakes? ☐ Yes ☐ No

Number of Pits and Size

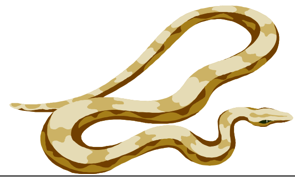
Pit #	Width (cm)	Length (cm)	Depth (cm)	Estimated # of Snakes
1				
2				
3				

Estimated Total Number of Snakes at Den Site __________________________

How did you estimate this? ____

Other Notes (general habitat description, snake observations, threats to site, etc.):

APPENDIX K

2001/2002 ROADKILL SNAKE MONITORING PROGRAM							
Date			Length	UTM Location*			
(yy/mm/dd)	Species	#	(cm)	Easting	Northing	Zone**	Notes (including location description)
* - ensure that you are using NAD 83			Return data sheets and specimens to:				
* - lat/long also accepted			Sue Cotterill, Fisheries and Wildlife Management Division, ASRD				
** - Zone 11 (-117) or Zone 12 (-111)			7th Floor, O.S. Longman Bldg, 6909 - 116 Street, Edmonton, AB T6H 4P2				

APPENDIX L

Short Horned Lizard Data Sheet: Summer 2002
Individual Animal

GENERAL LOCATION: ______________________________

1/4 section: NE / NW / SE / SW Sec: _______ Twnshp: ______ Rg: _____ W4

Time: __________ Day:_________ Month: July / August Year: 2002 *(circle one)*

Researcher's Name: ______________________________

GPS location of capture: Elevation (m):
12U:
UTM:

Waypoint name/number: | Marked as:

Slope (%): 10 20 30 40 50

Aspect: N / NE / E / SE / S / SW / W / NW

Length (SVL):_____________mm Weight: _______________g

Male / Female | Young of Year?: Yes / No

Weather at time of capture: **Approx Temp**: ____________ C
Cloud cover: cloudy / mainly cloudy / partly cloudy / scattered clouds / cloudless
Wind: Beaufort scale 0 1 2 3 4 5

Description of vegetation within $100m^2$ (10m X 10m) around location of animal:

Estimate % of various plant in immediate $1m^2$:

Grass: Species:
Forbes: Species:
Shrubs: Species:
Rock: Type:
Open soil: | Animal was located:
Other:

Short Horned Lizard Data Sheet: Summer 2002
Individual Animal

GENERAL LOCATION: ______________________________

1/4 section: NE / NW / SE / SW Sec: _______ Twnshp: ______ Rg: _____ W4

Time: __________ Day:_________ Month: July / August Year: 2002 *(circle one)*

Researcher's Name: ______________________________

GPS location of capture: Elevation (m):
12U:
UTM:

Waypoint name/number: | Marked as:

Slope (%): 10 20 30 40 50

Aspect: N / NE / E / SE / S / SW / W / NW

Length (SVL):_____________mm Weight: _______________g

Male / Female | Young of Year?: Yes / No

Weather at time of capture: **Approx Temp**: ____________ C
Cloud cover: cloudy / mainly cloudy / partly cloudy / scattered clouds / cloudless
Wind: Beaufort scale 0 1 2 3 4 5

Description of vegetation within $100m^2$ (10m X 10m) around location of animal:

Estimate % of various plant in immediate $1m^2$:

Grass: Species:
Forbes: Species:
Shrubs: Species:
Rock: Type:
Open soil: | Animal was located:
Other:

APPENDIX M

Site Evaluation - Summer 2002

DAY: ________
JULY / AUGUST 2001

Searchers Present today: ____________________

LOCATION: ____________________

CONTACT PERSON FOR LAND ACCESS (Name, Address, Phone number):

Did you speak with the contact person prior to access? Yes or No
Comments:

Did you thank the contact person following access? Yes or No
Comments:

START TIME OF SEARCH:____________ **END TIME** OF SEARCH:____________
START TIME OF SEARCH:____________ **END TIME** OF SEARCH:____________
START TIME OF SEARCH:____________ **END TIME** OF SEARCH:____________
START TIME OF SEARCH:____________ **END TIME** OF SEARCH:____________

General Weather conditions today:

Mainly sunny	Partly cloudy	Mainly cloudy	Comments:
Estimated daytime high: Extreme heat (>35C) Very hot (30-34.9C) Hot (25-29.9C) Warm (20-24.9C) Cool (<19.9C)			
Last Night's Low Temperature:________			
Wind :see Beaufort scale below			

Describe General Weather conditions this Year (i.e. normal, severe drought, relatively wet?):	Beaufort Scale (circle one): Indicators of wind 0: smoke rises vertically 1: wind direction shown by smoke drift 2: wind felt on face; leaves rustle 3:leaves, small twigs in constant motion 4: Raises dust & loose paper; small branches are moved 5: small trees in leaf sway; crested wavelets on inland waters

General Vegetation description of searched area:

Riverine Habitat: - along South Saskatchewan - along Milk River
Coulee Habitat: - along Chin Coulee - along 40-Mile coulee
Juniper Dunes type habitat:
VEGETATION DETAILS:

Soil sample taken? Yes / No Where?
Photo taken? Yes or No
Photo location point: GPS location:

Photo #1	Photo #2	Photo #3

Compass direction of photo: *if more photos taken list details on back

Any other comments about today's search at this location?:

Describe human disturbances in nearby area:
How far from occupied habitat?

Other unusual species noted?
What species:
Where: GPS location:
When (Time of day):
Adult? Juvenile?
Male / Female?
Comments:

CHAPTER 3

HABITAT SUITABILITY INDEX MODELS

1.0 HABITAT SUITABILITY INDEX MODEL INTRODUCTION

Paul F. Jones, Alberta Conservation Association, Lethbridge, AB

With increasing demands on resource development, resource managers face the challenge of maintaining wildlife habitat requirements while making land use decisions. Since the 1970's, several modeling techniques have been developed to aid in making decisions regarding land use and the protection of wildlife habitat (Berry 1986). One technique has been the development of single-species models (Berry 1986). Habitat suitability index (HSI) models were developed by the U.S. Fish and Wildlife Service as part of the habitat evaluation procedures (HEP) to assess the environmental impacts of proposed water and land resource development projects (USDI Fish and Wildlife Service 1981, Cole and Smith 1983, Bart *et al.* 1984, Berry 1986).

HSI models are designed as planning tools for situations where habitat conditions are expected to change, and are a means of assessing the changes in habitat quality and quantity for selected wildlife species (Schamberger and O'Neil 1986, Morrison *et al.* 1992). The models are hypothetical in nature, as they are derived from quantitative accounts and expert opinion regarding a species' habitat preferences (Bart *et al.* 1984, Brennan *et al.* 1986, Morrison *et al.* 1992). Habitat suitability index models work by evaluating habitat components from 0 to 1, where a rating of 1 is considered optimal habitat and a rating of 0 as least suitable habitat (USDI Fish and Wildlife Service 1981, Wisdom *et al.* 1986). Each component is then combined into an overall habitat suitability value for that area.

2.0 MODEL DEVELOPMENT

2.1 Background

The HSI modeling approach was selected for application within the Milk River Basin project area. The approach used in the project was not to track changes in habitat for the selected species (Schamberger and O'Neil 1986, Morrison *et al*. 1992), but instead to predict potential habitat. The goal was to predict where potential habitat is located for each individual species modeled, and then combine the individual ratings into an overall rating. The overall rating is to be used to prioritize stewardship activities by identifying "hot spots" within the Milk River Basin. Hot spots are defined as areas of high habitat potential for more than one species.

Habitat suitability index models were developed for 15 species in the Milk River Basin project area in 2002 / 2003 (Table 3.1.1). All models are considered preliminary for this upcoming year and will be sent for peer review. All species are considered Species at Risk (SAR), with classifications ranging from "Sensitive" to "At Risk" except the Richardson's ground squirrel (*Spermophilus richardsonii*) which is classified as "Secure" (Alberta Sustainable Resource Development 2001). Models were developed by Alberta Conservation Association and Alberta Fish and Wildlife staff, with support from the Alberta Resource Data Division. A workshop was held for those developing models to review the modeling process and provide feedback on preliminary models. Where applicable, experts were consulted during model development. If available, local inventory data was used to model habitat relationships (*e.g*. sharp-tailed grouse model). All models were developed for application within the Milk River Basin at a landscape level, so application outside of this area or for site-specific analysis may not be valid.

Table 3.1.1 Status of the 15 habitat suitability index models for application within the Milk River Basin species at risk project area, 2002 -2003

	Common Name	Scientific Name	Species Code	Model Status	Map Status
1	Sharp-tailed Grouse	Tympanuchus phasianellus	STGR	Complete	Complete
2	Ferruginous Hawk	Buteo regalis	FEHA	Draft	Not Complete
3	Burrowing Owl	Athene cunicularia	BUOW	Draft	Not Complete
4	Prairie Rattlesnake	Crotalus viridis	PRRA	Draft	Not Complete
5	Great Plains Toad	Bufo cognatus	GPTO	Draft	Not Complete
6	Loggerhead Shrike	Lanius ludovicianus excubitorides	LOSH	Complete	Complete
7	Prairie Falcon	Falco mexicanus	PRFA	Draft	Not Complete
8	American Badger	Taxidea taxus	AMBA	Draft	Not Complete
9	Richardson's Ground Squirrel	Spermophilus richardsonii	RIGS	Draft	Not Complete
10	Olive-backed Pocket Mouse	Perognathus fasciatus	OBPM	Draft	Not Complete
11	Short-horned Lizard	Phrynosoma hernandesi hernandesi	ESHL	Complete	Complete
12	Plains Spadefoot	Spea bombifrons	PLSP	Draft	Not Complete
13	Western Small-footed Myotis (Bat)	*Myotis ciliolabrum ciliolabrum*	WSFB	Draft	Not Complete
14	Sprague's Pipit	*Anthus spragueii*	SPPI	Complete	Complete
15	Weidemeyer's Admiral	Limenitis weidemeyerii	WEAD	Complete	Complete

2.2 Model Variables

HSI models estimate the value of habitat for wildlife by relating structural and spatial variables of vegetation to particular life requirements (*i.e.* food and cover) (USDI Fish and Wildlife Service 1981, Bessie *et al.* 1996). Habitat variables are the building blocks of an HSI model; the variables are selected from available databases and are chosen based on their ability to represent important habitat features for a selected species. Each variable chosen must be measurable using available map bases and are generally physical, chemical, or biological characteristics of the habitat (USDI Fish and Wildlife Service 1981, Bessie *et al.* 1996). Spatial variables are used to modify available habitat and take the form of distance to or from a particular feature (*e.g.* distance from roads). Spatial variables were measured through the use of geographic information systems (GIS's) (Bessie *et al*. 1996). During model development each habitat variable is separated into components to the point that each component is related and measurable. For example, in the sharp-tailed grouse model the variable native prairie cover (NPC) is

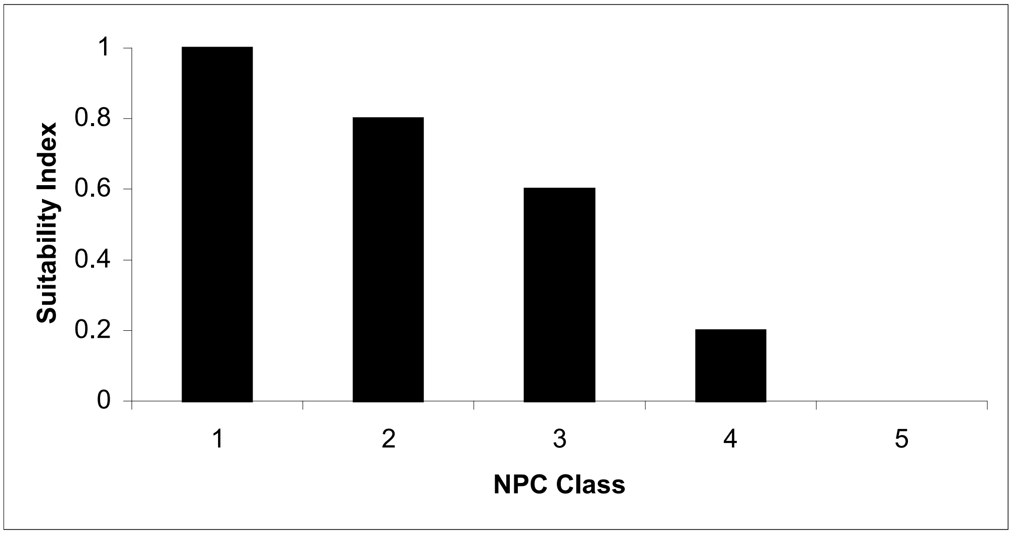


Figure 3.1.1 Habitat suitability index for native prairie cover class (V_1) for the sharp-tailed grouse HSI model.

used. It is broken down into its components (*i.e.* classes 1 – 5) with each class being assigned an HSI value (Figure 3.1.1). A graphic relationship is determined for each variable on a scale of 0 to 1, zero representing least suitable habitat and 1 representing optimum habitat (USDI Fish and Wildlife Service 1981).

A total of 13 structural variables and 2 spatial variables were chosen for constructing the 15 HSI models (Table 3.1.2). The selection of variables was governed by available databases. Variables selected in the modeling process for the Milk River Basin Species at Risk Project were derived from four available databases: the Native Prairie Vegetation Inventory (NPVI)(Resource Data Branch 1995), Agricultural Region of Alberta Soil Inventory Database (Version 3.0) (AGRASID) (Alberta Soil Information Centre 2001), Digital Elevation Model (DEM), and Provincial Base Features (provided by Spatial Data Warehouse).

The NPVI is a database developed by conducting an inventory at the resolution of a quarter section using 1991 – 1993 1:30,000 aerial photography (Resource Data Branch 1995). Native vegetation was classified into either tree, shrub, graminoid (grass), riparian, lake, or wetland to the nearest 5% of each quarter section (Resource Data Branch 1995). AGRASID is a database that portrays the spatial distribution of Alberta's soils and associated landscapes in the agricultural or white zone. The five components that make up AGRASID 3.0 include an Agricultural Region of Alberta Soil Inventory Database, a Basic Soil Evidence File, Soil Names File, a Soils Layer File, and a Land System Legend table. The projection used to portray AGRASID was Ten-Degree Transverse Mercator (NAD83) with a false Easting of 500,000 meters. The fields within NPVI and AGRASID databases constitute the bulk of the structural variables used in the models.

The construction of the models was limited to the available variables and resolution of the databases. For the Milk River Basin Species at Risk Project area this was the quarter section, the resolution of the Native Prairie Vegetation Inventory. Because of the resolution of available databases, the models produced for this project are coarse in nature. Each HSI model chapter discusses the limitations of available databases and its effect on model development. Certain variables (*e.g.* single tree cover for ferruginous hawk) were omitted from these models that likely would have been included in more fine grain (*i.e.* site- specific) models.

Table 3.1.2 Model variables available for selection during the development of the 15 habitat suitability index models for the Milk River Basin project area, 2002-2003

Variable	Units	Source*	Resolution
Structural			
Native Prairie Cover	Categorical	NPVI	Quarter section
Grass Cover	Percentage	NPVI	Quarter section
Shrub Cover	Percentage	NPVI	Quarter section
Tree Cover	Percentage	NPVI	Quarter section
Riparian	Percentage	NPVI	Quarter section
Lake	Percentage	NPVI	Quarter section
Soil Texture	Categorical	AGRASID	25 meter
First and Second Order Soil Classification	Categorical	AGRASID	25 meter
Badlands (shallow to gravel)	Categorical	AGRASID	25 meter
Valleys	Categorical	AGRASID	25 meter
Elevation	Meter	DEM	25 meter
Slope	Degrees	DEM	25 meter
Aspect	Categorical	DEM	25 meter
Spatial			
Distance to Access (roads)	Meter	PBF	5 – 20m
Distance to Hydro (rivers, water bodies)	Meter	PBF	5 – 20m

* NPVI - Native Prairie Vegetation Inventory
AGRASID - Agricultural Region of Alberta Soil Inventory Database
DEM - Digital Elevation Model
PBF - Provincial Base Features

2.3 Model Equations

Once the relationship has been determined for each variable, they are combined using a mathematical equation to produce the habitat suitability index. The index ranges from 0 to 1. The equation used to combine the variables must take into account how the species utilizes the different variables in its habitat (Bessie *et al.* 1996). Bessie *et al.* (1996) states that there are 3 guidelines used in determining the appropriate equation. First, the level of interaction between variables determines how they are combined (additive or multiplied). Secondly, one variable may compensate for another and determines whether one variable increases the effect of another. Lastly, different weightings can be applied to certain variables to reflect their importance. Basic equations used to combine the variables are:

Cumulative Relationship (Additive) - simply sums the values of two or more variables, where a threshold may be met by one or a combination of variables. This formula is used when there is no interaction between variables and the total cannot exceed 1 (Bessie *et al.* 1996).

$$HSI=V_1+V_2+V_3 \text{ (max. value of 1).}$$

Complete Interaction (Multiply) – occurs when there is complete interaction of all variables. This equation will result in 0 if one variable is rated 0, and the index value gets increasingly higher as each variable approaches 1 (Bessie *et al.* 1996).

$$HSI= V_1*V_2*V_3$$

Limiting Factors (Minimum Function) - a variable with lowest suitability overrides all other factors and is often used when more than one model is developed for different life requisites (*e.g.* food, shelter, nesting). For example, if HSI models were constructed for the life requisites of food, hiding cover and thermal cover and had values of 1.0, 0.5 and 0.23 respectively, the overall model would have an HSI value of 0.25.

$$HSI= \text{minimum } (V_1, V_2, V_3).$$

Compensatory Relationships - when a variable with low value is offset by high suitability of other variables. Compensatory relationship equations can take the form of the arithmetic mean or the geometric mean (Bessie *et al*. 1996). The arithmetic mean is used when variables can be combined but all are not required to have suitable habitat.

$$HSI=(V_1+V_2+V_3)/n.$$

The geometric mean is used when a value of 0 for any variable results in an overall value of 0. The geometric mean will result in a lower overall value than the arithmetic mean.

$$HSI=(V_1*V_2*V_3)^{1/n}$$

2.4 Mapping of Potential Habitat

Base data for the analysis consisted of polygonal and linear features (with associated geographic databases) derived from Alberta's Base Features, Native Prairie and AGRASID data sets. For analysis involving slope or aspect the Alberta topographic information in Arc/Info GRID format was used. All data used for the project is in NAD 83 10TM projection. All data sets were clipped for the Milk River drainage study area. Once data preparation needed for the polygonal or linear data sets (such as buffering) was completed the data sets were converted into Arc/Info GRID format of 25-meter cell resolution. Final habitat modeling was completed in GRID using equations supplied by habitat biologists to produce a Habitat Suitability Index in Arc/Info GRID format. The GRIDs were then mapped using ArcView 3.2a. Questions concerning metadata should be conveyed to the Resource Information Unit of Alberta Sustainable Resource Development, Prairie Region. When completing the maps we utilized a categorical system to depict the range in potential habitat (Table 3.1.3). The categories range from highly suitable to least suitable.

Table 3.1.3 Potential habitat categories and the corresponding habitat suitability index values used in the Milk River basin species at risk project

Potential Habitat Category	HSI Range
Highly Suitable	0.76 – 1.00
Suitable	0.51 – 0.75
Less Suitable	0.26 – 0.50
Least Suitable	0.00 – 0.25

3.0 MODEL APPLICATION

The HSI models developed during this project are to be used in a planning exercise to prioritize the landscape within the Milk River Basin project area for future stewardship activities. With the difficulties associated with the soil database and the inability to map potential habitat for 10 of the species, the determination of "hot spots" will be accomplished in 2003 / 2004. The determination of "hot spots" will allow the initiation of stewardship activities in 2004 / 2005.

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5.0 SPECIES SELECTION

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Under ideal circumstances, each organism present in the Milk River Basin would warrant having populations inventoried and habitat mapped. This, however, would be impractical due to limitations of budget, staffing, and time. Traditionally, wildlife managers have carried out inventory and management of game species. With increased concern about species declines, the list of priority management species has expanded to include species considered to be sensitive or at risk. In recent years there have also been attempts to develop management systems based upon biodiversity. While this project strives to include key landscape processes, a comprehensive model of biodiversity is not within the scope of this project. Such models are dynamic in time and space, and very complex (Salwasser 1986). They may be useful for maintaining large habitat types on the landscape, but are likely unreliable for management of species already documented to be in decline, or those with particular sensitivities to habitat variables below the large landscape level.

Multi-species management approaches have been developed, including systems based on guilds (Sveringhaus 1981). A guild is defined as "a group of species that exploit the same class of environmental resources in a similar way. This term groups together species that overlap significantly in their niche requirements" (Root 1967). Thomas (1979) grouped species into "life forms" based on habitats used for breeding and feeding. Systems based solely upon these approaches may not achieve an objective of successful ecosystem management (Verner 1984). The use of indicator species to predict the responses of other species has been criticized due to the large numbers of variables to be considered (Morrison *et al*. 1992). Extrapolation beyond primary species also presents mapping difficulties due to overlaps of species between guilds and life forms (Bonar *et al.* 1990).

The Milk River Basin Species at Risk Project's primary goal is to maintain habitat and populations of species at risk. A review has been made of important natural processes, their importance to the selected management species, and the status of these processes within the basin. This allows for some interpretation to the landscape level, and ameliorates the previously cited weaknesses of single and multiple-species approaches.

Through selection of species with a wide spectrum of habitat associations, and subsequent management for them, it is possible that other species with similar habitat associations will also benefit, but this is not measurable. A species selection criterion has been adopted which may increase the likelihood of other species with similar niches being managed for under this project. Each species model includes mention of other species that are believed to exhibit similar habitat use characteristics during critical life stages. This is not, however, being portrayed as an evaluation beyond the species selected, as this would be fraught with inherent error.

For the Milk River Basin Species at Risk Project high priority management species (At Risk, May be at Risk, Sensitive) were selected for model development based on having high ecological importance as determined by one or more criteria (Landres *et al.* 1988, Morrison *et al.* 1992, Thomas and Verner 1986). Primary criteria for species selection included:

- Strong representative of a group of species with similar habitat associations.
- Strong association with a specific major ecosystem (*e.g.* native grasslands).
- Strong association with specific habitat structures (*e.g.* cliffs).
- Narrow ecological tolerances.
- High sensitivity to habitat changes and human activities.
- Value as a "keystone species" (*e.g.* important prey species).

Further modification of the list of selected species was done through consideration of the availability of information for species, a desire for proportionate representation amongst major taxa, documented declines in other jurisdictions, and comparative ease of inventory and monitoring. A list of selected management species for the Milk River Basin Species at Risk Project is included in Table 3.2.1.

Additional species were considered for model development, but were excluded for a variety of reasons. Two of these, the swift fox and long-billed curlew, were selected later in the process, and will be included for HSI model development in 2003-2004. A list of excluded species and associated reasons is included in Table 3.2.2.

The Milk River Basin Species at Risk Project is primarily designed to maintain habitat for species at risk through application of landscape-level management. The selection of appropriate species, development of habitat suitability index models for them, and mapping of relative habitat values throughout the basin, will help to determine landscape "hot spots" of suitability for selected species at risk. The use of habitat variables and thresholds present in the Prairie Unit's Resource Information Branch's ArcView files has allowed for mapping of habitat across the Milk River Basin.

Table 3.2.1 Selected management species for the Milk River basin species at risk project

Species	Justification	Range in Milk River Basin
Ferruginous Hawk	Native grasslands association, dependent on keystone prey, sensitive, recent inventory	Throughout, but highest numbers in Milk River Ridge
Prairie Rattlesnake	Prairie coulees & grasslands association, sensitive	Throughout, highest in Writing-on-Stone and Lower Milk River
Great Plains Toad	Ephemeral ponds, narrow ecological tolerance, recent inventory	Lower Milk River and Lodge Creek
Short-horned Lizard	Prairie coulees & valley breaks, narrow ecological tolerance, recent inventory	Writing-on-Stone, Lower Milk River, and Lodge Creek
Weidemeyer’s Admiral	Riparian shrub association	Writing-on-Stone
Sharp-tailed Grouse	Grassland/shrubland, current monitoring program	Throughout, but highest numbers in Milk River Ridge
Plains Spadefoot	Ephemeral ponds, recent inventory	Throughout, except Milk River Ridge Unit
Loggerhead Shrike	Shrub/grassland association	Throughout
Sprague’s Pipit	Native grassland association, strong species group representative	Throughout
Burrowing Owl	Native grassland association, sensitive	Throughout
Badger	Native grassland, dependent on keystone prey, makes burrows for burrowing owls	Throughout
Prairie Falcon	Habitat structure association (cliffs)	Primarily Milk River Valley
Olive-backed Pocket Mouse	Grassland and sandy soil association	Unknown
Richardson's Ground Squirrel	Important prey for several species; keystone species	Throughout
Western Small-footed Myotis (Bat)	Riparian (cottonwood and cliffs) association	Throughout Milk River Valley

Table 3.2.2 Species excluded from Milk River basin modelling process

Species	Reason for Excluding
Western Silvery Minnow	Riverine, key variable flow rates which cannot be mapped
Brassy Minnow	Tributaries and mainstem, variables cannot be mapped
Sage Grouse	U of A research project underway includes development of habitat model. Specific recovery process already underway for this species, including conservation initiatives likely to occur within Milk River Basin.
Shorthead Sculpin	Riverine, key variable flow rates which cannot be mapped
Yucca/Yucca Moth	Very limited distribution already known and these species are already scheduled for specific recovery planning.
Western Blue Flag	Specific recovery initiatives are already underway through the Western Blue Flag Conservation Program.
Piping Plover	Few, very specific locations will receive site-specific management through the Piping Plover Recovery Plan.
Short-eared Owl	Insufficient information on habitat and distribution
Long-tailed Weasel	Insufficient information on habitat and distribution
Pronghorn	A separate management project includes the development of a habitat model that can be applied in the Milk River Basin.
Western Hog-nosed Snake	Insufficient information on habitat and distribution
Bullsnake	Insufficient information on habitat and distribution
Northern Leopard Frog	Extensive suitable habitat is vacant due to past declines; management recommendations will be made at known occurrence sites.
Western Painted Turtle	Very limited distribution

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Sharp-tailed Grouse (*Tympanuchus phasianellus*)

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1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for sharp-tailed grouse (*Tympanuchus phasianellus*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

Sharp-tailed grouse are a common upland game bird found throughout Alberta, though higher numbers are concentrated in the grassland, aspen parkland, and Peace River parkland areas. The subspecies plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi*), considered the most prevalent of the six subspecies (Hamerstrom and Hamerstrom 1961, Johnsgard 1973), is found within the Milk River drainage. Though considered the most prevalent subspecies, populations of sharp-tailed grouse have been decreasing in southern Alberta as a result of agricultural practices (Moyles 1981, Goddard 1995).

3.0 GENERAL HABITAT ASSOCIATIONS

Native grass and shrubs are critical habitat components for maintaining viable sharp-tailed grouse populations (Pepper 1972, Hillman and Jackson 1973). Swenson (1985) described optimum habitat in Montana as a mosaic of upland grassland with sumac and riparian hardwood draws. In South Dakota, lightly grazed mixed-grass prairie with occasional shrubby draws is considered optimal habitat (Hillman and Jackson 1973). Moyles (1981) stated that optimal habitat in the central parkland of Alberta consisted of grassland and grassland-shrub mixtures. During certain times of the year and for different life stages, particular habitat types are chosen.

3.1 Cover

3.1.1 Nesting Cover

Sharp-tailed grouse tend to nest within 1.6km of a lek, with the average being 900m (Pepper 1972). For the Milk River Ridge area, Roersma (2001) found the average distance to the nest from the lek was 1.1km. Lush, dense residual cover associated with shrub cover, particularly buckbrush (*Symphoricarpos occidentalis*) and rose (*Rosa* spp.), are considered prime nesting habitat for sharp-tailed grouse (Pepper 1972). Sharp-tails will nest in tame pasture, hay fields, and cultivated stubble but not in treed bluffs or groves (Pepper 1972). They also tend to avoid areas where the vegetation is taller than 6m and are rarely found in areas where the dominant vegetation is less than 24.5cm

(Christenson 1970, Pepper 1972). Roersma (2001) determined that sharp-tailed grouse nests on the Milk River Ridge contained more woody (shrub) cover and less grass cover than random plots, and that heights of all vegetative components tended to be higher at nest sites (Roersma 2001). Nesting habitat characteristics tend to be related to vegetation height and density and not particular species (Pepper 1972, Hillman and Jackson 1973, Prose 1987).

3.1.2 Brood Rearing Habitat

With the young being precocial, sharp-tailed grouse hens leave the nest shortly after hatching in search of brood rearing habitat. Brood rearing habitat consists of shrubs and trees for hiding cover and grassland areas for foraging (Evans 1968, Johnsgard 1973). Shrub cover tends to be selected over treed areas because of its additive value as forage (berries and buds) (Roersma 2001). In Wisconsin, Hamerstrom (1963) reported croplands, weedy fields, meadows and savannahs as open cover brood habitats. Moyles (1981) reported hens in the parkland area of Alberta utilized grassland and grassland- low shrub transition zones for rearing broods. Roersma (2001) determined that brood rearing sites had greater grass cover and reduced litter cover than random sites. The brood sites also had taller vegetation and greater horizontal cover values than random sites (Roersma 2001).

4.0 SPECIAL HABITAT ASSOCIATIONS

4.1 Dancing Grounds

During the spring mating period, male sharp-tailed grouse congregate on leks, or dancing grounds (Johnsgard 1975). On average, 8 to 12 males display on a lek (Ammann 1957, Johnsgard 1975). In 2002, on the Milk River Ridge in southern Alberta, there was an average of 9.4 males per lek for the 27 leks monitored. Resident males establish territories that are adjacent to each other and are approximately 1.8m – 2.7m across (Pepper 1972). Males defend their territories and attract females through acoustic displays (Bergerud and Gratson 1988). Central males tend to be dominant and perform most of the copulation. Most mating occurs in the early morning, with females then leaving the lek to establish a nest (Johnsgard 1975). Habitat characteristics vary for individual dancing grounds but can be generalized as having low, sparse vegetation allowing for good line of sight and unrestricted movement (Johnsgard 1973). They tend to be located on high knolls and ridge tops. Tame pasture, stubble, hayfields, and bogs are used for leks (Ammann 1957).

5.0 HABITAT AREA REQUIREMENTS

It is generally believed that the lek is the focal area for sharp-tailed grouse. Management for prairie grouse has centered on a set area around the lek, termed the breeding complex (Giesen and Connelly 1993). The breeding complex is the area around a lek that encompasses the majority of nesting sites. A breeding complex with a radius of 2 km, resulting in an area of 13 km^2 (1,260 ha), has been suggested for Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) (Giesen and Connelly 1993, Roersma 2001). For the Milk River Ridge, Roersma (2001) introduced the term total nesting area, which was the area encompassing all nests associated with a dancing ground. The average total nesting area for 5 dancing grounds was 148.1 ha (range 18.6 to 292.5 ha).

Marks and Marks (1987) reported the home range size for Columbian sharp-tailed grouse in Idaho as 190 ha while Giesen (1997) reported the home range size for Columbian sharp-tailed grouse in Colorado as 110 ha. Based on spring and summer locations, Roersma (2001) documented a home range size of 69 ha for sharp-tailed grouse in the Milk River Ridge.

6.0 ASSOCIATED SPECIES

Some of the species associated with sharp-tailed grouse include: the mallard (*Anas platyrhynchos*), American wigeon (*Anas americana*), Gadwall (*Anas strepera*), Northern pintail (*Anas acuta*), Northern shoveler (*Anas clypeata*), Wilson's phalarope (*Phalaropus tricolor*), Upland sandpiper (*Bartramia longicauda*), Long-billed curlew (*Numenius americanus*), Marbled godwit (*Limosa fedoa*), Bobolink (*Dolichonyx oryzivorus*), Sage grouse (*Centrocercus urophasianus*), and songbird and sparrow spp.

7.0 THE HSI MODEL

The resolution of the Native Prairie Vegetation Inventory (NPVI) database did not allow for the modeling of specific habitat characteristics required for different life stages of the sharp-tailed grouse. For example, the quarter section resolution was not adequate for modeling nesting habitat, where height and condition of the range were required. Therefore, the HSI model developed for sharp-tailed grouse is a general habitat model, based on the analysis of lek characteristics (using the NPVI database) (Appendix N) and the work completed by Roersma (2001) for the Milk River Ridge. This model should suffice at the scale of the available data, as leks are the centers of activity.

7.1 Selected Habitat Variables

The HSI model for sharp-tailed grouse is comprised of two habitat variables to describe general habitat needs. They are native prairie cover class (V_1) and percent shrub cover (V_2), and are assumed to represent hiding, nesting, brood rearing, and winter habitat.

7.1.1 Native Prairie Cover (V_1)

Figure 3.3.1 depicts the HSI relationship for the native prairie cover class. A decrease in HSI value occurs as the cover class increases or the percent class for the quarter section comprised of native vegetation decreases. The native prairie cover class #5, which represents 0% native prairie or agricultural land, was given an HSI score of 0. Even though cropland is utilized by sharp-tailed grouse, as the area converted to agricultural land increases, habitat use decreases until it becomes detrimental to sharp-tailed grouse. Within the NPVI database there is no spatial component that relates where agricultural land is within the quarter section, just what percentage of the quarter section is agricultural land. Therefore, we could not evaluate the spatial distribution of the agricultural land. To account for this, the model airs on the side of caution and gives native prairie class #5 a score of 0.

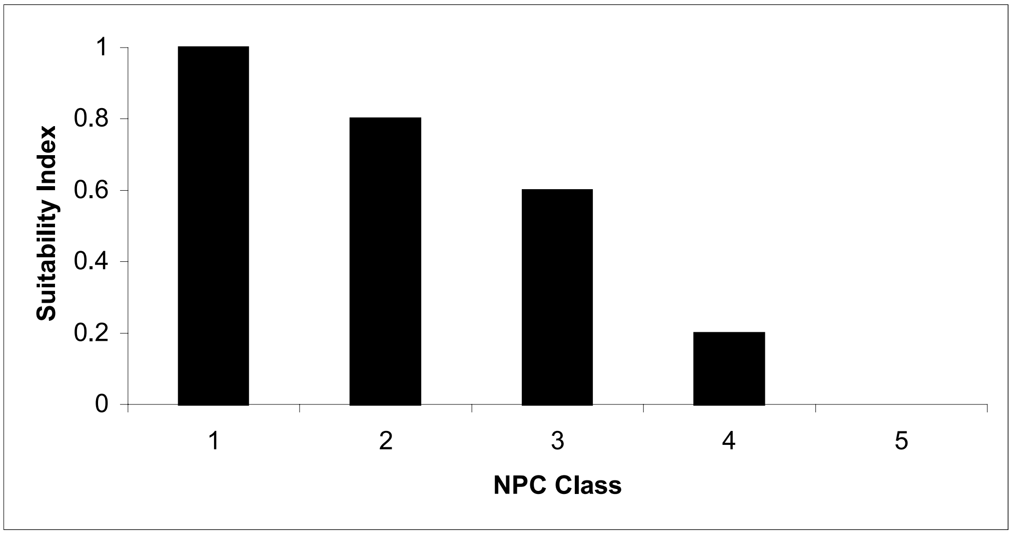

Figure 3.3.1 Habitat suitability index for native prairie cover class (V_1) for the sharp-tailed grouse

7.1.2 Percent Shrub Cover

The HSI relationship for shrub cover is shown in Figure 3.3.2. If no shrub cover is detectable then an HSI score of 0.4 is given. This is based on the assumption that shrub cover is present, just not in a clump that would represent 5% of a quarter section (how it is determined in the NPVI database) and be recorded. An HSI value of 1 is given to the range of 5% to 15% shrub cover (Prose 1987) and then the value decreases until shrub cover reaches $\geq$20% at which point the HSI value is 0. With the model not focusing on any specific life requisite it can be applied across the entire study area and likely the Grassland Natural region.

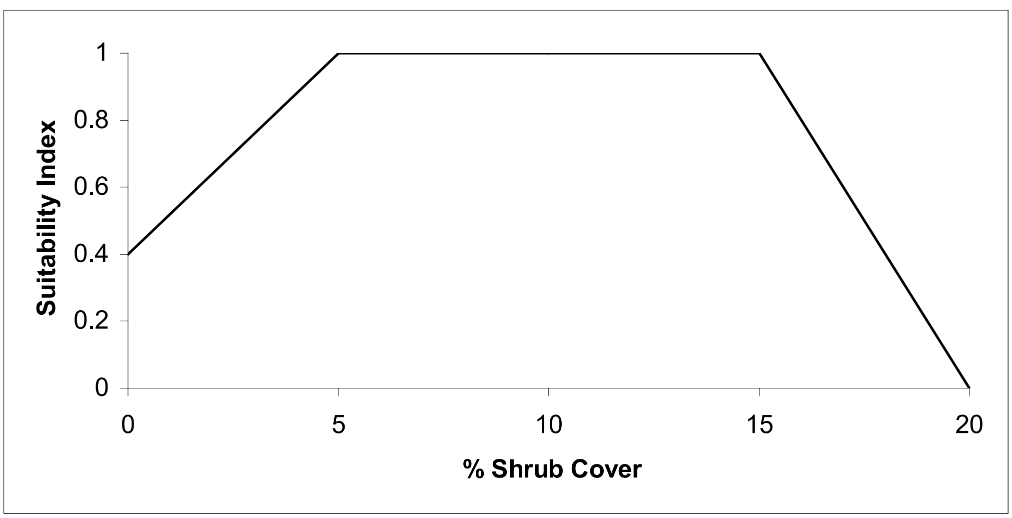

Figure 3.3.2 Habitat suitability index curve for percent shrub cover (V_2) for the sharp-tailed grouse

8.0 HSI EQUATION

The equation used to determine the overall HSI value assumes full value for V_1 (native prairie cover class) and 0.1 for V_2 (percent shrub cover). The native prairie cover represents nesting, hiding and brood rearing habitat and is the key variable in the model. Shrub cover represents a component of nesting habitat as well as winter habitat, however, because of the limitations of the NPVI database it is rated as 10% the value of V_1. The two variables are not interactive and are combined using the additive formula:

$$\mathbf{HSI = V_1 + (0.1V_2)}$$

9.0 HABITAT SUITABILITY MAP

A habitat suitability map depicting the potential sharp-tailed grouse habitat within the Milk River Basin is found in Appendix O. The two largest areas of greatest habitat potential for sharp-tailed grouse are the Milk River Ridge to the west and the Sage Creek area in southeastern Alberta. There is a high density of leks on the Milk River Ridge but the density of leks in the Sage Creek area is relatively unknown. I believe the map is a good representation of potential sharp-tailed grouse habitat.

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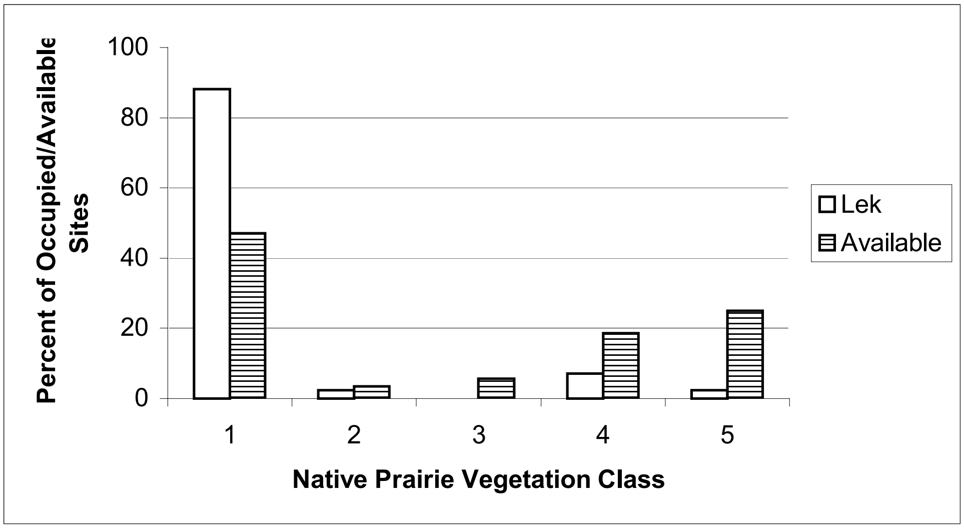
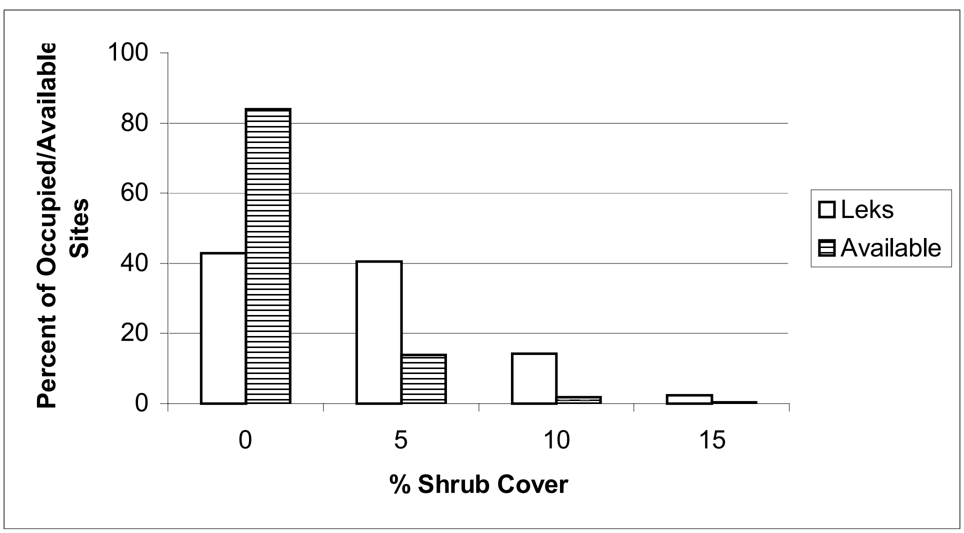
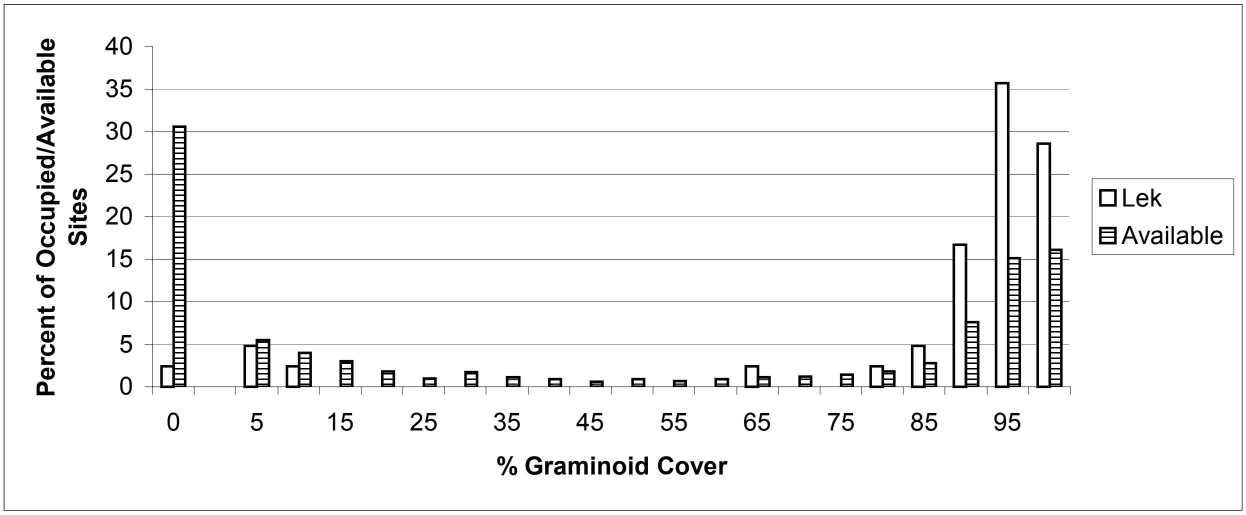
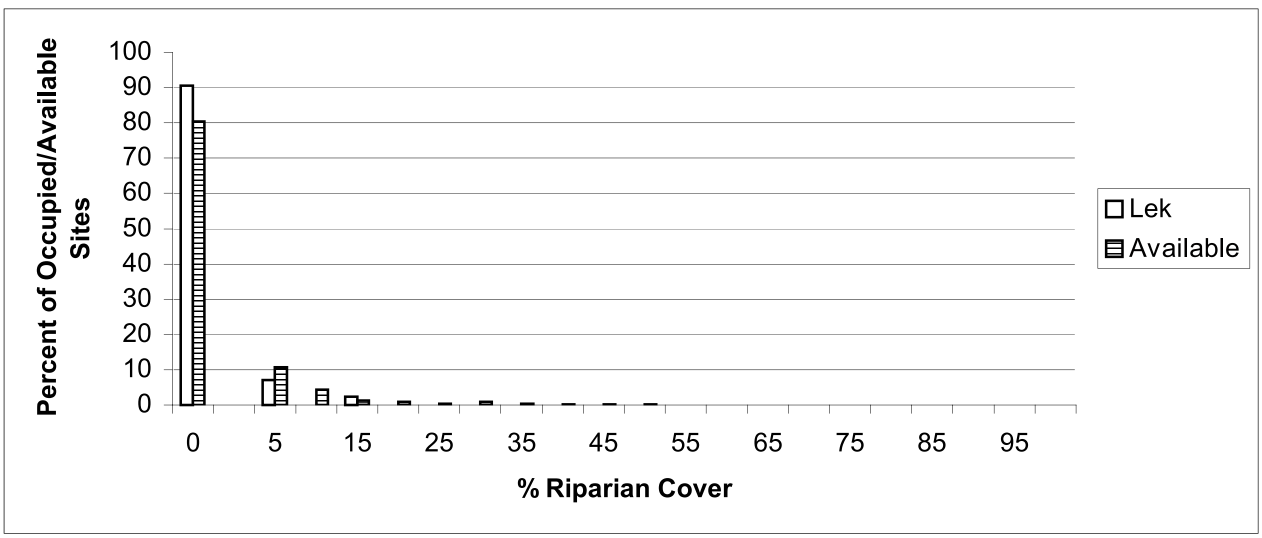
11.0 APPENDICES

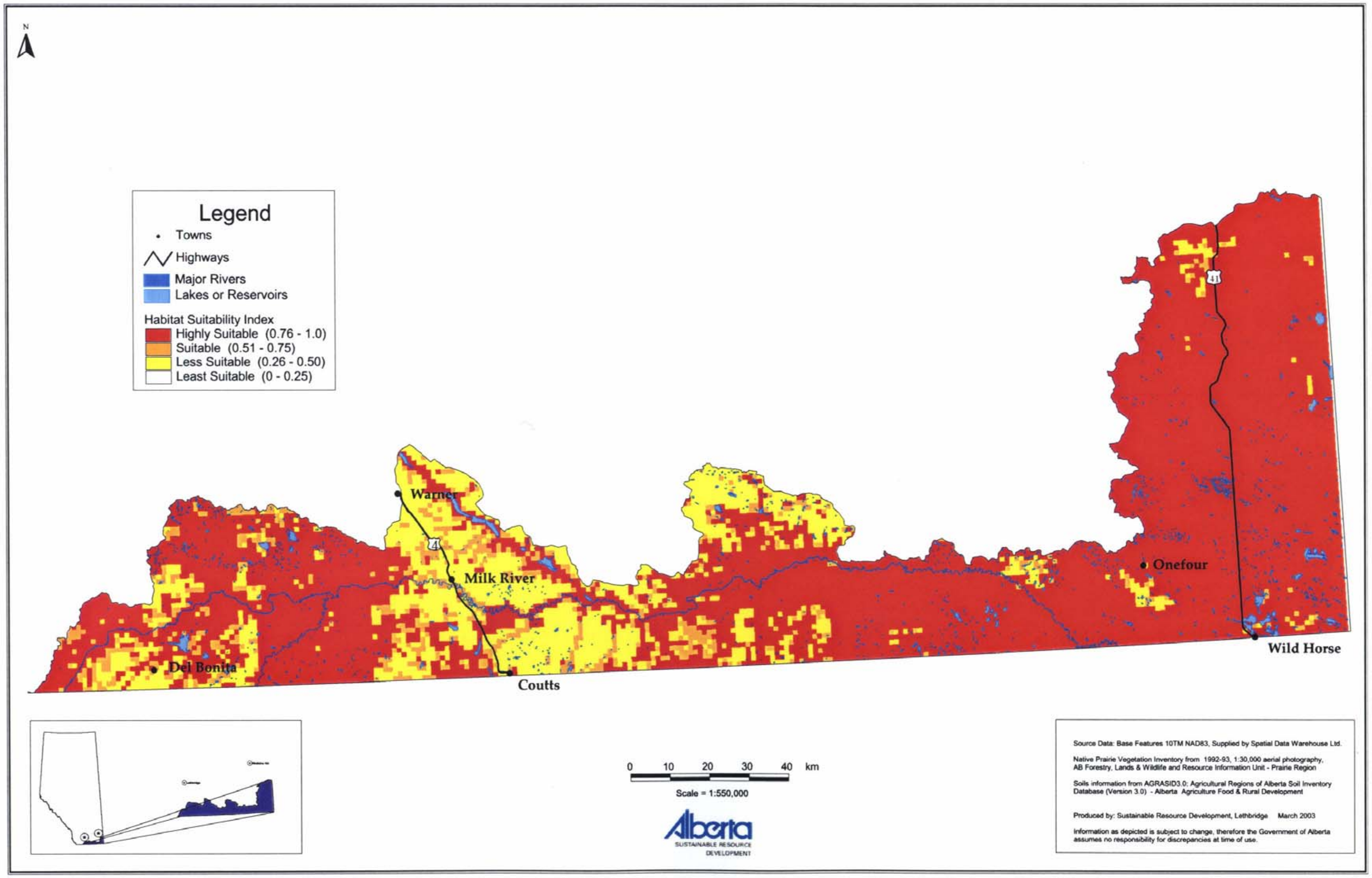
Appendix N: Histograms of habitat variables for occupied sites (sharp-tailed grouse lek sites on the Milk River Ridge, n=42) and available sites (4219 quarter sections on the Milk River Ridge)






Percent of Occupied/Available Sites
40
35
30
25
20
15
10
5
0
0
5
15
25
35
45
55
65
75
85
95
% Graminoid Cover
Lek
Available


Percent of Occupied/Available Sites
100
90
80
70
60
50
40
30
20
10
0
0
5
15
25
35
45
55
65
75
85
95
% Riparian Cover
Lek
Available



Appendix O – Potential habitat for sharp-tailed grouse in the Milk River Basin

Loggerhead Shrike (*Lanius ludovicianus excubitorides*)

Brad A. Downey
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1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for loggerhead shrike (*Lanius ludovicianus excubitorides)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The loggerhead shrike, also known as the "butcher bird," is a predatory songbird of the grasslands and parklands. Loggerhead shrike are currently ranked as a "Sensitive" species and a species of "Special Concern" in Alberta (Alberta Sustainable Resource Development 2001). They are also listed as "Threatened" in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The loggerhead shrike's range within Alberta has decreased over the last few decades (Collister 1994), with several studies referring to loss of habitat as a key cause. Loggerheads are slightly smaller than American robins (*Turdus migratorius*) and are identified by their grey body and head, black face mask through their eyes, white belly, and white patches on their black wings (Collister 1996, National Geographic 1999). Males and females look similar in appearance (Prescott and Bjorge 1999), however sex can be determined by the presence of a brood patch on the female's belly (only the female incubates). Nesting in Alberta usually occurs around mid-May, with most shrikes fledged by early July (Collister 1994). Shrikes will also renest nearby if their first nesting attempt fails.

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Food

Prey includes several invertebrates such as grasshoppers, beetles, and bees along with vertebrates dominated by small mammals, birds, and on rare occasions amphibians and snakes. Shrikes do not have raptorial feet so they impale their prey on barbed wire or plant thorns, which makes them easier to handle. Barbed wire is also used to store food for future consumption when prey may be hard to find (Prescott and Bjorge 1999).

Loggerhead shrikes are visual predators and require hunting perches to effectively forage (Collister 1994). Perching locations such as power lines, barbed wire fences, corrals, snags, and dead branches are ideal for hunting, enabling them to spot and easily swoop down on their prey.

3.2 Cover

Loggerheads prefer open habitat (grassland and agricultural areas) containing scattered clumps of shrubs or hedgerows within close proximity to multiple landscape types such as pastures, meadows, and right of ways (Collister 1996, Bjorge and Prescott 1996, Brooks and Temple 1990). These open habitats are often heavily grazed or mowed (De Smet 1993) with shrikes avoiding tall, dense vegetation (Gawlik and Bildstein 1993), although taller vegetation adjoining heavily grazed native pasture (edge habitat) is favoured for hunting (Prescott and Collister 1993). Shrikes have also been known to use cropland and bare ground for foraging (Prescott and Bjorge 1999).

Shrikes in the Milk River Region of Alberta utilize several species of shrubs and trees. Of all the shrikes found in the Milk River Region by Wershler (1989), 20 % used thorny buffaloberry (*Shepherdia argentea*), 33% willow (*Salix*), 20% common caragana (*Caragana arborescens*), 13% Manitoba maple (*Acer negundo*), 7% Siberian elm (*Ulmus rubra*), and 7% sagebrush (*Artemesia cana*). Loggerhead nests were found in natural shrub communities in valleys, including the Milk River, as well as in exotic shelterbelts and scattered upland sites (Smith 1991). Valleys and exotic shelterbelts accounted for 78% of the sites, with 43% of shrikes being found in cultivated areas and 57% in grassland (Smith 1991). In southeastern Alberta shrikes prefer small clumps of shrubs and hedgerows/shelterbelts for nesting and hunting perches (Collister 1994). Yosef and Grubb, Jr. (1994) confirmed that hunting perches are a limiting factor for shrike habitat.

4.0 HABITAT AREA REQUIREMENTS

The mean territory size for loggerhead shrikes in southeastern Alberta changes from 5.9 ha during incubation to 6.7 ha during the nestling period (Collister 1994). The total mean area covered during breeding was 8.5 ha, with the distance between nests usually 200m (Collister 1994). Collister's (1994) study occurred along a narrow 1 km by 36 km strip of rail line where there was excellent habitat throughout (somewhat atypical for Alberta) and a dense population of shrikes, showing that these birds can tolerate restricted territories.

5.0 ASSOCIATED SPECIES

Badgers *(Taxidea taxus),* burrowing owls *(Athene cunicularia)*, ferruginous hawks *(Buteo regalis),* and Richardson's ground squirrels *(Spermophilus richardsonii)* can be found in similar habitat as loggerhead shrikes. Shrikes compete for suitable nesting habitat with Eastern kingbirds *(Tyrannus tyrannus),* Western kingbirds *(Tyrannus verticalis),* and Brewer's blackbirds (*Euphagus cyanocephalus).* Black-billed magpies *(Pica hudsonia)* and Brewer's blackbirds have been known to depredate shrike's nests (De Smet and Conrad 1989 in Johns *et al.* 1993) and kestrels (*Falco sparverius*) and kingbirds have been observed in aggressive interactions with shrikes (Chabot 1994).

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Shrub Coverage (V_1)

Shrub encroachment increases the availability of perch and nest sites in grasslands, however as shrub density increases, foraging space decreases. Therefore, even though there would be more nesting opportunities for shrikes, the lack of foraging space would decrease the suitability of the site (Telfer 1992). The Native Prairie Vegetation Baseline Inventory (Prairie Conservation Forum 2000) only accounts for dense clumps of shrubs comprising greater than or equal to 5 % of each quarter section. As such, areas classified as 0% shrub cover may technically still contain shrubs and are therefore assigned an HSI value of 0.2, not 0 (Figure 3.4.1).

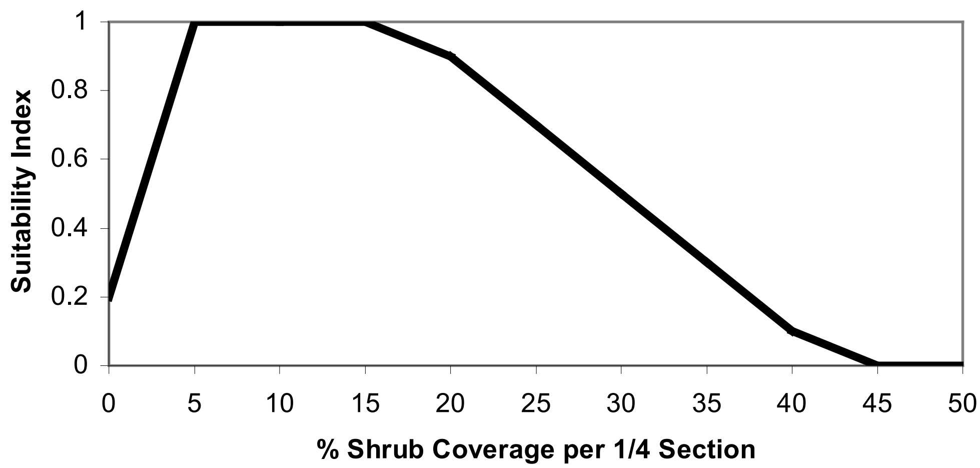

Figure 3.4.1 Habitat suitability index for shrub coverage (V_1) for the loggerhead shrike

6.1.2 Graminoid Coverage (V_2)

Collister (1994) found that the average loggerhead shrike territory contained >80% graminoids. Therefore, this was chosen as the threshold and assigned an HSI value of 1 (Figure 3.4.2).

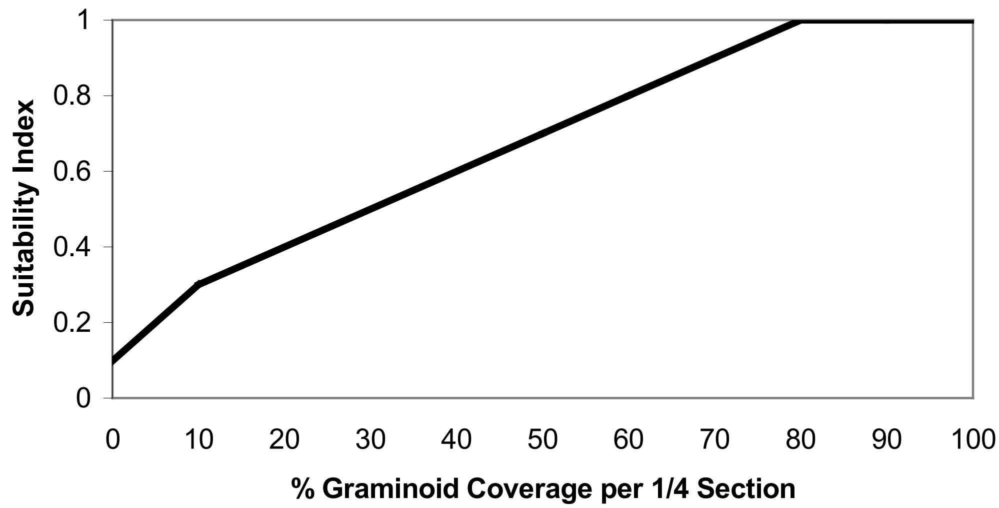

Figure 3.4.2 Habitat suitability index for graminoid coverage (V_2) for the loggerhead shrike

6.1.3 Slope (V_3)

Shrikes prefer relatively flat, open prairies and parklands so they can easily spot and catch prey. Therefore, any incline that would decrease the shrike's ability to detect prey is given a lower HSI value (<1)(Figure 3.4.3).

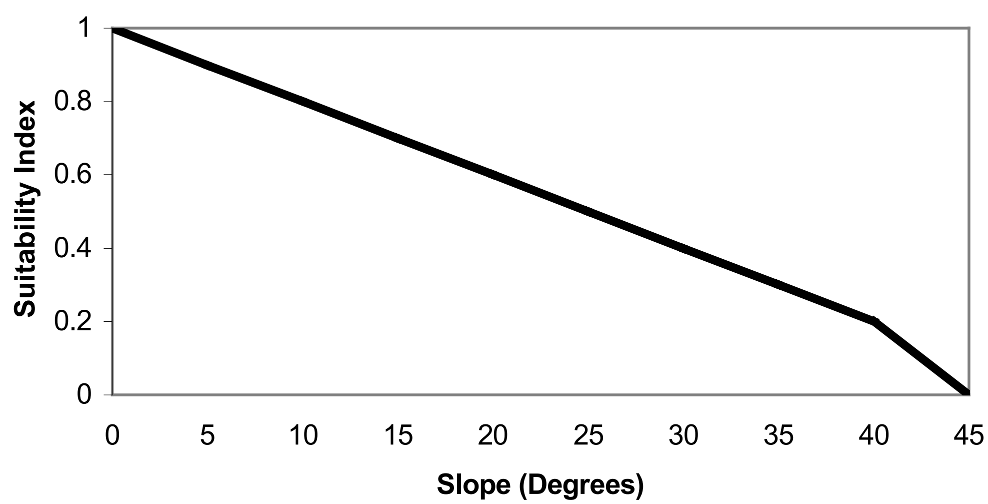

Figure 3.4.3 Habitat suitability index for slope (V_3) for the loggerhead shrike

6.1.4 Wetlands (V_4)

Based on the results from the Native Prairie Vegetation Index, 203 of the 520 shrike locations found in the Biodiversity/ Species Observation Database (BSOD) and the local database contained wetlands. Quarter sections that contain wetlands have a higher chance of containing shrub growth, especially in the drier areas of southeastern Alberta. In most years the wetlands in the Milk River Basin contain very little water, however, it is the dry margins around wetlands or sloughs that would contain shrubs in which shrikes could nest (Figure 3.4.4).

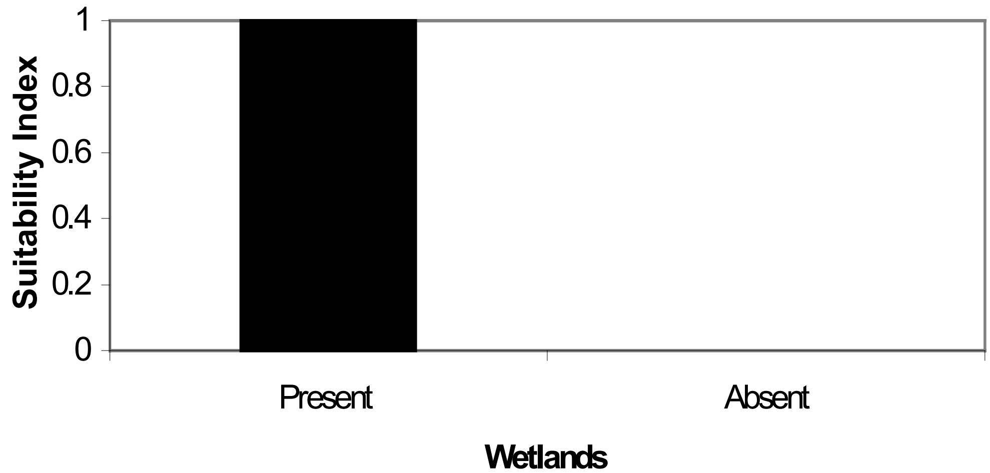

Figure 3.4.4 Habitat suitability index for wetlands (V_4) for the loggerhead shrike

7.0 HSI EQUATION

$$\mathbf{HSI = (V_1*V_2*V_3)^{1/3} + (.15* V_4)}$$

Shrubs (V_1), graminoids (V_2), and slope (V_3) are compensatory, with lower values of one variable being improved by another. The formula, however, can also be non-compensatory in cases where one of the first three variables receives a 0 value. In those cases, the 0 value negates the values of the other two variables. For this study, the ¼ sections containing at least 80% graminoids and 5% shrubs on flat terrain would be ideal loggerhead shrike habitat. Conversely, as slope and percent shrub cover increases the habitat suitability of the site decreases. Wetlands (V_4) increase the HSI values of poorer quality sites due to an increased probability of shrubs existing there.

7.1 Other Variables Considered

7.1.1 Island Habitat

Farmyards within a sea of cultivation can act as island refuges for shrikes and other shrub nesting birds. Most farmyards provide edge habitat, consisting of grassland and cultivation separated by hedgerows. Unfortunately, the data layer was unavailable for mapping.

7.1.2 Grass Heights

There was no available database containing information on grass heights. This variable would have been useful in identifying areas of tall vegetation adjacent to short vegetation; transition zones favoured by shrikes for hunting.

7.1.3 Shrub Complexes

Being able to identify whether there are several single shrubs scattered throughout a ¼ section, a few hedgerows, or a dense clump of shrubs/trees would allow more precise modelling of loggerhead shrike habitat. The highest HSI values would have been assigned to ¼ sections containing small scattered clumps of shrubs or hedgerows/ shelterbelts, the preferred habitat for shrikes in southeastern Alberta for nesting and hunting (Collister 1994). Unfortunately, this data layer does not exist for the Milk River Basin.

7.1.4 Riparian Areas

Shrikes are primarily birds of the flat prairie and parkland regions; however, small riparian zones may be beneficial by providing them with nesting sites, especially in the dry regions of the Milk River Basin. For these riparian zones to be valuable they would have to contain large flat valleys with shrubs (e.g. Lost River in southeastern Alberta). Unfortunately, the data layer could not differentiate between small narrow valleys and larger wider valleys, so it was not practical to include this variable.

8.0 FUTURE MANAGEMENT/RECOMMENDATIONS

Increasing suitable loggerhead shrike habitat can be achieved through a variety of means:

1) The addition of at least one patch of thorny buffaloberry or willow per ¼ section in suitable locations can improve habitat (Telfer 1992).

2) Land management practices that promote heterogeneous herbaceous vegetation heights rather than intensive grazing.

9.0 HABITAT SUITABILITY MAP

Please refer to Appendix P for a colour map which indicates areas where there is potential for shrikes to occur within the Milk River Basin, based on the four selected habitat variables (graminoids, slope, shrubs, and wetlands). The amount of highly suitable habitat may become further limited once other variables, such as the farmstead and shrub components, are refined through ground truthing and air photo interpretation. This refinement would also negate the need for the wetland variable, which was chosen as an indicator for potential shrub growth (an important habitat component for loggerhead shrike).

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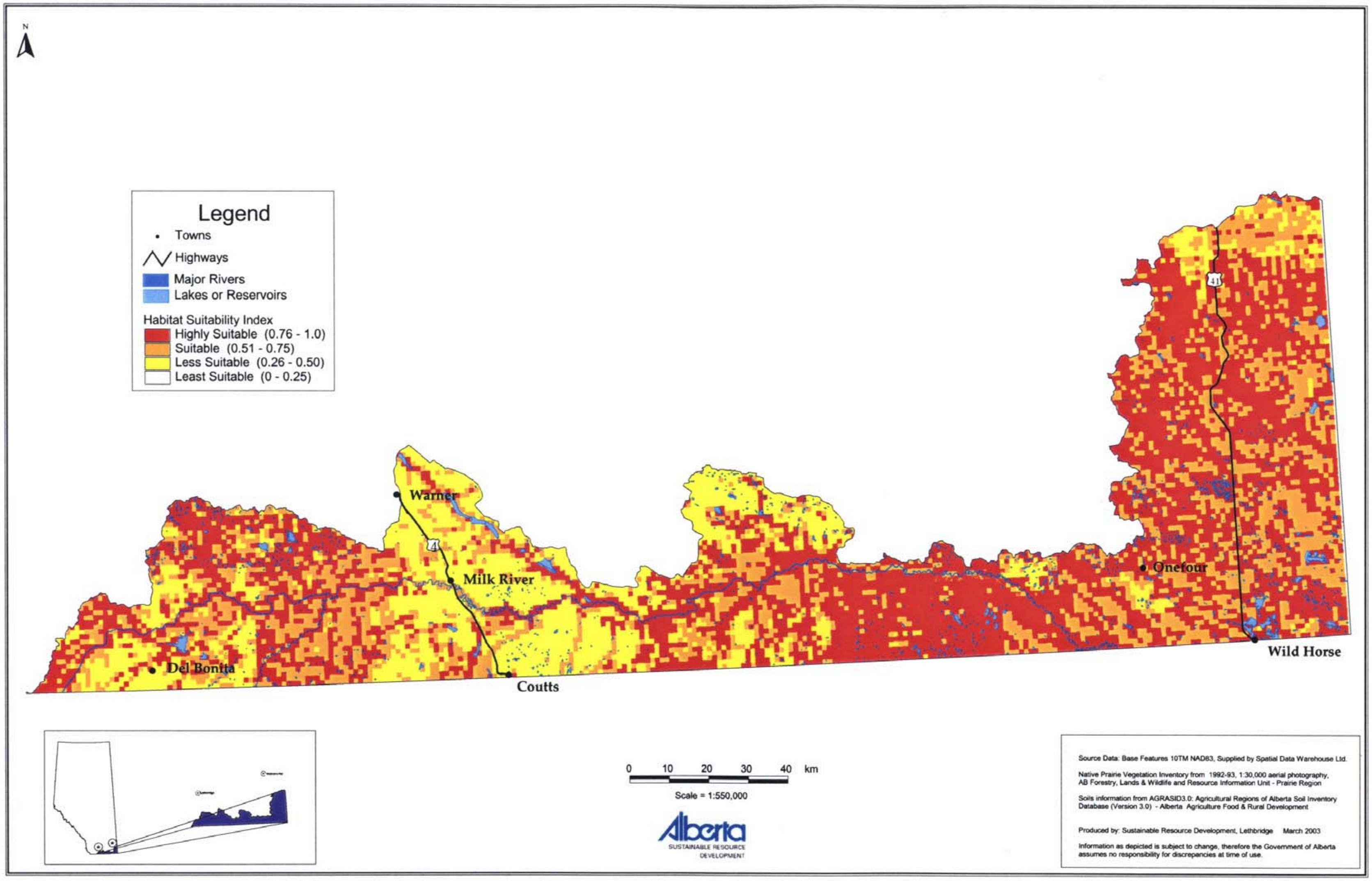
Brian Huffman



Appendix P – Potential habitat for loggerhead shrike in the Milk River Basin

Sprague's Pipit (*Anthus spragueii*)

Julie P. Landry
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential nesting and foraging habitat for Sprague's pipit (*Anthus spragueii*) within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL DESCRIPTION

The Sprague's pipit is a songbird of the native grasslands (Sibley 2000), similar in appearance to sparrows such as the vesper sparrow (*Pooecetes gramineus*) and the Baird's sparrow (*Ammodramus bairdii*) (Salt and Wilk 1958). Distinguishing features include buff and streaked upper feathers (Semenchuk 1992), extensive white on its outer tail feathers (Sibley 2000), and a slender pointed beak (Salt and Wilk 1958). The Sprague's pipit has a distinctive song which is sung from a high altitude and is a "rolling, jingling cascade of high, dry whistles" (Sibley 2000). Breeding occurs in southern Alberta, Saskatchewan, Manitoba, Minnesota, North Dakota, and Montana (Sibley 2000). This species migrates to wintering grounds in the southern United States and Mexico (Salt and Wilk 1958).

In Alberta, The General Status of Alberta Wild Species 2000 (Alberta Sustainable Resource Development 2001) designates the Sprague's pipit as a "Sensitive" species, while the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2001) has the Sprague's pipit classified as "Threatened."

3.0 HABITAT ASSOCIATIONS

3.1 Food

The Sprague's pipit is predominantly insectivorous, catching prey on or near the ground (Semenchuk 1992, Salt and Wilk 1958). In May, beetles comprise more than 40% of the adult diet and in September grasshoppers comprise 91% (Maher 1974, as cited in Prescott 1997). The nestling diet consists primarily of grasshoppers, but also may include lepidopteran larvae, leaf hoppers, spiders, and ants (Harris 1933, as cited in Prescott 1997).

3.2 Cover

The Sprague's pipit tends to occupy native grassland habitats (Wilson and Belcher 1989, Dale *et al.* 1997) containing very little or no woody vegetation (Davis and Duncan 1999, Dale 1983, as cited in Prescott 1997), with non-native areas populated to a significantly lower extent (Davis and Duncan 1999).

Research on these birds has shown them occupying grassland habitats with varying characteristics. Sutter *et al.* (1996) described that this bird forages in dense grassy vegetation, whereas, Sutter and Brigham (1998) identified occupied areas as sparse to intermediate in density with intermediate vegetation heights. In Saskatchewan, Sprague's pipits avoided heavily grazed areas and were positively associated with narrow-leafed grasses equal to or less than 10 cm tall, and were negatively associated with shrubs 20-100 cm tall (Anstey *et al.* 1995, as cited in Dechant *et al.* 2001). In North Dakota, if vegetation reached 8cm tall, Sprague's pipit incidence decreased by 50%, and decreased to less than 5% at vegetation heights of 19 cm (Madden *et al.* 2000). In addition, Sprague's pipits were completely absent from areas of deep litter (Sutter 1997) or dense nesting cover (Prescott and Murphy 1999) and from areas that had not seen fire disturbance for >80 years (Madden *et al.* 1999).

In Alberta, Owens and Myres (1973) found that Sprague's pipit were common on idle native prairie, and to a lesser extent were also found on lightly grazed native prairie with dense grasses. Sprague's pipits may also occasionally occupy grasslands that receive periodic disturbances such as fire, heavy grazing, and mowing (Owens and Myres 1973). In Alberta, Prescott and Murphy (1996) found that preferred areas had moderate cover diversity and moderate grass height and height variation.

3.3 Nesting Cover

Sprague's pipits build their nests on the ground in small depressions (McConnell *et al.* 1993) where grass is denser and taller, and where forb and shrub density is low (Sutter 1997). The nests are woven cups lined with coarse and fine graminoids (McConnell *et al.* 1993) and often have overarched grasses (Salt and Wilk 1958). In Saskatchewan, Sutter (1997) found nest sites had higher grass and sedge cover, lower forb and shrub cover, higher maximum vegetation height, lower bare ground cover, and lower forb density than found at random sites (Table 3.5.1).

Table 3.5.1 Nest characteristics of nest sites (n=47) in Saskatchewan (Sutter 1997)

Grass and Sedge Cover:	52.7%
Forb and Shrub Cover:	10.5%
Litter Cover:	15.2%
Bare Ground Cover:	16.8%
Maximum Height:	27.7cm
Litter Depth:	2.4cm

4.0 HABITAT AREA REQUIREMENTS

Predominantly, Sprague's pipit have been recorded on larger tracts of native prairie (Owens and Myres 1973). For example, in Saskatchewan the minimum area required was 190 ha (Saskatchewan Wetland Conservation Corporation 1997, as cited in Dechant *et al.* 2001). Kantrud (1981) found the amount of grazing an area received as well as land usage type depicted how many pairs may occupy an area.

It is interesting to note that in Manitoba, brown-headed cowbird brood parasitism was higher on smaller tracts of land (22 ha) than on larger ones (64 ha) (Davis and Sealy 2000, as cited in Dechant *et al.* 2001).

5.0 ASSOCIATED SPECIES

A few species associated with the Sprague's pipit include the Baird's sparrow (*Ammodramus bairdii*), grasshopper sparrow (*Ammodramus savannarum*), Le Conte's sparrow (*Ammodramus leconteii*), western meadowlark (*Sturnella neglecta*) (Madden *et al.* 1999), and chestnut-collared longspur (*Calcarius ornatus*) (Davis and Duncan 1999).

6.0 THE HSI MODEL

6.1 Assumptions and Limitations

- It will be assumed that all water requirements are attained through consumption of insects because no water requirements have been documented for this species.
- Since vegetation height, density, and grass to forb ratio could not be determined for this model, it will be assumed that within native grasslands the variability needed for foraging and nesting will be available.
- Within each quarter section, the native prairie coverage cannot determine if the percent of native grass is contiguous or not. Upon ground truthing, highly suitable areas may not be as suitable as once determined. For our purposes, we will assume native grass is contiguous within each quarter section.

6.2 Selected Habitat Variables

6.2.1 Percent Native Grass (V_1)

In Alberta, Prescott and Wagner (1996) observed that Sprague's pipit were 15 times more common on native fescue or mixed-grass prairie than in tame pastures or agricultural fields. For this model, areas comprised of 25% or more native grass were assigned a suitability value of 1. Since non-native areas are not completely devoid of Sprague's pipits, zero percent native grass areas did not receive a habitat suitability value of zero but received a low suitability of 0.1. As native grassland percent cover increases from zero, the suitability increases (Figure 3.5.1).

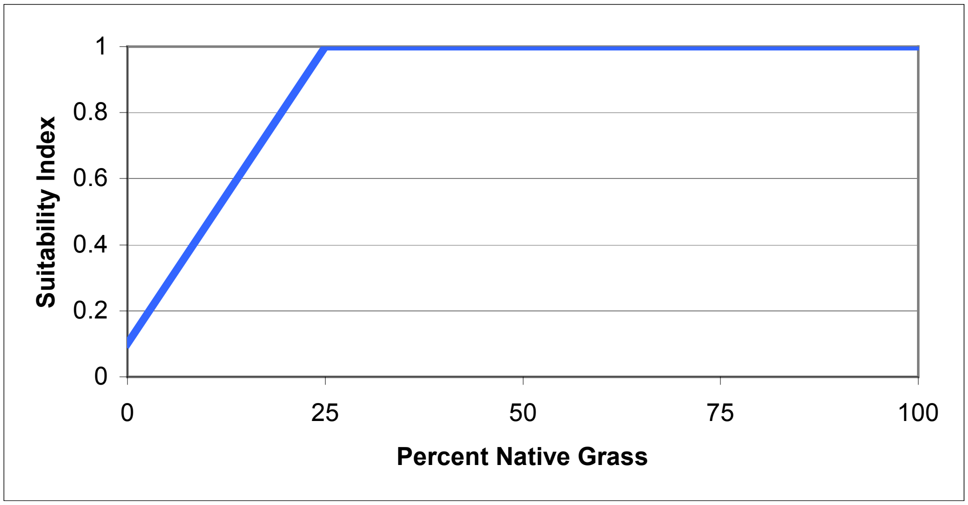


Figure 3.5.1 Habitat suitability index for percent native grass coverage (V_1) for the Sprague's pipit

6.2.2 Percent Trees and Shrubs (V_2)

To satisfy nesting and foraging requirements, Sprague's pipits require open grasslands with little or no amounts of woody vegetation (Davis and Duncan 1999). If woody vegetation increases above 15%, the habitat is no longer considered suitable (Prescott, pers.comm.) (Figure 3.5.2).

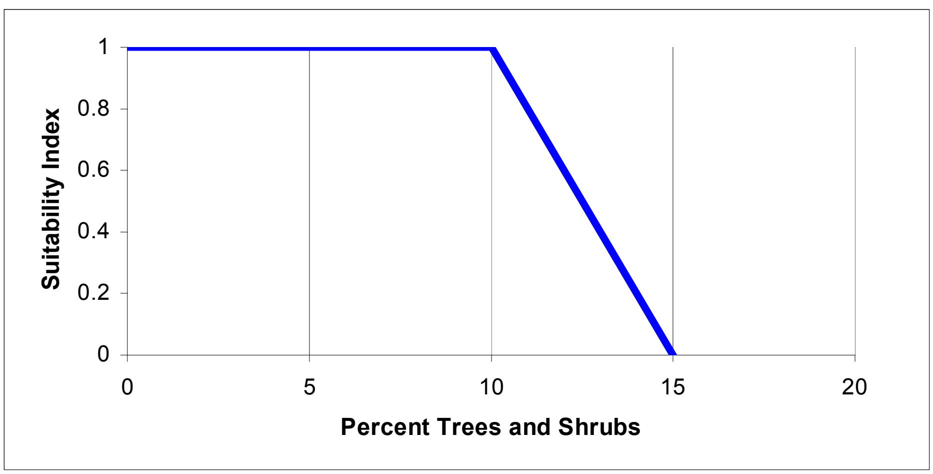


Figure 3.5.2 Habitat suitability index for percent tree and shrub cover (V_2) for the Sprague's pipit

6.2.3 Distance from Riparian Areas (V_3)

To further satisfy the Sprague's pipit's preference for open grasslands, riparian areas, which potentially contain woody vegetation, will be considered unsuitable habitat (Prescott, pers.comm.) (Figure 3.5.3).

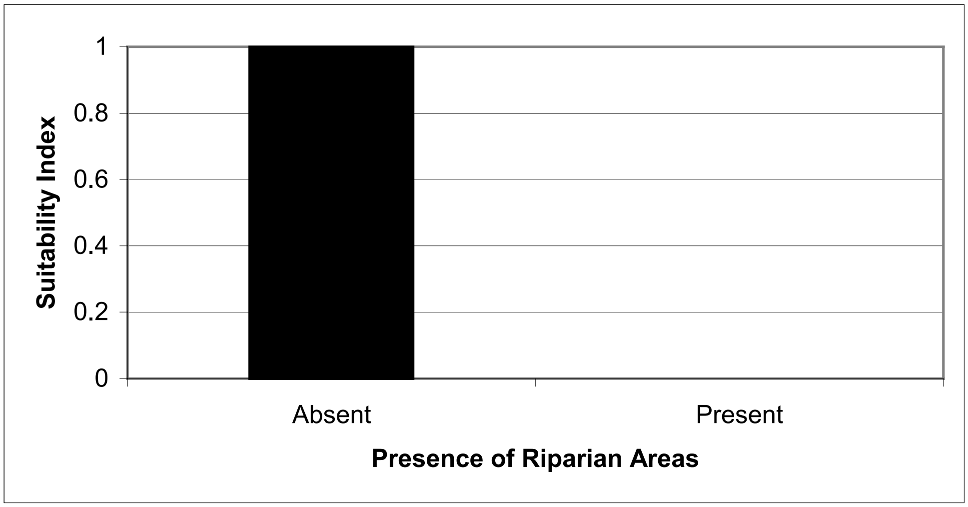


Figure 3.5.3 Habitat suitability index for riparian areas (V_3) for the Sprague's pipit

7.0 HSI EQUATION

$$\mathbf{HSI = (V_1 * V_2 * V_3)}$$

The equation used for evaluating nesting and foraging habitat for Sprague's pipits considers the 3 variables to be equal and non-compensatory. A low value in one of the variables cannot be compensated by a higher value in another. This equation describes a full interaction between the 3 variables, indicating that the use of native grasses as reproductive habitat only occurs where shrub and tree cover is low or nil.

7.1 Other Variables Considered

7.1.1 Grass Height

There was no available database containing information on grass heights. This variable would have been useful in selecting more specific nesting areas for Sprague's pipits (Sutter 1997).

8.0 SOURCES OF OTHER MODELS

One other habitat suitability model for the Sprague's pipit was created for the M.D. of Foothills No. 31 (Kienzle and Landry 2002).

9.0 HABITAT SUITABILITY MAP

Please refer to Appendix Q for a colour map that portrays the potential breeding, nesting, and foraging habitat for the Sprague's pipit within the Milk River Basin. This map was produced with the 3 habitat variables used in the HSI equation: percent native grass, percent trees and shrubs, and presence of riparian areas. Four different suitability ratings, ranging from "highly suitable" to "least suitable," were categorized on the landscape. Large contiguous areas of potentially highly suitable habitat for Sprague's pipits are found west of Highway 4, and in the southeastern portion of the Milk River Basin. The largest white area on the map from the Warner area and south to Coutts predominantly indicates agricultural land, which has been identified as the least suitable habitat for the Sprague's pipit. If additional information regarding microhabitat for the Sprague's pipit (*e.g.* grass height and density) were acquired, highly suitable habitat areas could be more refined.

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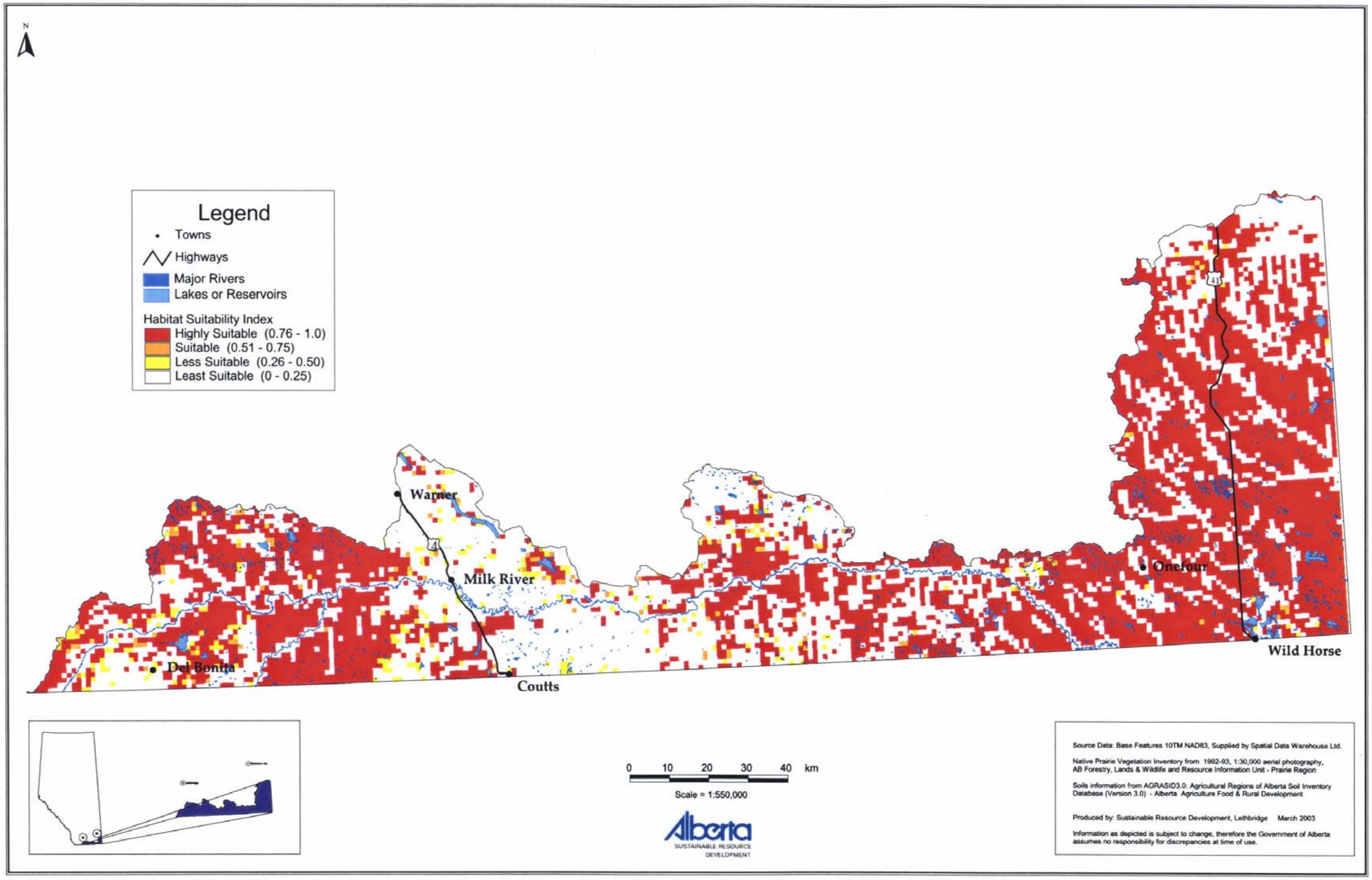

Appendix Q – Potential habitat for Sprague's pipit in the Milk River Basin

Short-horned Lizard (*Phrynosoma hernandesi hernandesi)*

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for short-horned lizards (*Phrynosoma hernandesi hernandesi)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The short-horned lizard is Alberta's only lizard. It is indigenous to semi-arid, short grass portions of the northern Great Plains and usually found in rather rough terrain (Conant and Collins 1991). The short-horned lizard is small, well camouflaged, and is a "sit and wait" predator (James *et al.* 1997). Population densities in Alberta appear to be low (Powell 1982, Powell and Russell 1993a). Short-horned lizards are currently classified as "May Be At Risk" in Alberta (Alberta Sustainable Resource Development 2001).

3.0 GENERAL HABITAT ASSOCIATIONS

3.1 Cover

In Alberta, short-horned lizards are mainly found on sparsely vegetated, south facing slopes of coulees and canyons along the interface between the prairie grassland and valley bottom (Powell 1982, Powell and Russell 1991, 1993a, James 2002). Short-horned lizards are also associated with exposed Bearpaw shale (McCorquedale 1965, cited by James *et al.* 1997). Powell and Russell (1991, 1993a) identified three basic habitat types for short-horned lizards. The Milk River Basin habitat type is characterized by the ecotone between the short grass prairie and the coulee and canyon margins. The Bearpaw habitat type is comprised of sandy dunes formed from Bearpaw shale and is commonly matted with creeping juniper (*Juniperus horizontalis*). North Marginal habitat occurs at the most northerly extensions of short-horned lizard range and is restricted to north rims of canyons and coulees with southern exposures.

3.2 Food

Most short-horned lizards feed on ants (Pianka and Parker 1975), however, short-horned lizards in Alberta exhibit a more generalist feeding pattern (Powell 1982). Ants, beetles, and grasshoppers made up 36, 24, and 22 percent dry weight in their diet, respectively (Powell 1982).

4.0 HABITAT AREA REQUIREMENTS

Short-horned lizards are prone to relatively long movements (> 30m) from mid-summer to early fall and have a median home range of $601m^2$ (Powell and Russell 1993b, 1996).

5.0 ASSOCIATED SPECIES

The habitat of prairie rattlesnakes (*Crotalus viridis viridis*), western hog-nosed snakes (*Heterodon nasicus*), garter snakes (*Thamnophis spp*.), and great plains toads (*Bufo cognatus*) all overlap short-horned lizard habitat. Ferruginous hawks (*Buteo regalis*) can also be found in areas suitable for short-horned lizards.

6.0 THE HSI MODEL

6.1 Selected Habitat Variables

6.1.1 Topographical Features (V_1)

Historic short-horned lizard observations were analyzed at the landscape level utilizing Arcview 3.2 and the Agricultural Region of Alberta Soils Inventory Database (AGRASID) Morphology data layer (Alberta Soil Information Centre 2001). The utilization-availability methodology suggested by Neu *et al.* (1974) was used to determine overuse or underuse of the topographical features. Short-horned lizards selected for valleys while all other features were selected against (χ^2 = 612.0, ρ< 0.0001). Short-horned lizard radio telemetry data indicated forays of around 70m from the valley break into the adjoining prairie (Powell and Russell 1996). Most of the daily movement patterns during the summer rarely exceeded 30m, and generally occurred along the slopes of the valleys or valley bottoms (Powell and Russell 1996). Consequently, all valleys and all prairie habitat within 100m of valleys would be considered the best habitat (Figure 3.6.1).

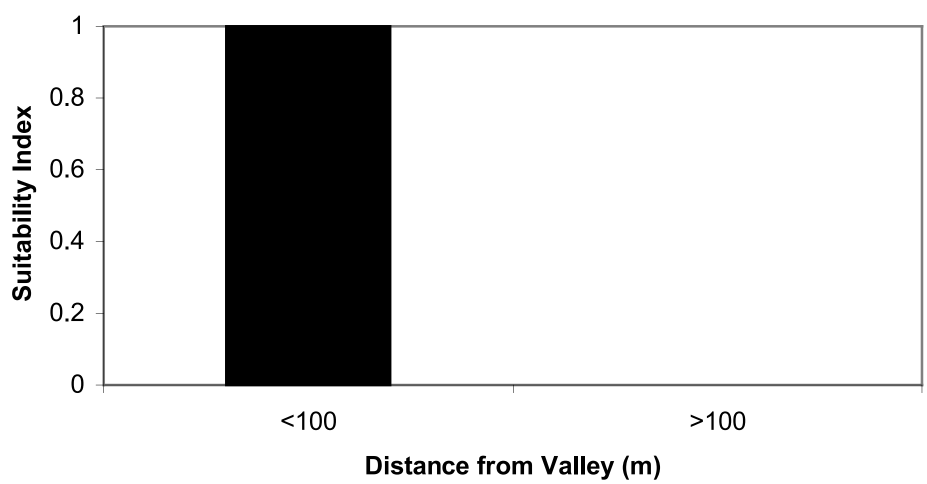

Figure 3.6.1 Topographical (V_1) habitat suitability index for the short-horned lizard

6.1.2 Native Prairie Class (V_2)

Native Prairie Class (NPC) is derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment. Class 1 is comprised of greater than 75% native prairie components (*i.e.* shrubs, graminoids, riparian areas, lakes, wetlands, and trees), Class 2 is 50 – 75%, Class 3 is 25 – 50%, Class 4 is 1 – 25%, and Class 5 is 0% native prairie components (Prairie Conservation Forum 2000). Short-horned lizards are generally not found in areas that exhibit high levels of cultivation; consequently, as NPC increases the HSI value decreases (Figure 3.6.2).

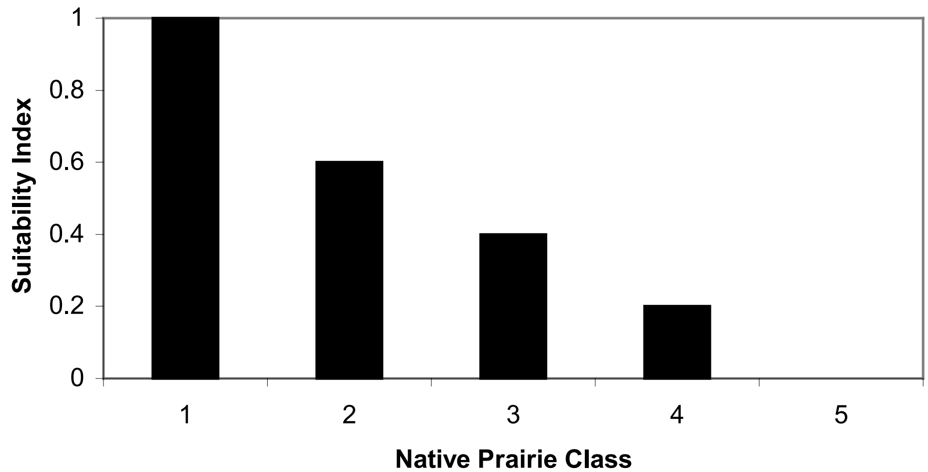

Figure 3.6.2 Habitat suitability index for native prairie (V_2) for the short-horned lizard

6.1.3 Elevation (V_3)

Short-horned lizards are generally found at elevations below 1100 m, however, a few short-horned lizards have been observed above this point. No lizards have been recorded above 1200 m (Figure 3.6.3).

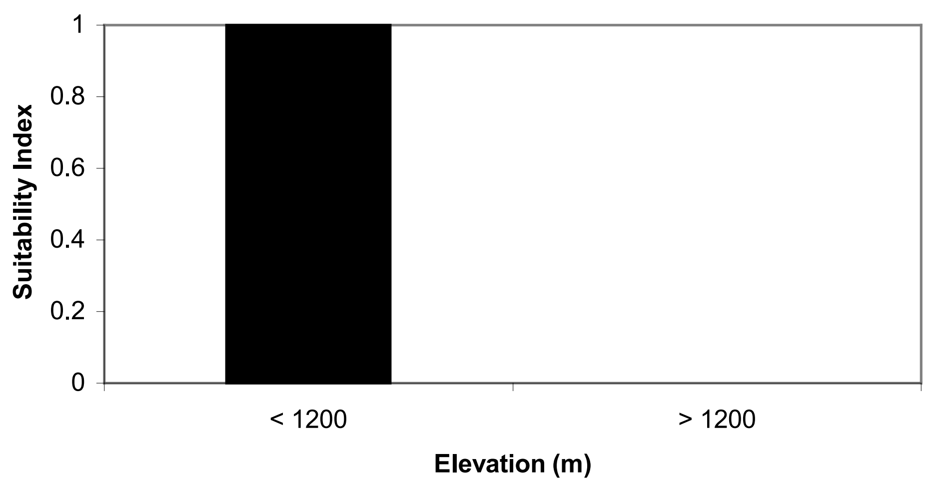

Figure 3.6.3 Habitat suitability index for elevation (V_3) for the short-horned lizard

6.1.4 Riparian Zones (V_4)

Short-horned lizards generally are not found in riparian zones because thick vegetation inhibits their movement. Due to the coarse resolution of the Native Prairie Vegetation Baseline Inventory polygons, quarter sections that contained more than 5% riparian features would be downgraded but not excluded from potential habitat sites (Figure 3.6.4).

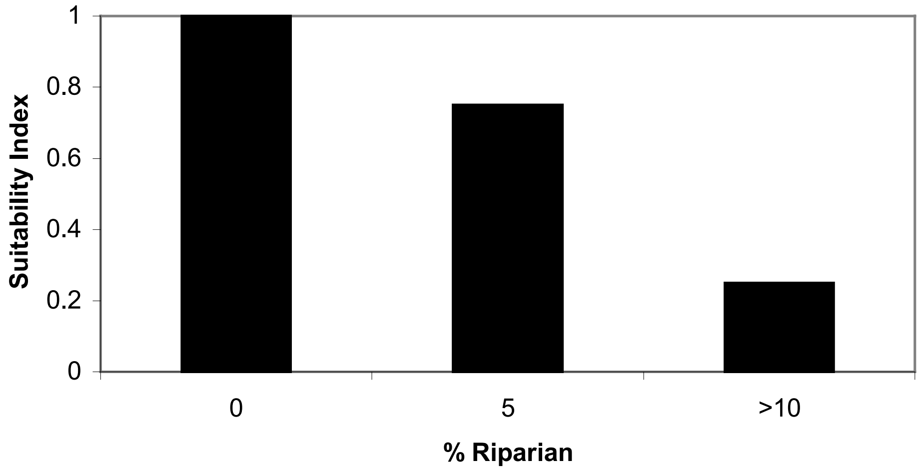

Figure 3.6.4 Habitat suitability index for percent riparian features (V_4) for the short-horned lizard

7.0 HSI EQUATION

$$\mathbf{HSI = V_1 * V_2 * V_3 * V_4}$$

All variables in this equation are considered equal and non-compensatory (low values of one variable can not be compensated by higher values of another) in defining the quality of habitat for short-horned lizards in the Milk River Basin. The equation is based on the assumption that the short-horned lizard is restricted to valley breaks and bottoms below 1100 m. It is further assumed that cultivated and riparian areas are poor habitat. Analysis of proximal and areal relationships between spatial data layers was not possible at the time of publication.

7.1 Other Variables Considered

7.1.1 Slope

Moderately shallow to moderately steep slopes (10 – 60 degrees) appear to be the selected habitat for short-horned lizards; however, this is generally at the microhabitat level. Very general slope categories were created for the landscape model; however, due to the scale and refinement of the data layer this variable was excluded from final calculations.

7.1.2 Aspect

The majority of short-horned lizards are found on south facing slopes, although along the Milk River, lizards have been noted on other aspects. Due to the scale and refinement of the data layer this variable was also excluded from final calculations.

8.0 HABITAT SUITABILITY MAP

Potential habitat for the short-horned lizard in the Milk River Basin clearly identifies some of the known areas of lizard occupancy. The map also indicates some areas that may need some additional exploration in order to test the validity of the model and to make further refinements.

Please refer to Appendix R for a colour map indicating potential habitat for short-horned lizards within the Milk River Basin.

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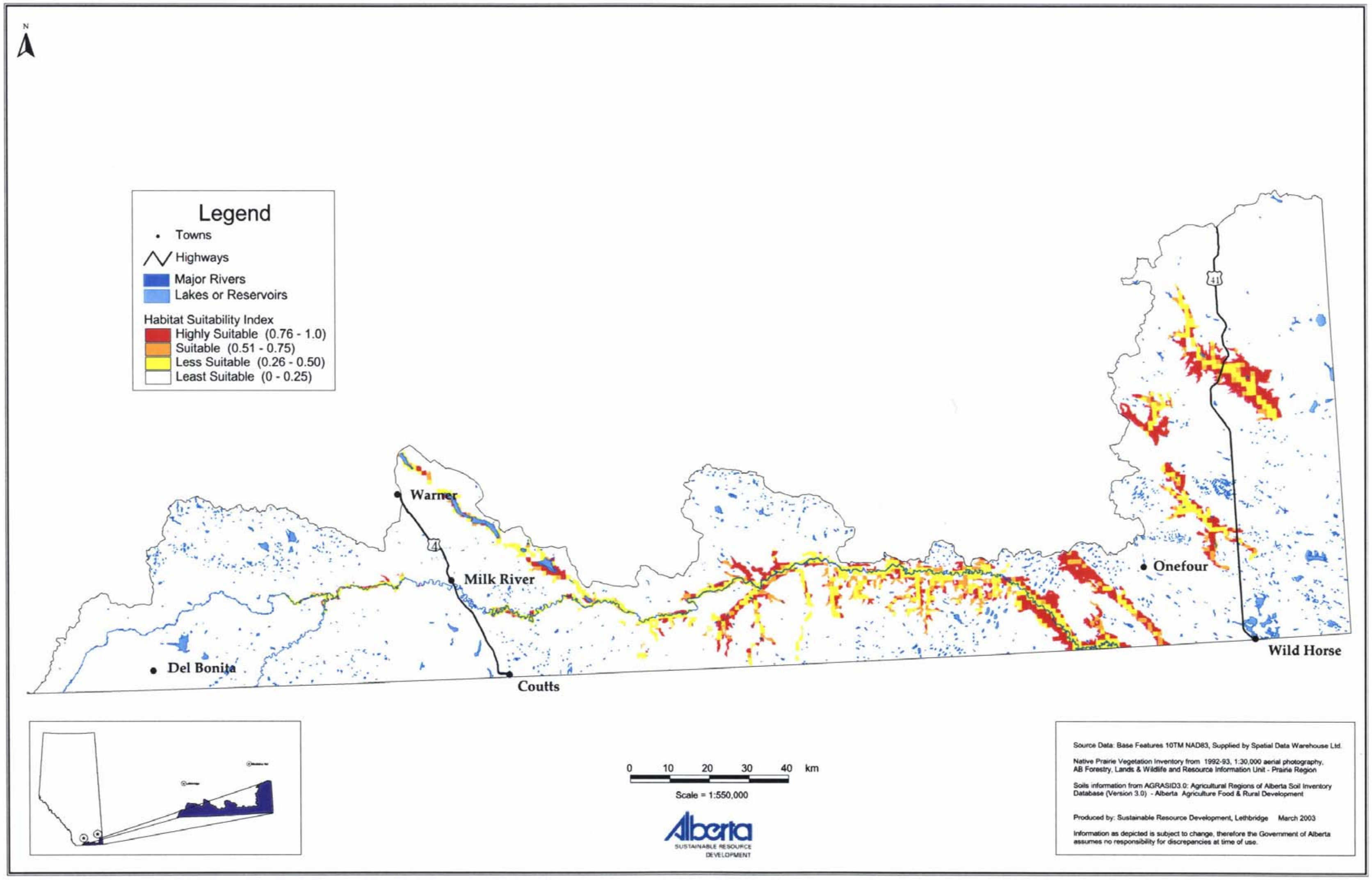

Appendix R – Potential habitat for short-horned lizard in the Milk River Basin

Weidemeyer's Admiral (*Limenitis weidemeyerii)*

Brad N. Taylor
Alberta Conservation Association, Lethbridge, AB

1.0 PURPOSE AND LIMITATIONS

The purpose of this model is to indicate potential habitat for Weidemeyer's admirals (*Limenitis weidemeyerii)* within the Milk River Basin. As this is a landscape level model with coarse variables, it may not be directly applicable to other areas or for site-specific analysis.

2.0 GENERAL INFORMATION

The Weidemeyer's admiral is a relatively large butterfly which is mostly black with bold white bands on both wing surfaces and extensive grayish white markings on the underside of the hind wings (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). It is widely distributed in the western interior of the United States; however, it is limited to an 80 km stretch along the Milk River and its tributaries in southeastern Alberta (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). The Weidemeyer's admiral is currently considered "May be at Risk" (Alberta Sustainable Resource Development 2001).

3.0 GENERAL HABITAT ASSOCIATIONS

Admirals use the woody riparian vegetation along the valleys associated with the Milk River and its tributaries, particularly the shrub complexes (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). Weidemeyer's admirals are typically associated with deciduous treed and shrubby areas, which provide the necessary habitat components: larval host plants, moisture and nectar sources for adults, and elevated perches for mate location (Canadian Wildlife Service 2002, N. Kondla, pers. comm.). Within the Milk River drainage, Pike (1987) identified the following tree and shrub species that were common to areas where adult Weidemeyer's admiral were observed: cottonwoods (*Populus deltoides* and hybrids), saskatoon (*Amelanchier alnifolia*), western clematis (*Clematis ligusticifolia*), and thorny buffaloberry (*Shepherdia argentea*). If one or more of these species were missing, adults were not observed. Willow (*Salix spp*.) occurring in large stands or thickets is a negative indicator for Weidemeyer's admirals (Pike 1987).

4.0 HABITAT AREA REQUIREMENTS

Studies on the area requirements of Weidemeyer's admiral have not been conducted.

5.0 ASSOCIATED SPECIES

Given its strict habitat limitations, the Weidemeyer's admiral is not closely associated with other species, although there are a few species that may share similar habitat types. The loggerhead shrike (*Lanius ludovicianus*) is also associated with shrub complexes, particularly thorny buffaloberry. Western small-footed bats (*Myotis ciliolabrum ciliolabrum)* are associated with riparian cottonwoods, prairie falcons (*Falco mexicanus*) are often found nesting along cliffs in the Milk River valley, and short-horned lizards (*Phrynosoma hernandesi hernandesi*) are also found in the ecotone between plains and valleys in the Milk River.

6.0 THE HSI MODEL

6.1Selected Habitat Variables

Two variables were selected to model potential habitat for Weidemeyer's Admiral. Topographical features (V_1) derived from the Agricultural Region of Alberta Soils Inventory Database (AGRASID; Alberta Soil Information Centre 2001) and percent shrub cover (V_2) derived from the Native Prairie Vegetation Baseline Inventory developed by Alberta Environment (Prairie Conservation Forum 2000).

6.1.1 Topography (V_1)

Valleys are the only areas identified as being capable of sustaining sufficient habitat for the Weidemeyer's admiral; consequently, all other areas (*i.e.* plains, uplands, benches, escarpments, plateaus) received an HSI value of 0 (Figure 3.7.1).

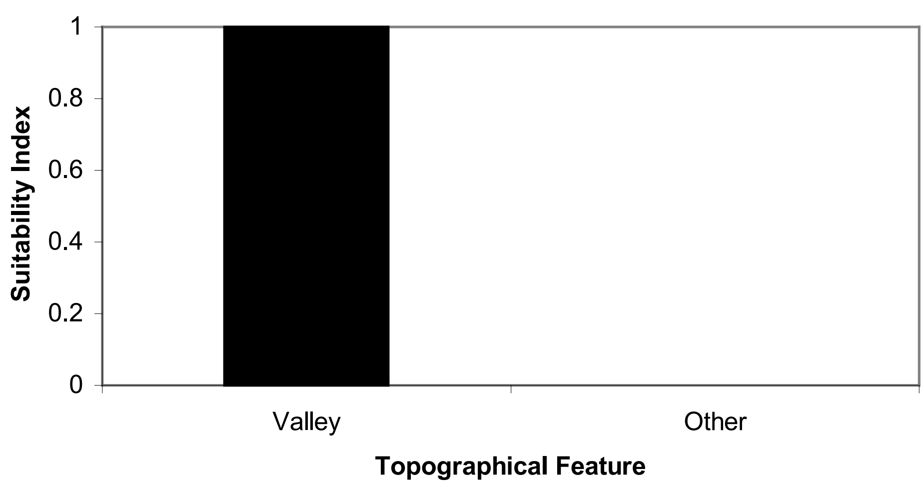

Figure 3.7.1 Habitat suitability index for topographical features (V_1) for the Weidemeyer's admiral

6.1.2 Shrub Cover (V_2)

Areas devoid of shrubs would not meet the habitat requirements of this species. However, zero percent shrub cover was still given a value since it is possible that shrubs in a riparian zone were simply classed as riparian in the Native Prairie database, or shrubs were present but did not constitute five percent of the quarter section (Figure 3.7.2).

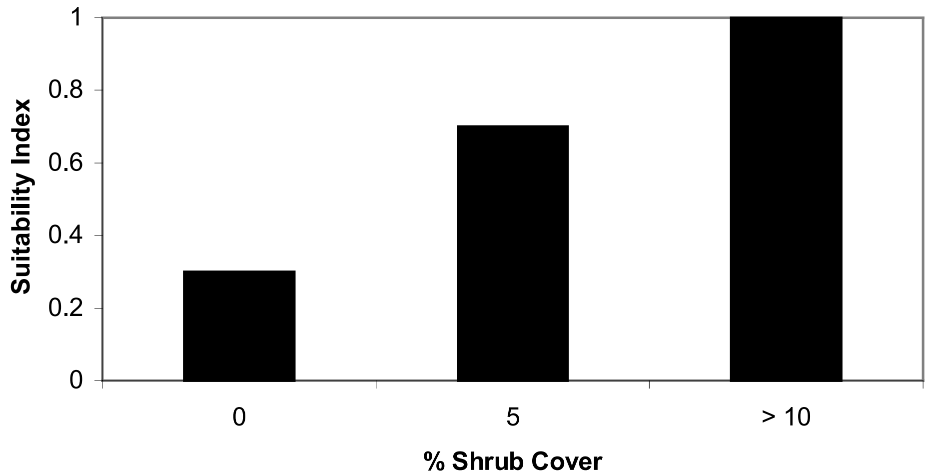

Figure 3.7.2 Habitat suitability index for percent shrub cover (V_2) for the Weidemeyer's admiral

7.0 HSI EQUATION

$$HSI = V_1 * V_2$$

Weidemeyer's admirals are limited to the valleys, as well as to areas where shrubs are present. Consequently, the formula is designed to reduce the habitat suitability in areas where there are not any valleys or there is a low percentage of shrub cover.

8.0 HABITAT SUITABILITY MAP

According to this model, the best potential habitat for Weidemeyer's admiral in the Milk River Basin is associated with the valley shrub complexes along the tributaries to the Milk River. This corresponds to known occurrences of the species. Although some of the potential habitat identified is outside of the known range of these butterflies, these areas should be investigated to confirm presence or absence in order to refine the model.

Please refer to Appendix S for a colour map indicating potential habitat for Weidemeyer's admiral butterflies within the Milk River Basin.

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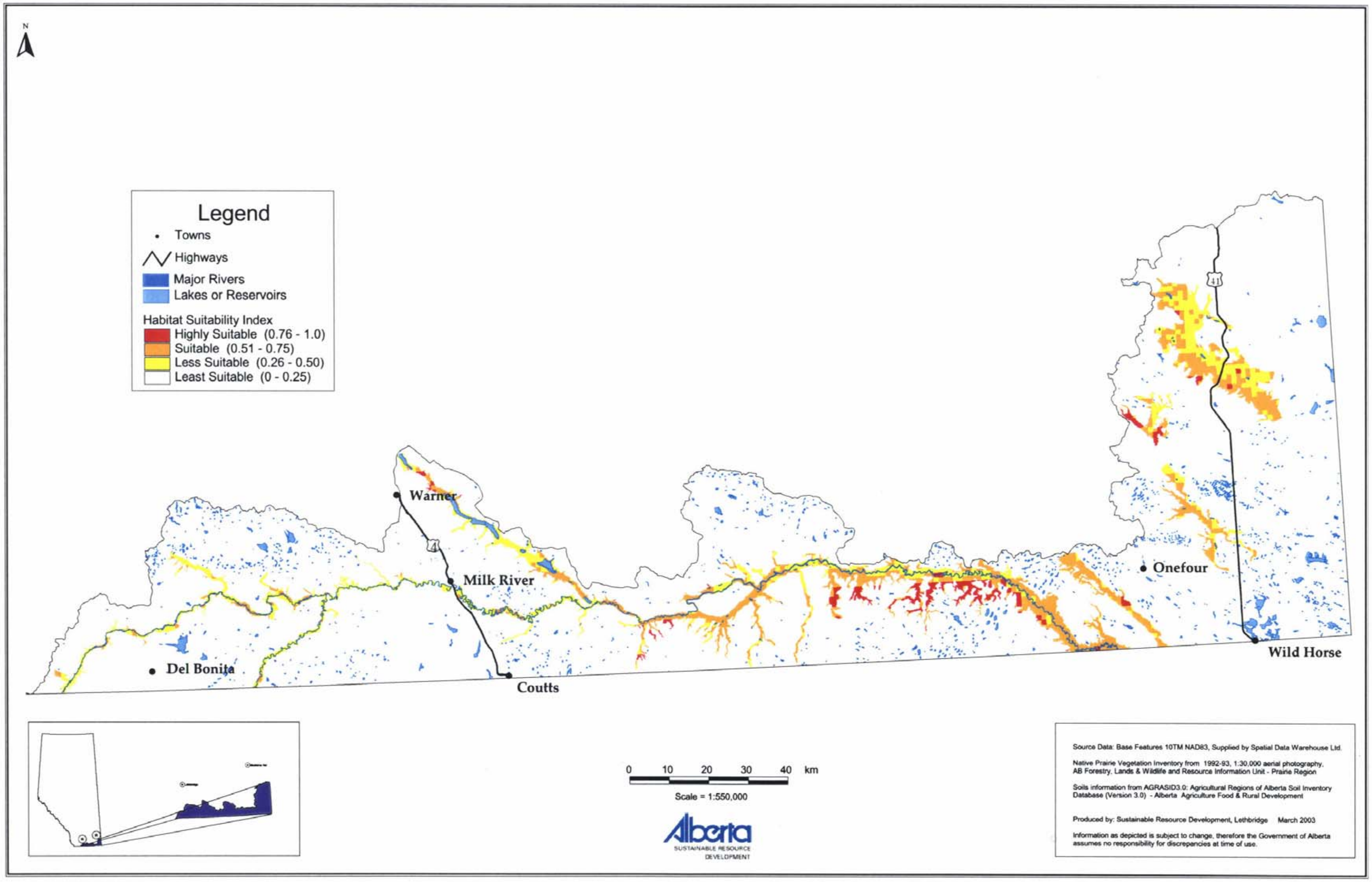
10.0 PERSONAL COMMUNICATIONS

Kondla, Norbert.G. BC Fish and Wildlife, Castlegar, BC.



Appendix S – Potential habitat for Weidemeyer's admiral in the Milk River Basin

CHAPTER 4

BENEFICIAL MANAGEMENT PRACTICES FOR THE MILK RIVER DRAINAGE, ALBERTA

1.0 INTRODUCTION

Rangeland Conservation Service Ltd., Airdrie, AB

The fauna and flora of the Milk River Drainage basin have evolved in response to natural processes such as fire and native herbivore grazing as well as aboriginal manipulation of the environment. The underlying assumption of many range management practices is that techniques that best mimic local natural use patterns will be beneficial for native flora and fauna. This assumption is based on the theory that native flora and fauna are physiologically or behaviourally adapted to suit a certain evolutionary disturbance regime. Part I of this chapter provides an overview of natural historical disturbance processes and reviews how current grazing management practices impact or potentially serve certain ecosystem processes. In Part II, a description of key grazing management principles is given in addition to a description of seven grazing systems that are suitable for use in the Milk River Basin.

In Part III of the chapter, potential beneficial management practices for sharp-tailed grouse, a priority management species, are presented. In this case, the ecology and critical habitat needs of the species is given. Potential impacts that previously described grazing systems may have on this species and on maintaining or enhancing its habitat are discussed. Lastly, the recommended beneficial management practices for the sharp-tailed grouse are summarized.

The purpose of this report is to develop an educational tool that can be used by landowners and land managers in guiding stewardship activities for the conservation of wildlife species within the Milk River Basin project area. Additional beneficial management practices reports will be prepared for several other Species at Risk and priority management species within the Milk River Basin and will be published in a future report.

2.0 STUDY AREA

The Milk River Basin occupies an area of approximately 6,776 km^2 in southern Alberta, extending north from the United States border along the Saskatchewan border to Cypress Hills Provincial Park and west to Whiskey Gap. The North Milk and Milk rivers flow within the basin toward the Gulf of Mexico.

The Milk River Basin is located within the Grassland Natural Region and contains areas of the Dry Mixedgrass, Mixedgrass, and Fescue Subregions (Strong and Leggat 1992). The Dry Mixedgrass Subregion occupies the majority of the drainage basin and is composed of shortgrass species, such as blue grama *(Bouteloua gracilis),* and mid-grasses like western wheat grass *(Agropyron smithii)*, June grass *(Koeleria macrantha)*, and spear grass *(Stipa spp.)*. The Mixedgrass Subregion is restricted to the northeast corner of the basin near the Cypress Hills and in the south central area north of the Sweet Grass Buttes. This subregion has a slightly moister and cooler climate than the Dry Mixedgrass Subregion, and therefore contains similar vegetation with the exception of more western porcupine grass *(Stipa curtiseta)* and northern wheat grass *(Agropyron dasystachyum)*. The Fescue Subregion receives the greatest precipitation and makes up a small percentage of the basin's total area. It occupies an area to the west including the Milk River Ridge and portions of Cypress Hills Provincial Park. Fescue grassland communities are dominated by rough fescue *(Festuca scabrella),* Idaho fescue *(Festuca idahoensis),* Parry's oatgrass *(Danthonia parryi)* and intermediate oatgrass *(Danthonia californica)*.

Cattle production is the primary land use in the Milk River Basin. Three large provincial grazing reserves (Pinhorn, Sage Creek, and Twin River), an Agriculture and Agri-food Canada research substation (Onefour), as well as numerous grazing leases, preserve some of the native grasslands within the basin. Approximately 30 percent of the basin is cultivated, with the majority of cultivation around the town of Milk River. Oil and gas activity is present throughout the basin with drilling activity apparently on the increase. Several ecological reserves also occur within the study area including Writing-on-Stone Provincial Park, portions of Cypress Hills Provincial Park, the Milk River Natural Area, and Kennedy Coulee Ecological Reserve.

3.0 METHODS

A thorough literature review was conducted to compile relevant published scientific literature for the Milk River Basin area. Subject searches were done using The *Agricola* and *Biological Abstracts* databases as well as information available from Alberta Public Lands and Alberta Sustainable Resource Development libraries and websites. Professional experts in the fields of range ecology and wildlife biology were contacted to provide current information. The habitat suitability model for sharp-tailed grouse presented in Section 7.0 assisted in identifying its critical habitat needs.

PART I

4.0 NATURAL PROCESSES OF THE MILK RIVER BASIN AREA

The grasslands natural region of Alberta occupies approximately 9.7 million hectares (24 million acres) of land, of which nearly 43% remains as native prairie (Prairie Conservation Forum 2000). Dry Mixedgrass, Mixedgrass and Foothills Fescue Natural Subregions occur in the Milk River Drainage Basin, of which the Dry Mixedgrass Subregion forms the most significant land base component (Strong and Leggat 1992). The prairie landscape as we see it today has been forming for millennia. The topographic and physical characteristics have their origins in the last glaciation. The development of the landscape was influenced by the advance and retreat of several glaciations, the most recent being the Laurentide Glacier, and the erosion and deposition processes that took place following this period. The pattern and type of soils and associated vegetation that have since come to dominate the prairies is largely the result of periodic drought, flood, fire, large and small herbivore grazing and predators.

Grasslands exist as a result of natural causative agents that affect an area to favour grass or grass-like vegetation. Grasslands evolved in response to several natural agents, acting singly or, more likely, collectively. Climate, topography and wind, large ungulate herds, and fire are often cited as primary natural agents favouring grasslands over woodlands.

The survivability of certain vegetation or community types is likely the result of these species to adapt to a historical disturbance regime. Although the size, intensity and return interval of disturbance prior to European settlement is largely unknown, scientific and cultural knowledge indicate that natural variation was great (Bradley and Wallis 1997).

4.1 Fire

Fire is an important ecological process in terrestrial ecosystems, limiting encroachment by woody species, facilitating plant community renewal by removing excess dead plant material, and recycling nutrients. Under protection from fire, areas that have historically consisted of grassland or open prairie savanna have experienced an increase in the cover of woody vegetation (Bailey and Wroe 1974, Vogl 1974, Bock and Bock 1984). The advance of woody species in previously grassland dominated regions is evidenced in the photographic records from near the turn of the century, historical accounts and biosequence (grassland to wooded types) of soils (Baumeister *et al.* 1996, Dormaar and Lutwick 1966).

The historic fire return interval for fescue prairie is estimated to be 5-10 years (Wright and Bailey 1982, Arno 1980). The availability and continuity of fuel, topography, and climatic (mostly wind) conditions determine the propagation of fire and its behaviour on the prairie landscape (Pyne *et al.* 1996). Prairie fires would have varied in intensity and size depending on these factors. Historical accounts indicate that prairie fires often burned for days and single fires covered huge areas, running for 100 to 200 km or more (Nelson and England 1971, Higgins 1986).

Many plant communities require fire to rejuvenate growth and return species composition to an earlier seral stage (Wright and Bailey 1982). In areas where the rate of litter accumulation exceeds decomposition with plants curing and dying back each year, fire acts as a mechanism for accelerating the recycling of nutrients into the soil. Prairie landscapes, as influenced by historical fire and bison grazing events, existed as a mosaic of seral communities (transitory stages of plant community development), each with unique disturbance histories.

Grasslands in the drier regions of the Great Plains are maintained by climatic factors, whereas at the fringe of grassland and forest ecotones, a combination of fire, drought and grazing/browsing serve to determine the type of vegetative cover (Coupland 1992). Since common woody species such as aspen (*Populus tremuloides*) and buckbrush (*Symphoricarpos occidentalis*) sprout vigorously following fire, occasional fire events alone would not control shrub cover. Extensive browsing of woody shoots by bison as well as wallowing, trampling and toppling of trees by rubbing against them likely contributed significantly to the suppression of aspen growth on the prairies (Campbell *et al.* 1994).

Changes in the composition of fescue prairie as a result of fire have been primarily attributed to an altered microenvironment, particularly moisture regimes (Romo 1996). Burning mostly shifts the environment in fescue prairie from one with light limitation to one that is water limited. Grasses adapted to drier environments are favoured over species adapted to more mesic environments. Annual spring burning in the parkland causes a shift from species of the fescue prairie towards a mixedgrass prairie association (Anderson and Bailey 1980). The persistence of these drier conditions is dependent on the severity of the fire and the climatic conditions following the fire event. Under favourable climatic conditions, the recovery of burned fescue prairie to pre-burn composition and production may only require a few years (Joudannais and Bedunah 1990, Redmann *et al.* 1993).

Fire has important ecological effects on vegetation composition and structure, including productivity, insect populations and soil properties (Kerr *et al.* 1993). Fire favours vegetation that is adapted to periodic removal of above ground growth. Fire commonly favours forbs over grasses in grasslands (Daubenmire 1968, Antos *et al.* 1983, Bailey and Anderson 1978). Plant species diversity may increase by removing litter from areas that have heavy accumulations. Excessive litter build up can be detrimental to seeding establishment of some species. In the fescue prairie, large bunches of rough fescue are more seriously damaged by fire than smaller bunches, indicating these plants are adapted to shorter intervals between fires or disturbance which limit the expansion in plant diameter (Antos *et al.* 1983). Fescue grasslands are generally resistant to fire, as single defoliation events following fire do not have a detrimental effect on rough fescue (Bogen *et al*. 2003). This resistance is likely facilitated by reduced production in rough fescue plants after fire, which diminishes the value of grazing especially with regard to the increased risk to the plant with subsequent grazing.

Historical records of lightning-set fires are rare compared with the accounts of Native American-set fires (Higgins 1986). Higgins (1984) found that on average 6-24 lightning fires per year per 10,000 km^2 occurred in the mixedgrass prairie during a period from 1940-1981. The majority of these fires occurred in July and August. In more mesic environments, the incidence of lightning caused fire may be less significant. In Yellowstone National Park, for example, lightning strikes on average 4 times per km^2/year, but has not initiated a single fire in the northern range despite an abundance of available fuel (Kay 1995). This is likely because when conditions are conducive to lightning strikes, the herbaceous vegetation is too green to carry a fire. Historically, aboriginal burning occurred in every month of the year except January (Higgins 1984).

4.2 Native Americans

Fire caused by Native Americans differs from lightning fire in terms of seasonality, frequency, severity and ignition patterns (Kay 1995). Aboriginal fires were mostly set in spring, between snowmelt and greenup, or late in the fall at a time when burning conditions would not create as severe effects as those caused by lightning fires during dry periods (Kay 1995). Whereas lightning fires tend to be infrequent and intense, native burning during these periods was more frequent, but produced a lower intensity fire. The impact of native burning on plant communities was undoubtedly great, contributing to the formation of the mosaic of vegetation types on the prairie that were prevalent at the time of European settlement.

It is suggested that where precipitation is sufficient to support the growth of trees, grasslands were of anthropogenic rather than climatic origin (Denevan 1992). However, other climatic and topographical factors influence the persistence of parkland or forested vegetation. Burning at the grassland-forest transition will create drier conditions favouring grassland, pushing back the forest edge. Some regions of the prairies may have been maintained only through nearly annual burning by Native Americans during the last 5,000 years (Anderson 1990). Native Americans were active landscape architects, using fire extensively to manipulate the plant community and distribution of game (Dormaar and Barsh 2000). Fire was used by Native North Americans to modify the plant community to maintain, for example, patches of naturally occurring medicinal and food plants such as camas and wild turnip, and many other cultural and inter-tribal relation reasons (Kay 1995). The nomadic nature of tribes influenced the occurrence of useful medicinal and food plants by the collection of plants from certain areas and cultivation by transplanting shoots or runners.

Native Americans also had the capability to influence the ungulate population through hunting, which in turn would influence the native prairie. Lewis and Clark (1893) noted that "with regard to game in general, we observe that the greatest quantities of wild animals are usually found in the country lying between two nations at war." Aboriginal hunting tended to extirpate or drive out game animals, and resource depletion around camps and villages has frequently been reported in studies of modern hunter-gatherers (Kay 1995).

4.3 Bison

Herds of bison (*Bison bison*) on the northern Great Plains distributed themselves in response to variable climatic factors, fluctuations in the quality and quantity of available forage, availability of water and hunting pressure. The number of bison in North American has been estimated at 40 to 60 million animals by Seton (1929) based on assumptions regarding carrying capacity, range area, habitats and population trends. The migratory nature of bison makes it difficult to estimate the population that existed in western Canada. From historical accounts of western Canada's early explorers, individual bison herds would have ranged in the thousands, and millions were likely present on the grasslands of western Canada at any given time (England and DeVos 1969). Undoubtedly, their impact on the landscape was significant. Larson (1940) suggested that their presence in the short grass prairie maintained that plant community in a state of disclimax and without bison overgrazing the community would likely be more representative of mixedgrass prairie.

Although bison overgrazing was prevalent throughout the prairies, their transient nature would have likely resulted in large herds not returning to these areas for several years. Bison may also have demonstrated what Epp (1988) refers to as a "dual dispersion strategy" having both migratory and non-migratory herds. River valleys, parklands, ranges of hills and sand hills with abundant water may have been inhabited by small sedentary herds of bison, which fed in nearby grassy uplands (Epp 1988). Bison may have also remained on the plains during mild winters (Moodie and Ray 1976).

It is generally believed that bison migration was from the mixedgrass prairie of the northern Great Plains to the fescue prairie in the foothills and parkland in Alberta and similar regions in Saskatchewan and Manitoba with the onset of winter (Moodie and Ray 1976, Morgan 1980). In early autumn soon after the summer rut, large herds of plains bison split into smaller units and migrated to wintering grounds. However, other views have challenged this notion, suggesting that bison movements were erratic, only governed by the availability of food (Hanson 1984).

Based on a preference of fescue prairie for wintering by bison, movement to the foothills and parkland was likely driven by three fundamental energy requirements to survive the winter: 1) deposit fat reserves prior to the onset of winter; 2) utilize a winter diet of adequately high energy forage and 3) take advantage of protein-rich, early spring forage growth (Baumeister *et al.* 1996). Rough fescue (*Festuca campestris*), the characteristic grass of the fescue prairie, initiates spring growth approximately one month earlier than dominant mixedgrass prairie species such as blue grama (*Bouteloua gracilis*). Early spring growth is typical of most cool season grasses and providing soil moisture is sufficient enough, additional growth may occur in the fall (Stout *et al.* 1981). This lends to the adaptation of rough fescue grassland to grazing during dormant periods. Repeated defoliation of rough fescue during the growing season can be detrimental, resulting in reduced yields, vigor and eventual elimination of plants from the community (Willms 1988, Willms and Fraser 1992). In comparison, mixedgrass communities may be more resistant to grazing during the growing season based on the historic use pattern of these ranges. Repeated defoliation at a moderated utilization level throughout the growing season generally does not negatively impact species composition in mixedgrass communities (Biondini *et al.* 1988).

Selective use of habitats or plant species by large herbivores can influence plant populations, diversity and community structure, and ecosystem processes (Vinton *et al.* 1993). The opportunity for selective grazing within plant communities in the northern Great Plains by immense migratory bison herds was likely low. Rather, the forage supply would have been completely utilized before the herd moved on as indicated by accounts in the journals of early explorers. Where vast herds of bison had passed, the ground was completely denuded of vegetation leaving little or no forage available for the explorers' horses (Nelson 1973). However, where sedentary herds existed, there would be a greater opportunity for selective grazing and regrazing of more favourable forage.

Bison behaviour and activity, besides grazing, also influenced the structure and composition of grasslands. Wallowing, pawing, trailing and other similar non-grazing bison activities create micro-environmental effects that increase heterogeneity on the landscape. These small changes on the landscape increase the diversity of environmental conditions plants are able to take advantage of, and potentially increase overall species richness (Hartnett *et al.* 1997).

Although cattle, as large grass-feeding herbivores, may be able to fulfill the same ecological function as bison, there are inherent differences in their grazing behaviour. Cattle grazing patterns are influenced by slope, as well as horizontal and vertical distance from water, regardless of forage availability (Van Vuren 1982). Cattle use a significant lower percentage of upland habitat compared with bison and tend to favour floodplain habitat. Forage availability appears to be the only factor affecting bison distribution, as rugged terrain seldom impedes their movement and they will travel considerable distance from water, spending less time at a water source. Bison are far more efficient water users than cattle and can better utilize lower quality, drier forage (Wuerthner 1998). The construction of fences, stockwater supplies and other developments undoubtedly alter bison and cattle foraging behaviour alike, compared with the natural wanderings of large bison herds.

4.4 Other Wildlife

The Great Plains are described as teeming with abundant game in historical accounts of Pre-settlement times. Nelson (1973) describes the early explorers' accounts of the variety of species such as bison, elk (*Cervus elaphus*), antelope (*Antilocapra americana*), wolves (*Canis lupus*) and cougars (*Felis concolor*) as common in their thousands and millions, along with a multitude of birds. The area around Cypress Hills was likened to parts of Africa where the plains were swarming with animal life of all kinds.

Antelope numbers were estimated to be as numerous as the bison (Rand 1945). The historical range of antelope extended to the North Saskatchewan River east into Manitoba and northwest to Rocky Mountain House, Alberta (England and Devos 1969). There is little account of the slaughter of antelope to the excess experienced by the bison during the same period, but their numbers decreased greatly. This may be due to a loss of suitable habitat with the extirpation of bison herds. The diet of antelope consists largely of forbs and browse and the abundance of suitable forage would have largely been dependent on grazing by bison herds and fire to favour these plant species. The demise of large antelope herds may have been linked with the extirpation of the bison as well as the construction of barbed wire fences and other obstructions to antelope movement with the onset of European settlement.

As a result of long-term control measures and other human activities, several species of carnivores have been extirpated from rangelands of North America (Jones and Manning 1996). These include species such as wolves, black bears (*Ursus americanus*), grizzly bears (*Ursus arctos*) and cougars. Conversely, species such as coyotes (*Canis latrans*) and badgers (*Taxidea taxus*) now inhabit areas that were not used by them historically (Jones and Manning 1996). Carnivore predation, in addition to native hunting, may have influenced ungulate populations and distribution. According to predator-prey theory, prey populations will increase if they have a refugium where they are safe from predation (Taylor 1984). By undertaking long-distance migrations, bison were able to outdistance most of their carnivorous and human predators (Kay 1995).

The abundance and influence ungulate species other than bison had on the prairies is questionable in some regions of western North America (Kay 1995), but the influence of the beaver (*Castor canadensis*) in shaping the landscape of western Canada is significant. Where humans wielded fire, beavers controlled the water. While beaver were commonly found along mountain streams, large numbers also inhabited water courses on the prairies (Kay 1995). It is suggested millions of beaver inhabited western North America before the fur trade (Johnson and Chance 1974). Beavers continually dammed up streams and rivers often causing new water courses to be formed. Changes in drainage patterns had distinct influence on vegetation and likely attracted other animals, such as moose (*Alces alces*) and ducks, to the area. Beaver are not nearly as common as they were prior to

European settlement and are even considered ecologically extinct in regions of western North America (Kay 1995).

Small burrowing mammals may have also contributed to the structure and function of the native prairie. The black-tailed prairie dog (*Cynomys ludovicianus*) is the most widespread of the prairie dog species in the mixedgrass and shortgrass prairies of the Great Plains (Hoogland 1995). Pre-settlement distribution and abundance is largely unknown, but lands currently occupied by prairie dogs are thought to represent less than 10% of their historical range (Anderson *et al.* 1986). Prairie dogs likely inhabited the Milk River Basin at one time, but their distribution in Canada is presently restricted to extreme southern Saskatchewan. Prairie dogs can have large and significant effects on plant productivity, community dynamics and nutrient cycling (Whicker and Detling 1988) similarly, though not equal, to the effects of other burrowing mammals on the prairie. Prairie dogs are principally herbivores and their grazing activities tend to increase the abundance of forbs in the vicinity of established colonies. These modified habitat conditions likely affected the distribution, at least on a regional level, of other foraging animals such as antelope and bison (Stapp 1998). Burrowing activities that affect nutrient cycling and other associated ecosystem processes thereby may also modify soil micro-climate and plant production. The effects prairie dogs and other small mammals have on the ecosystem tended to increase the overall diversity and promote functional integrity of native grassland communities (Stapp 1998).

4.5 Implications for Ecosystem Management

Prairie species evolved in response to certain levels of disturbance and many plant communities became dependent on disturbance for their regeneration or survivability (Bradley and Wallis 1996). These disturbances occurred in such a manner that promoted biodiversity while maintaining high productivity capable of sustaining large ungulate populations. For example, more diverse plant communities are more resistant to and recover more fully from a major drought (Tilman and Downing 1994). Native prairie is in a state of dynamic equilibrium, self-sustaining and resilient to disturbance within the natural range of variation. The stability of long-term primary production in prairie ecosystems is dependent on the maintenance of biodiversity (Tilman and Downing 1994).

Although it is neither feasible nor practical to manage for all components of the ecosystem, striving for ecological integrity through promotion of biodiversity and sustained function (*e.g.* grass production) is a principle of ecosystem management. Objectives of current range management tend to be uniform distribution of use with moderate grazing pressure. These management techniques strive to maintain the health of native prairie and avoid degradation of areas where livestock may congregate, such as riparian habitats. Most grazing systems are applied with moderate grazing pressure that permit selective grazing and the creation of overgrazed and undergrazed patches. Patchy grazing contributes to landscape heterogeneity, but it is usually within fields on a small scale (*i.e.* small patch size). Grazing systems can be used that allow the creation of planned heterogeneity on a larger scale by controlling the grazing pressure and time of grazing within fields.

By allowing natural processes, such as erosion/deposition, drought, flood, fire or herbivory to occur on the landscape or by approximating them through management, it is assumed there will be a better chance of preserving biodiversity and sustaining ecosystem processes (Bradley and Wallis 1996). Patchy grazing on a large scale, with lightly, moderately and heavily used areas may be desirable. These patterns of livestock use appeal to a greater variety of plant and wildlife species. However, these practices applied on a smaller scale may not produce varying plant communities significantly large enough to be effective habitats for certain species. It may be more effective in some cases to create heterogeneous communities between fields on a landscape level. Range management that over-intensifies or homogenizes grazing consistently across the landscape will tend to reduce the range of natural variation. Specialized grazing systems can create a mosaic of grass cover types to satisfy a diversity of animal species, while still accommodating livestock grazing.

Prior to agricultural settlement, a wide range of interrelated factors such as drought, fire and bison grazing created dynamic and varied landscapes. This likely included extremes in environmental conditions from highly impacted areas (due to grazing, fire or drought, for example) to areas of low use. These extremes are largely absent from the present day landscape, but may have been very important to vegetation and wildlife dynamics. A better understanding of missing features and natural processes on ecosystem health may be required for prairie conservation.

PART II

5.0 OVERVIEW OF GRAZING MANAGEMENT

5.1 Principles

Range management is referred to as the art and science of producing sustained yields for livestock and wildlife while maintaining ecosystem integrity for a variety of purposes (Society for Range Management 1998). Proper range management leads to increased livestock production, and improved watershed and ecosystem stability (Holechek *et al.* 1995). To achieve these results, the four basic principles of range management must be followed (Wroe *et al.* 1988, Grazing and Pasture Technology Program 1995):

1. Graze range at the right time of year and leave adequate leaf area to ensure regrowth by balancing the number of animals with the available forage supply.
2. Use the kinds of livestock most suited to the forage supply and objectives of management.
3. Allow each range unit a period of rest from grazing animals during the active growth season to manage and maintain the vegetation.
4. Control livestock distribution and access to minimize selective grazing behaviour and prevent regrazing of plants.

Planning for the current grazing system involves evaluating the past grazing season. Understanding the growth of plants and how grazing management affects growth is basic to range management. The amount of new spring growth depends on the amount of energy stored the previous season. Energy or carbohydrate (food) reserves of perennial plants will be at their seasonal lows soon after early spring growth starts.

5.2 Proper Use Factor

A proper use factor is the percentage of utilization for a plant species or range deemed acceptable to allow improvement or maintenance of range condition (Grazing and Pasture Technology Program 1995). Proper use factors are useful but difficult to apply because they do not deal with repeated defoliation of individual plants. Plant species also vary in their resistance to grazing. Certain species can easily sustain themselves with 70% utilization, while other species may only tolerate 20% removal during the growing season. The range management rule of thumb was once considered to be "take half and leave half" for current year's forage growth. This rule is now being brought into question, as the understanding of how plants grow and how they respond to defoliation is increased. A low proper use factor does not necessarily eliminate overgrazing. Certain areas are more attractive for grazing, such as riparian areas, and may receive 100% utilization, while other areas (*e.g*. uplands) remain unused.

Using the correct grazing system to meet grazing, wildlife, and vegetation enhancement objectives can help determine the proper use factor to be applied to these systems. However, the implementation of a specialized grazing system does not ensure that range deterioration will not occur. Stocking rate, within the context of climatic conditions, is and always will be the major factor affecting the condition of the rangeland resource (Willms 1990, Hart *et al.* 1993, Holechek *et al.* 1995).

5.3 Grazing Distribution

Implementing a grazing system usually requires some degree of fence construction or intensive management to manipulate livestock distribution. Depending on the environment and the landscape, other distribution tools (supplement locations, water development) may effectively fulfill the same management objectives without additional fencing. However, most of these distribution tools work best in conjunction with grazing systems to increase their effectiveness. Distribution of livestock on the range is affected by different types of vegetation, soils, slopes, terrain, weather, supplements and, most importantly, water (Springer 1998). One of the greatest challenges to managing any grazing system is to overcome the tendency of livestock to overgraze preferred areas. Over time, grazing may result in poor range condition and lost grazing opportunities (Robertson *et al.* 1991).

The carrying capacity for a grazing unit is the average number of livestock and/or wildlife that may be sustained based on the management objectives for that unit (Society for Range Management 1998). Without effective livestock distribution, grazing is generally confined to preferred areas, reducing grazeable land area and consequently reducing stocking rates. This lower stocking rate is often referred to as the grazing capacity and reflects a need for better range management (Robertson *et al.* 1991). Improvements in range condition and achieving the carrying capacity for a grazing unit is reliant on increasing overall utilization of the field through manipulating livestock distribution.

Considering the number of multiple uses that can occur on a particular landscape, a homogenous plant community may not be the appropriate range management goal. Wildlife species respond to a variety of range conditions and plant community structural characteristics. This variety may be created within a field or between grazing units. However, to obtain improvements in range conditions the simplest method is often to improve livestock distribution.

Poor water distribution is often the main cause of uneven grazing distribution. In the interest of livestock gains and movement across the field, the following guidelines for maximum travel distance to water, taking terrain into account, are as follows (Springer 1998):

Rough country	0.5 miles (800 m)
Rolling, hilly country	1 mile (1.6 km)
Flat country	2 miles (3.2 km)
Smooth, sandy country	1.5 miles (2.4 km)
Undulating, sandy country (dunes)	1 mile (1.6 km)

Climatic conditions will also affect these distances. In cooler areas and cooler seasons, livestock may walk longer distances to water with no adverse effects on weight gain (Springer 1998).

Terrain may also form barriers to livestock movement, restricting access to benches and ridge-tops, and concentrating use along valley bottoms and lowlands. Promoting livestock use of uplands is usually further compounded by the presence of water below the toe of the slope. The degree to which livestock will utilize slopes largely depends on the class and age of livestock. Several sources cite different points at which steepness of the slope becomes too great for livestock to utilize, including 10% (Holechek *et al.* 1995), 15% (Robertson *et al.* 1991, Grazing and Pasture Technology Program 1995) and 20% (Springer 1998) slopes. Development of watering points at shorter intervals helps to minimize uneven grazing in rough country (Springer 1998). The reluctance of livestock to use steep slopes is not entirely undesirable since these areas are often fragile and valley bottoms can typically better withstand grazing (Holechek *et al.* 1995).

Livestock will seek out vegetation that best meets their nutritional needs (Holechek *et al.* 1995, Springer 1998). Seasonal preference for different plant community types is closely associated with the relative crude protein content of standing forage. For example, in the mixedgrass prairie cattle prefer vegetation types dominated by western wheatgrass and blue grama in the spring and summer (Holechek *et al.* 1986). In the fescue prairie, range types dominated by rough fescue are preferred in the summer and winter (Willms and Rode 1998). Fencing based on vegetation units will improve the overall utilization of those units. Where feasible and practical, fences should separate hillsides from lowlands, brush or forest cover from grassland, and native pasture from seeded pasture (Robertson *et al.* 1991).

Distribution of grazing may also be directly affected by weather. Warm weather will force livestock to congregate on north facing slopes, shaded areas, and higher elevations, whereas cold weather will cause animals to graze south facing slopes. Cattle also generally travel in the same direction as a cold wind in an attempt to reduce its chilling effects. Insects can drive cattle to higher ground where wind may reduce biting and irritation.

Properly placed salt, mineral or supplemental feed can be an effective tool to manipulate livestock movement. Livestock usually go from water to grazing and then to salt (Holechek *et al.* 1995). Therefore, it is not necessary to place salt at watering points and is inadvisable to do so. Where salt content in plants and soils is high, the placement of salt in certain areas to attract cattle may not be effective (Springer 1998).

Herding livestock within a field may be used to improve distribution. Herding may be more effective where livestock are driven from lowlands to upland benches and ridges that have available water. These areas will then be more readily utilized once livestock have become aware of available forage even though steep terrain may inhibit access. Upon entering a field, livestock will tend to congregate at the gate through which they traditionally use. By continuing to herd cattle through the field to an alternate area of available water and forage, this habit may be overcome. Changing the point of entry can also change this pattern.

5.4 Biodiversity

The overriding mechanism for change in plant communities of the native prairie is climate. Fire, insects, grazing and other physical disturbances influence change within the context of climatic conditions (Clark *et al.* 1943, Hurtt 1951, Reed and Peterson 1961, Olson *et al.* 1985, Hart *et al.* 1988, Biondini *et al.* 1998). That is to say, weather patterns ultimately determine plant species composition, with grazing and other disturbances playing a secondary role. When grazing pressure does not exceed 50% utilization of the current year's growth in the mixedgrass prairie, grazing frequency tends to have a minimal impact on relative species composition (Biondini and Manske 1996). Therefore, a grazing pressure of 50% of the current year's growth appears to be sustainable and compatible with the maintenance of range condition in the mixedgrass prairie.

Protection from grazing in fescue grassland tends to simplify the flora, whereas light grazing results in the development of richer flora dominated by Parry oatgrass (*Danthonia parryi*) (Johnston 1961). Grazing systems that maintain good range condition tend to promote optimum biodiversity (Bai *et al.* 2001). There is an intermediate point of range condition as influenced by grazing pressure at which species richness is maximized. Structural parameters, such as cover, height or thickness of standing plants (live or dead) and litter, increase with range condition (Bai *et al.* 2001). In terms of structure, the diameter of bunchgrasses decreases when the prairie is utilized (Johnston 1961, Moss and Campbell 1947).

5.5 Ecological Site Dynamics

An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation (Range Health Task Group 2002). Plant communities for an ecological site are dynamic, responding to changes in environment and disturbances by adjusting the kinds, proportions and amounts of plant species in the community (Butler *et al.* 1997). Climate, soil and topography are the major factors that interact to produce a distinctive climax plant community. The climax plant community is that which would exist under light to no grazing (or other major disturbance). It is a relatively stable balance of plant species having evolved under a certain historical disturbance regime (fire, bison grazing, drought, *etc.*). These species are adapted to their surroundings and survive within the environmental limitations of the area.

It is necessary to understand the ecological site within the context of the historical disturbance and climatic regime to interpret the effects of management practices used on the rangeland. Many complex factors contribute to change in the composition, function and trend of plant communities. Individual species or groups of species in a plant community respond differently to the same disturbance pattern or stress. Specific species may be severely affected by improper use or stress during their critical growth period, but tolerant at other times.

5.6 Establishing Management Objectives

Management objectives that are compatible with the needs of the landowner, the resources and the long-term viability of species biodiversity and wildlife habitat must be determined. Before any management system can be implemented, present vegetation condition and health as well as the desired plant community must be identified. Knowledge of the range resource base assists in focusing and formulating realistic management goals and facilitates the implementation of an effective management plan. Defining management objectives makes it possible to develop strategies directing the desired change in the soil-plant-animal complex. The desired plant community may achieve a number of management objectives within the criteria of maintaining a healthy ecosystem, conserving biodiversity, promoting water and soil conservation and providing an adequate amount and quality of forage for livestock.

6.0 GRAZING SYSTEMS

Grazing systems for native prairie are designed to manipulate livestock in a planned manner, optimizing livestock and forage production while maintaining the ecological integrity of the range through correct stocking rates and forage use levels. An effective grazing system controls timing, intensity and frequency of grazing of individual plants and improves livestock distribution. The goal of any grazing system is to allow the range to improve while it is being used. Selection of an appropriate grazing system is dependent on vegetation type, physiology of the plants being grazed, type of livestock and objectives of the manager.

Each livestock operation must develop a grazing management system tailored to its resources and objectives. Managers should have the option to combine traits from more than one grazing system to develop a system that suits their needs and goals. There is no universal best grazing system applicable to native prairie and some systems are only successful in certain environments. The implementation of a specialized grazing system does not ensure good range health. The principles of range management must still be adhered to. The success of a grazing system relies on proper stocking rates, animal distribution, proper use, and monitoring.

Many grazing systems have been developed for native prairie, each having distinct characteristics, objectives, advantages and disadvantages. Grazing systems that make use of different areas of the available rangeland at different times of the year may complement or compete with various wildlife species. The management of plant communities depends on an understanding of the ecological processes and ecology of the communities being managed for. There are several considerations to take into account before any management system can be implemented.

6.1 Continuous (Season-long)

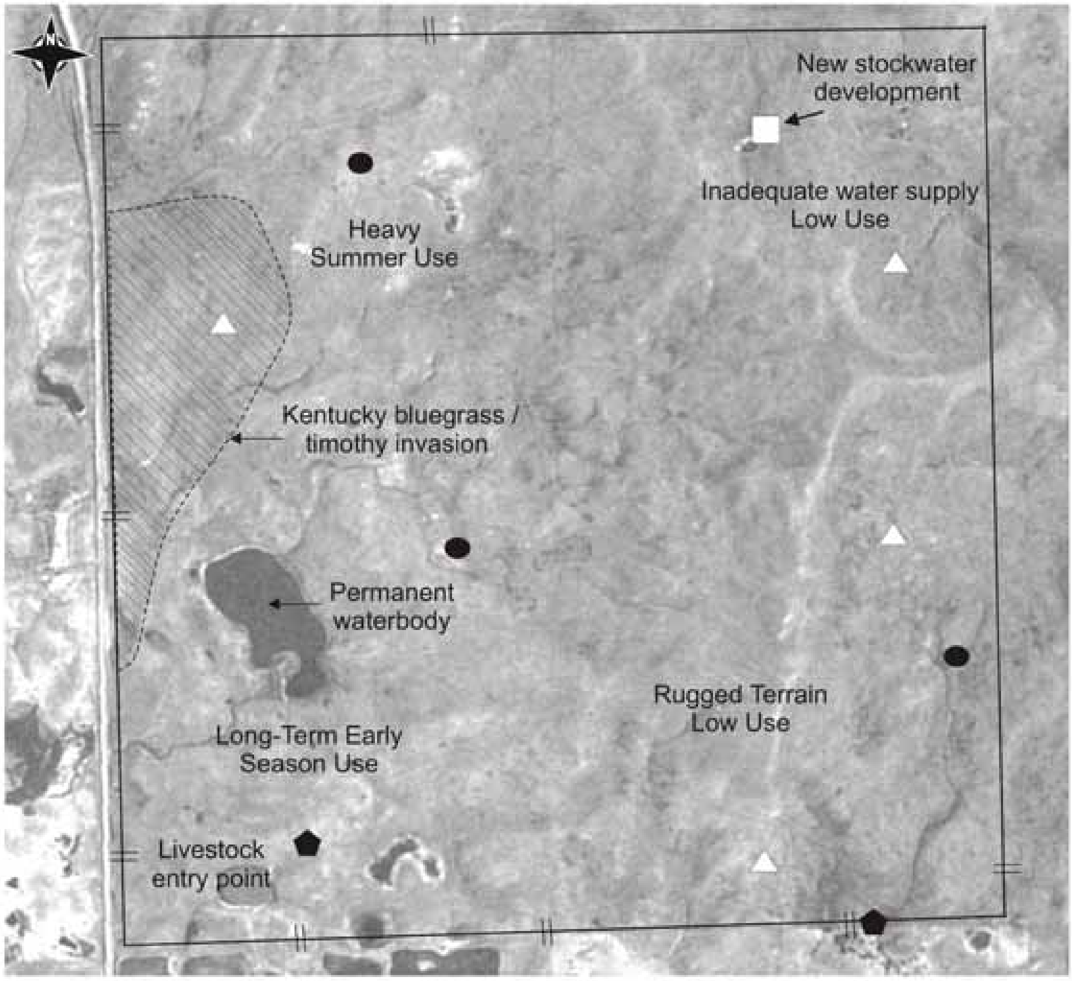
Season-long grazing may be distinguished from continuous grazing in that animals are grazed on a particular pasture for only part of the year, usually the growing season. Low annual precipitation and adverse ecological conditions during the winter in southeastern Alberta generally do not make continuous grazing year round feasible. For the purposes of this discussion continuous grazing is considered to be the same as season-long grazing.

In a continuous grazing system, livestock are held within one grazing unit or field for the duration of the grazing season. The grazing season is usually the active growing period for plants. With appropriate stocking rates and livestock distribution, range condition can be maintained under this system. Improvements in range condition may be possible through applying proper grazing pressure and correct grazing distribution and timing (Figure 4.1). However, adequate grazing distribution may be difficult to achieve.

Declines in range condition are often associated with this type of system as a result of livestock continuously regrazing favoured plants and areas. Regrowth on native grasses is more palatable and nutritious to livestock than is mature initial growth available on other previously ungrazed plants. As forage matures later in the growing season, livestock gains diminish due to senescence (weathering) of vegetation. Stunted flowering stalks produced in regrowth have little or no seed for reproduction purposes and if the plants are not rested, the carbohydrate reserves will become so reduced they eventually die (Wambolt 1979).

The overuse of the preferred species tends to change the species composition of the rangeland vegetation from a mixture of desirable species to an aggregation of low-producing, undesirable plants. It is often difficult to determine a proper use factor for season-long grazing systems due to the unevenness of range use and selective grazing. Livestock will utilize the preferred species heavily, while grazing less desirable plants lightly, if at all, thus allowing the inferior species to gain a growth advantage. If a proper use factor is applied only to forage species being utilized, the result is usually an underutilized range.

CONTINUOUS (SEASON-LONG) GRAZING



GRAZING NOTES

A. Range Improvements

Strategic salt placement is used to improve grazing distribution. Herding cattle periodically during the grazing season is used to move cattle from areas of high to low use. Water supply is still the limiting factor in livestock movement.

B. Management Practices

The field is one section in size (640 acres or 259 ha) and the herd is approximately 100 head of cattle. Cattle begin grazing the field in May and are taken out in August. Changing the entry point for cattle in the field is used when feasible.

C. Benefits

Livestock distribution has improved somewhat due to greater management input. There is less pressure on high use areas early in the season with a change in entry points for livestock into the field. However, cattle still congregate near consistent water supplies throughout the summer.

Uneven grazing pressure throughout the field creates areas of high utilization and areas that are seldom used. This results in either poor or good (to excellent in unused areas) range conditions.

Plant and wildlife species that are able to take advantage of the two extremes in range condition benefit from this system.

Rangeland Conservation Service Ltd.
Environmental Services

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Alberta Conservation Association

LEGEND

— Fence line
═ Gate
Abandoned cultivation
△ Salt
⬟ Developed spring
● Undeveloped spring
☐ New stockwater development

FIGURE 1

CONTINUOUS GRAZING USED IN THE FESCUE PRAIRIE

RCS 03-1121 | April 2003

Figure 4.1 Continuous grazing used in the fescue prairie

Continuous grazing is advantageous from a management perspective in that the level of input is minimal. The capital investment of fencing and water development is generally less than with other grazing systems. Livestock may benefit from this type of system as they are able to select each plant species at its peak nutrition when they have access to the entire grazing unit throughout the growing season. Initially, this often results in greater gains than under other grazing systems, but even with conservative stocking rates, less palatable and nutritious species will increase, decreasing the overall forage availability.

In fescue grassland, season-long (mid-May to mid-November) heavy grazing results in increases in plant species that are shallow-rooted and less productive, but more resistant to grazing (Dormaar and Willms 1990) and a decline in range condition (Willms *et al.* 1985). Repeated defoliation of rough fescue during active growth reduces plant production, height, number of stems per plant, and growth rate (Willms and Fraser 1992). The frequency and time of defoliation is more detrimental to rough fescue plants than the severity of the defoliation or amount of plant material that is removed (Willms pers. comm.). Summer grazing also tends to favour Parry oatgrass, which is more tolerant of grazing, but forage production of the grassland is reduced (Willms 1991).

Season-long grazing at high stocking rates also changes soil characteristics to that of a more arid climate, reducing fertility and water-holding capacity (Dormaar and Willms 1998). However, season-long grazing at moderate stocking rates may maintain soil quality, productivity and economic returns (Dormaar and Willms 1990). With lower livestock density as compared with other grazing systems there is less risk of soil compaction.

Grasses in the mixedgrass prairie evolved with heavy bison grazing and are quite grazing resistant. Prolonged periods of overgrazing, interspersed with large-scale drought events, may be required before substantial changes in above ground net primary production (ANPP) and/or species composition can be observed (Biondini *et al.* 1998). Smoliak *et al.* (1972) found that after 20 years of varied season-long grazing pressures, the basal area of blue grama (*Bouteloua gracilis*), low sedge (*Carex eleocharis*) and little clubmoss (*Seleginella densa*) increased with increased grazing pressure, whereas, basal area of needle-and-thread (*Stipa comata*) and western wheatgrass (*Agropyron smithii*) decreased. Although the differences in species composition as a result of grazing pressure were minimal in this study, it represents the long-term trend in range condition.

Given the flat nature of the terrain in the mixedgrass prairie, and if there is close proximity of watering points, the tendency of livestock to congregate and linger in the most convenient areas is minimized, evening the grazing pressure. For example, continuous grazing at a moderate stocking rate where watering points are seldom farther than 3.2 km apart has been as effective as rotational grazing systems in terms of vegetation productivity (Smoliak 1960). On ranges deteriorated by drought, Biondini *et al.* (1998) found that ANPP was not improved with moderate or even no grazing versus heavy grazing in the short term (<10 years). Although this study found no difference in ANPP due to grazing, root biomass declined with heavy grazing implying there are long-term impacts on productivity due to grazing.

Continuous grazing usually leads to the formation of grazed patches. The occurrence of overgrazed and undergrazed areas within a field is usually the result of select grazing where forage supply exceeds livestock demand (Spedding 1971). This is characteristic of range stocked season-long at a moderate rate intended to maintain plant vigour and to allow for carryover to the following year (Willms *et al.* 1988). Grazed patches are maintained by repeated grazing of regrowth, which is preferred to more mature vegetation. Willms *et al.* (1988) found that these grazed patches are persistent in the short and long-term within rough fescue grasslands, however, the grassland will tend to deteriorate in these grazed patches despite a moderate stocking rate.

Patchy grazing creates heterogeneous grassland, having varied effects on the ecosystem. A more diverse habitat for wildlife may be created depending on the size of patches within the mosaic, but the ungrazed patches represent unused production. Undergrazed patches, however, also ensure the presence of climax species in the community and the potential for recolonizing overgrazed areas as well as providing emergency forage during years of below average precipitation.

Negative range trends (*i.e*. a decline in range condition and health) are generally not associated with continuous use of range in the fall and winter when plants are dormant. Year-round continuous grazing may be less harmful than other grazing systems as utilization needs to be low enough during the growing season such that sufficient forage remains during the dormant season to meet the nutritional requirements of livestock. However, the ability for the manager to adjust stocking rates in response to environmental conditions is reduced.

6.2 Season-of-Use Grazing

This system involves several fields, each receiving one grazing pass at approximately the same time every year (Abouguendia and Dill 1993). This system is well suited in cases where vegetation types differing in their season of growth are available. For example, it may be applicable in portions of the mixedgrass prairie where range units dominated by needle-and-thread (a cool-season grass) and others dominated by sand grass (*Calamovilfa longifolia*) and sand dropseed (*Sporobolus crytandrus*) (warm-season grasses) exist. The season of growth for cool-season grasses is generally late spring whereas the season of growth for warm-season grasses is in late spring and early summer (Holechek *et al*. 1995). In areas where both mixedgrass and fescue prairie grazing units are available, mixedgrass prairie may be used in late spring and early summer and the fescue dominated range may be saved for late summer and early fall grazing.

Repeated seasonal use of native vegetation is generally detrimental to the plant species that are most palatable during the period of use. Continuous early season (May through July) grazing in the mixedgrass and fescue prairie tends to increase the amount of bare ground (Naeth *et al.* 1991). In mixedgrass prairie, forbs and shrubs may be more prominent under early season grazing and grasses more prominent under late season grazing (Naeth 1985). The composition of native grasses is also affected by grazing season. Late season grazing increases frequency of taller grasses such as spear grass (*Stipa* spp.), wheatgrass (*Agropyron* spp.) and June grass (*Koeleria macrantha*).

Seeded pasture is often incorporated into a season-of-use system that is based on varying vegetation types. In this regard, the season-of-use system would be similar to complementary grazing systems. Seeded pastures often provide highly nutritious forage earlier and later than native range, and can withstand more intensive grazing.

In the mixedgrass prairie, Smoliak (1968) found that incorporating crested wheatgrass (*Agropyron cristatum*) and Russian wild rye (*Elymus junceus*) with native range use benefited both livestock and the range. Given free choice between the three vegetation units, livestock preferred to use crested wheatgrass in the spring, native prairie in the summer and Russian wild rye in the fall. This system may not be as effective as other systems in improving range condition, as this study found that forbs and shrubs increased under free-choice or continuous grazing compared with rotational grazing. The basal area of blue grama also increased under free-choice grazing, but decreased with rotational grazing.

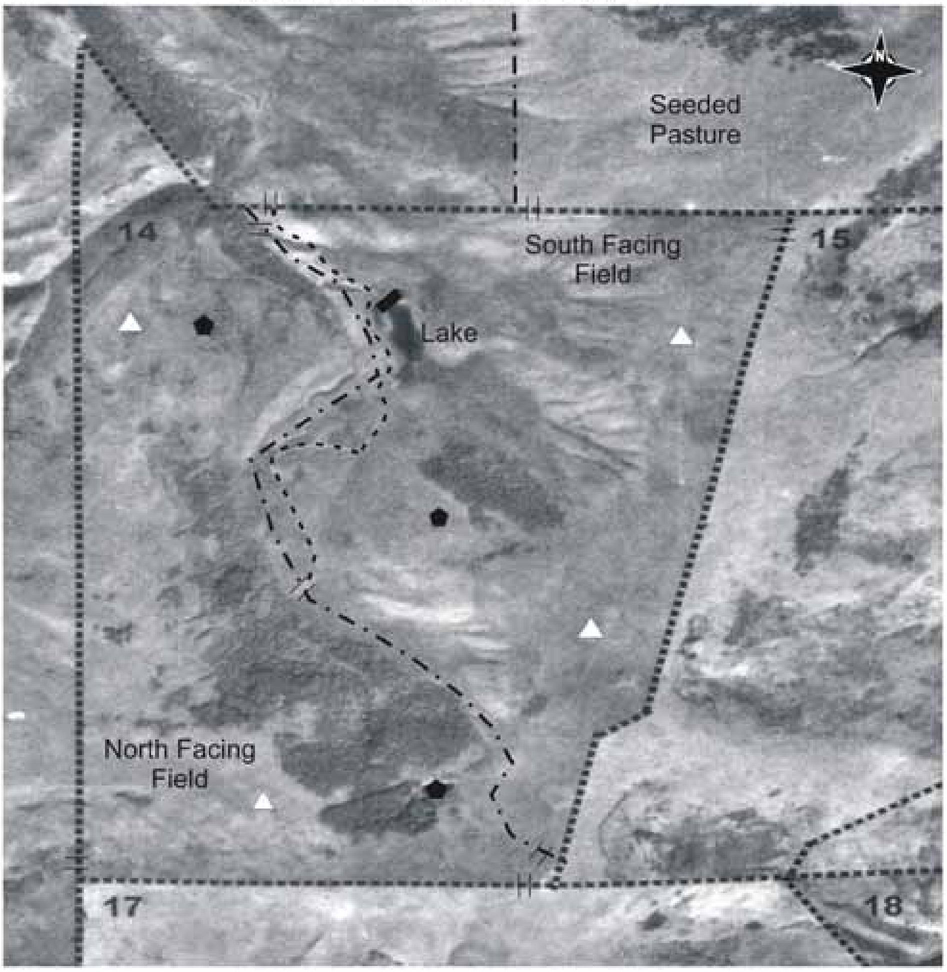
Ranges that are comprised of treed or shrubby areas (north-facing slopes), grassland (south-facing slopes) and meadow (riparian) vegetation types may be fenced and used separately to benefit vegetation, livestock and wildlife. Grassland forage species initiate growth earlier in the spring and mature earlier in the summer than do treed ranges (Holechek *et al.* 1995). Grazing different range types during their season of best use may result in overall forage quality and higher nutritional value. Figure 4.2 demonstrates how a season-of-use grazing strategy may be implemented for grazing units that contain both grassland and treed or shrubby vegetation. Incorporating seeded pasture in the season-of-use strategy for this grazing unit also defers the use of native vegetation later in the growing season. Fencing grazing units based on vegetation has the added benefit of controlling livestock use in riparian areas, which are generally used excessively due to the convenience of these areas to livestock. This strategy will be further discussed in Section 6.7 Riparian Areas Grazing.

More often a season-of-use system is used for operational convenience. Examples of seasonal grazing may include repeated spring grazing in a field closer to ranch headquarters to facilitate herd inspection during calving, repeated seasonal grazing of a field due to availability of shelter (trees, shrubs, topographic variation) from winter or early spring storms, or making use of fields where water supplies are only available early in the season (Abouguendia and Dill 1993).

6.3 Deferred Grazing

Deferred grazing generally means grazing is delayed on a pasture until specific plant species pass through a critical phenological stage, such as seed set. This system is usually used to protect decreaser species from being grazed at a critical stage of growth and the field is managed for the benefit of these species. Originally, the intended use was to defer grazing for the entire growing season, but shorter deferment periods have also been used (Abouguendia and Dill 1993). Deferred grazing systems can only be applied to operations that have alternate sources of forage or feed for the deferment period. These may be seeded pastures or other fields more suited to early season use.

SEASON-OF-USE GRAZING



GRAZING NOTES

A. Range Improvements
Vegetation types were fenced into separate units to give better control over livestock distribution. Seeded pasture is used early in the season to defer the use of native vegetation. Grassland vegetation on the south facing slopes initiates growth earlier in the season and matures earlier than north facing vegetation. Heavier grazing pressure was generally experienced in the south facing field.

B. Management Practices
Cattle graze seeded pasture until the end of June at which time they are moved to the south facing field. Cattle typically graze the north facing field from July until the end of August.

C. Benefits
Vegetation types are used more efficiently by improving overall livestock utilization. Plant vigour is improved with deferred grazing in the south facing field and more carryover is maintained with longer rest periods. Species are used during their best season of use benefiting rangeland and livestock health

This system improves wildlife habitat by avoiding important bird nesting and key mammal reproduction periods.

Deferred grazing in the south facing field can also improve the riparian area along the shoreline of the lake.

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LEGEND

- ------ Fence line
- -·-·- Cross fence
- ····· Trail
- = Gate
- △ Salt
- ⬟ Stockwater
- ▬ Dam

FIGURE 2

SEASON-OF-USE GRAZING IN THE MIXED PRAIRIE

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Figure 4.2 Season-of-use grazing in the mixed prairie

Deferred grazing systems may be used to improve plant vigour, reduce the harmful effects of early season grazing, accumulate litter, and ensure current year's growth is available for grazing after the deferment period. For areas that are heavily grazed in the mixedgrass prairie, late season grazing after July is better than early season grazing in terms of good ground cover and litter accumulation (Naeth *et al*. 1991). Early season grazing reduces the heights of standing and fallen litter, decreases live vegetative cover and organic matter mass, and increases bare ground. However, allowing plants to mature often means vegetation is less palatable and less nutritious. Rangelands that are in excellent or poor condition may receive little benefit from implementing a deferred grazing system (Abouguendia and Dill 1993).

Some range grasses may require up to 75% of their winter-stored carbohydrate reserves to initiate the first 10% of growth in the next spring growing season (Wambolt 1979). Grazing plants early in the growing season before there has been adequate leaf growth (2-4 leaf stage) inhibits the carbohydrate buildup in plants. Adverse effects from grazing during this period may also come from instability in the soils during the early season. Mechanical damage may occur to the plant through soil movement, especially on slopes, resulting from livestock impact on the range. However, a plant heavily defoliated in spring before leaf extension is completed and in an environment that is conducive to completing its growth (*i.e.* leaf extension) may very well tolerate defoliation if it is not grazed again (Bogen *et al*. 2003).

The most critical period to the long-term welfare of plants is when the plant has accumulated sufficient leaf area and is directing energy reserves to the seedhead (boot stage) (Wambolt 1979) particularly following a disturbance (Bogen *et al*. 2002). The demand on carbohydrate reserves is high between the time seedheads emerge and flowering ceases. This period also tends to coincide with seasonal lows in precipitation (*i.e.* mid-summer). Because moisture is limiting at this time, plants may be severely stressed to replace foliage and consequently, previous carbohydrate levels.

At the time seed set (ripening) is complete, native grasses normally reach their peak in carbohydrate reserves (Wambolt 1979). Even though the plant appears inactive through the dormant season, carbohydrate levels are somewhat diminished through continued plant respiration. Fall regrowth may also occur if the conditions are favourable, but the impact of defoliation is generally not as great because moisture is not as limiting and carbohydrate reserves are higher on well managed ranges. However, high utilization during fall will reduce energy available to the plant for new growth the following spring.

6.4 Complementary Grazing

Complementary grazing manages seeded pasture and native range to enhance the growth characteristics of both. This system takes into consideration the requirements of the different vegetation types and the needs of the grazing animal. Complementary grazing can accomplish the objectives of deferred grazing by utilizing seeded pasture in the spring and deferring the use of native range. This system is employed to improve the vigour, yield and condition of native prairie, improve overall forage quality, and lengthen the grazing season.

The amount of seeded pasture needed depends on the available forage supply from the native range, the desired length of the grazing season, the selected plant species and its intended season of use, soil zone, and the type and level of agronomic inputs (*e.g.* fertilization) (Abouguendia and Dill 1993). More recently, marginal cultivated lands have been seeded to perennial forage plants. These practices increase the availability of seeded pastures for possible integration with the native range.

In grassland systems, crested wheatgrass provides early, highly nutritious forage at a time when native range is most vulnerable to defoliation (Grazing and Pasture Technology Program 1995). Meadow brome (*Bromus biebersteinii*) may be used similarly in regions where crested wheatgrass invasion into native prairie is a concern or average growing season precipitation is higher. Seeded pasture can often be regrazed in the fall or taken off for hay.

Seeded pasture also requires some form of grazing management to maintain production and long-term viability. Grazing too soon is a major factor leading to pasture deterioration. Seeded species should have approximately 15 cm (6 inches) of growth before grazing is initiated (Alberta Agriculture, Food and Rural Development (AAFRD) 1998). Adequate carryover is also required for seeded species to ensure enough leaf area remains to facilitate new growth and store carbohydrates.

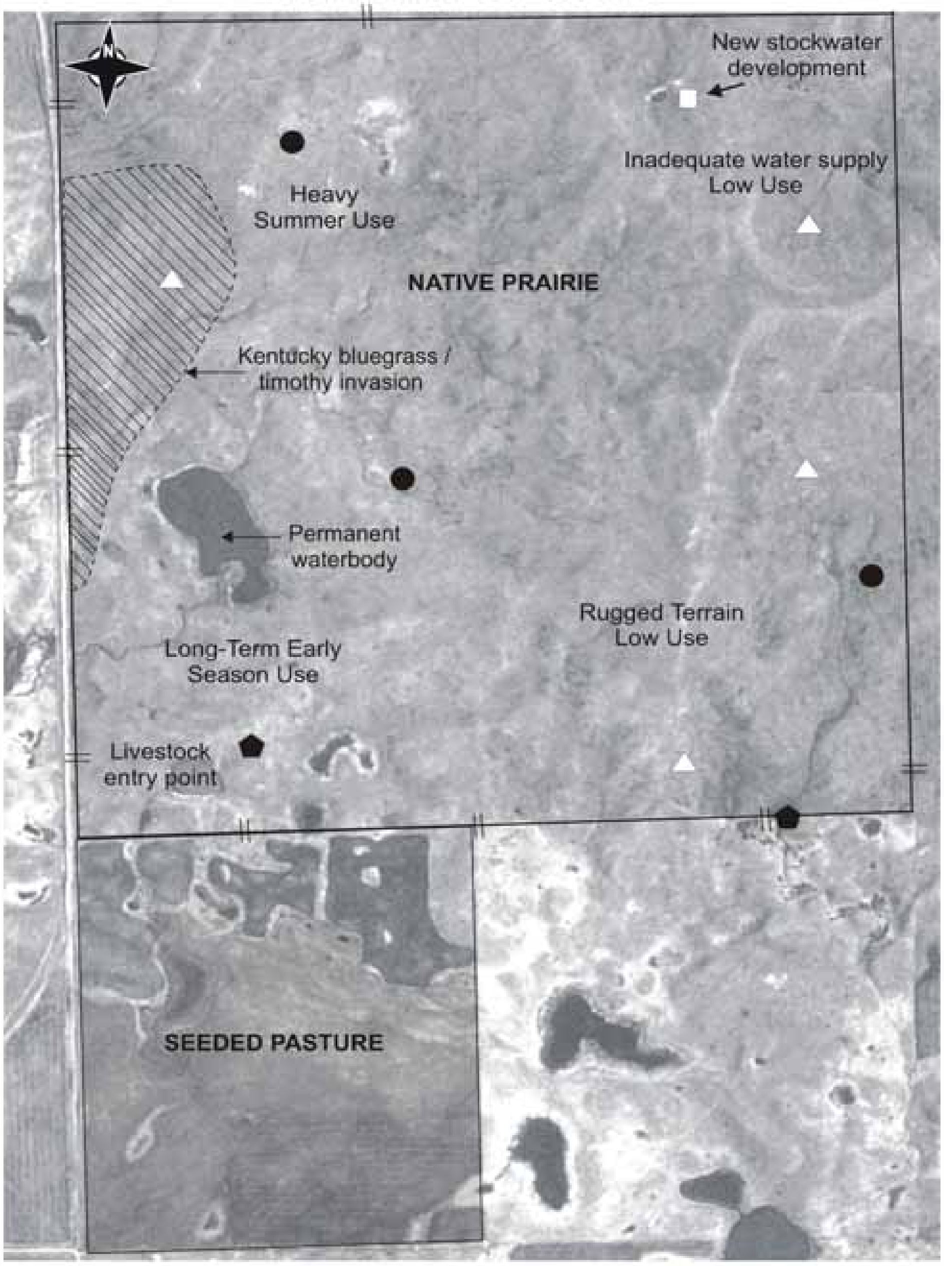
Figure 4.3 demonstrates how complementary grazing may be utilized on the fescue prairie for a ranch with a mosaic of native and seeded pasture. Fences constructed based on vegetation types allows for greater control of livestock distribution and better overall utilization of the forage.

6.4.1 Skim Grazing

Skim grazing is not usually considered a grazing system, but is useful to mention as a grazing strategy to be used in conjunction with a particular grazing system. It is similar to complementary grazing in terms of utilizing exotic (non-native) and native species during their season of best use. It is used to promote livestock use of native rangeland areas encroached by exotic forage. Commencing grazing in mid-May potentially reduces or prevents further expansion of exotic species encroachment by grazing these species when they are most palatable.

When utilizing this strategy, fields should be grazed for a short duration in the spring to avoid the utilization of native species. Rough fescue, if present in the field, may be preferentially grazed by livestock early in the growing season (Moisey et al. 2003). The grazing preference for rough fescue over exotic grasses at this time is dependant on the amount of standing residue within the rough fescue plant. Seed production in exotic grasses may be limited by skim grazing prior to inflorescence (heading out) providing adequate levels of standing residue are maintained in rough fescue. This practice will protect actively growing native plants and reduce the potential to detrimentally affect the long-term sustainability of rough fescue grassland.

COMPLEMENTARY GRAZING



C. Benefits

Seeding cropland back to forage has reduced the loss of soil on eroded drainages. Sloughs are not hayed until the end of July or mid August to avoid sensitive nesting periods.

Fencing plant community types into separate units has allowed for better management of both. Improved vigour and production in the native prairie as a result of deferred grazing.

Deferring grazing on native prairie in the spring, by using seeded pasture allows for better management and conservation of sensitive plant species that occur in the native prairie.

Deferred early season grazing in native prairie also allows for minimized disturbance to sharp-tailed grouse leks and ground nesting birds and waterfowl during the spring breeding and nesting period.

GRAZING NOTES

A. Range Improvements

Native prairie is fenced out as a separate grazing unit from seeded pasture. Cropland is seeded to pasture for spring and fall grazing.

B. Management Practices

Seeded pasture and native prairie are used in this grazing system. Crested wheatgrass is grazed from late April to mid-June. Livestock are then turned onto native range until mid-September.

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Alberta Sustainable Resource Development

Alberta Conservation Association

LEGEND

Fence line	Developed spring
Gate	Undeveloped spring
Abandoned cultivation	New stockwater development
Salt	

FIGURE 3

COMPLEMENTARY GRAZING USED IN THE FESCUE PRAIRIE

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Figure 4.3 Complementary grazing used in the fescue prairie

Skim grazing may also be considered in the fall when there is a greater preference for un-senesced (still green) Kentucky bluegrass (*Poa pratensis*), and particularly fall regrowth, than rough fescue (Moisey *et al*. 2003). Fall and fall regrowth grazing may be a practice conducive to the conservation of fescue grassland while taking advantage of the forage production of actively growing invasive species.

6.5 Rotational Grazing Systems

Rotational grazing is designed to reduce selective grazing and overgrazing by concentrating more livestock on a smaller area and forcing overall better utilization (Grazing and Pasture Technology Program 1995). There are many variations of rotational grazing including Switchback, Deferred-Rotation, Rest-Rotation and several intensive rotational systems.

6.5.1 Switchback Grazing

This system applies the same principles as the deferred grazing system, but each of the two pastures receives deferred grazing every other year. A switchback grazing system is the simplest form of a deferred-rotation grazing system. Vegetation response under this system has been slightly to moderately better than continuous or season-long grazing on most ranges (Holechek *et al.* 1995). Deferred-rotation grazing provides a better opportunity for preferred plants and areas to gain and maintain vigour than does continuous grazing (Abouguendia and Dill 1993). It works best where considerable differences exist between palatability of plants. For example, fields with riparian zones often receive excessive pressure in the riparian areas while the surrounding uplands receive little or no use. A deferred-rotation system allows species on the lowland and sacrifice areas the opportunity to store carbohydrates and set seed every other year.

Deferred-rotation systems are often associated with lower livestock gains due to less selectivity, but in terms of economics, the increased stocking rate possible under this system generally compensates for lower animal performance (Holechek *et al*. 1995).

6.5.2 Deferred-Rotation Grazing

This system is similar to switchback grazing, except that delayed spring grazing is rotated among three or more fields. This system delays grazing on a specific grazing area or pasture until desirable plant species have passed a critical growth cycle. This type of a system can provide management flexibility, extra grazing days, optimum stocking rates and a productive rangeland for other resources. Frequency of deferment will depend on the number of fields available to be rotated.

A deferred-rotational system based on phenological stages of key range plants would likely involve three fields. In the first year, one of the fields would be deferred until early growth is completed or until the initiation of flowering, reducing the impact of grazing newly initiated growth and to allow for seedling establishment. In the second year, the field would be deferred until seed set is complete to allow seed production and carbohydrate storage. In the third year, the field is grazed first in the rotation. A field grazed first in one year (early) would be grazed last during the next year (late) and grazed second (mid) in the subsequent year.

A deferred switch-back grazing system also allows each field to be grazed at a different stage in the growth cycle of vegetation. This reduces the pressure on plants being grazed repeatedly at a particular time of year when they are most palatable.

The main objective of this system is to improve the vigour of select forage species, usually the decreaser and/or most productive plants. The use of plant groups that initiate growth or are more palatable at different times of the year may be manipulated with this system. To detect changes in species composition when switching from a continuous to a deferred-rotation grazing system requires several years. Smoliak (1960) did not find any changes in the main forage species in the mixedgrass prairie after 8 years of implementing a deferred-rotational grazing system, but did observe a decrease in moss phlox (*Phlox hoodii*) and an increase in little clubmoss (*Seleginella densa*).

Shorter duration grazing also allows plants a longer period to recover following defoliation and reduces the chance of regrowth being grazed in the same season. "Once-over" grazing of native prairie is important in maintaining the health of native grasses as defoliation during the growing stage, especially of regrowth, greatly diminishes the production and vigour of these grasses. "Twice-over" grazing (2 rotations through the grazed fields) may be required in years of low vegetative production due to environmental conditions such as drought.

This system is more management intensive than continuous grazing, requiring additional fences and water development. More time is also required to monitor and move livestock. Table 4.1 provides an example of how a deferred-rotational grazing system may be implemented with three fields and growth stage of the key forage species being managed for (Figure 4.4).

Table 4.1 Deferred-Rotational Grazing System

Field	Year 1	Year 2	Year 3
A	Graze 1st*	Graze 3rd	Graze 2nd
B	Graze 2nd**	Graze 1st	Graze 3rd
C	Graze 3rd***	Graze 2nd	Graze 1st

*Active growth
**Flowering
***Seed set

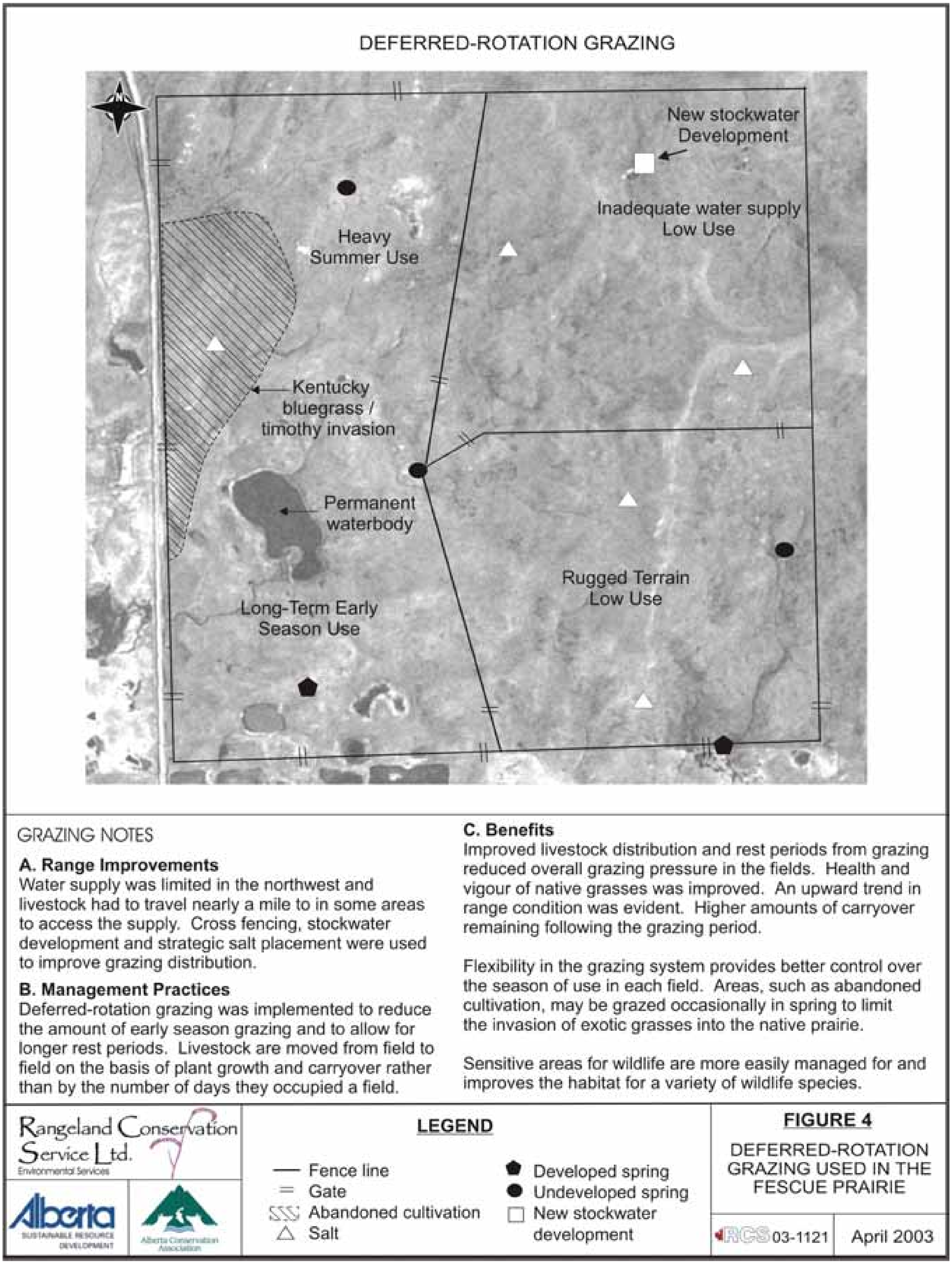


Figure 4.4 Deferred-rotation grazing used in the fescue prairie

6.5.3 Merill Rotational Grazing System

Deferred grazing may be used for multipasture, multiherd systems where the length of the grazing period is often longer than the length of the deferment period. An example of a deferred grazing strategy using multiple herds is the Merrill System. This system grazes three herds of livestock in four grazing units with one unit being deferred at all times. In this way the same grazing unit is not grazed at the same time each year. This type of system will repeat itself every 4 years. The Merrill System may be useful for operations that use specific herds for their breeding program. It also works well where common use of the range by more than one grazing animal is practiced. Table 4.2 provides an example of the Merrill grazing system.

Table 4.2 Three Herd-Four Field Merrill Grazing System

Season	Field A	Field B	Field C	Field D
Year 1				
Early	Ungrazed	Herd 1	Herd 2	Herd 3
Mid	Herd 1	Ungrazed	Herd 2	Herd 3
Late	Herd 1	Herd 2	Ungrazed	Herd 3
Year 2				
Early	Herd 1	Herd 2	Herd 3	Ungrazed
Mid	Ungrazed	Herd 2	Herd 3	Herd 1
Late	Herd 1	Ungrazed	Herd 3	Herd 2
Year 3				
Early	Herd 1	Herd 3	Ungrazed	Herd 2
Mid	Herd 1	Herd 3	Herd 2	Ungrazed
Late	Ungrazed	Herd 3	Herd 2	Herd 1
Year 4				
Early	Herd 3	Ungrazed	Herd 1	Herd 2
Mid	Herd 3	Herd 1	Ungrazed	Herd 2
Late	Herd 3	Herd 1	Herd 2	Ungrazed

*Adapted from Holechek *et al.* 1989

6.5.4 Rest-Rotation Grazing

In rest-rotation grazing one field is rested from grazing for the entire year. This system requires a minimum of four grazing units to be implemented. In a four-field system, for example, one field would receive early grazing one year, mid-season grazing one year, late grazing one year and a year of complete rest. Although livestock density is increased with rest-rotation grazing, moderate stocking rates are recommended with a proper use factor appropriate for the grassland type.

Rest-rotation grazing is strongly based on improving overall forage quality and minimizing livestock selectivity. It is often implemented to improve plant vigour, grazing distribution, and overall utilization by increasing animal density. Year-to-year fluctuations in forage production can be planned for due to stockpiled forage in the rested field (Grazing and Pasture Technology Program 1995, Abouguendia and Dill 1993). Rest-rotation grazing is generally superior to season-long grazing in areas where livestock distribution problems occur (Holochek *et al.* 1989). Under proper utilization rates rest-rotation will improve range condition and promote even use of fields in many grassland systems (Johnson 1965, Laycock and Conrad 1981, Holechek *et al.* 1987).

Rotational grazing strategies in the northern Great Plains have had little effect on botanical composition in the short-term (<10 years) (Pitts and Bryant 1987, Hart *et al.* 1988, Taylor 1989, Hart *et al.* 1993). In the mixedgrass prairie, short-term rest (<5 years) from grazing generally does not change the total cover or total herbage yield compared to moderate season-long grazing, but there tend to be changes for individual plants (Vogel and Van Dyke 1966). Vogel and Van Dyke (1966) demonstrated that moderate grazing in mixedgrass prairie increases the relative yield of grasses and sedges compared to forbs and shrubby plants. Although the yield of June grass on grazed areas was shown to be lower than areas protected for four years from grazing, there was twice the number of plants. Protected plants were taller and had larger basal areas. Grasses protected from grazing for a long period of time (>40 years) tend to have greater vigour with needle-and-thread dominating ungrazed sites and blue grama dominating heavily grazed sites (Dormaar *et al.* 1977, Smoliak *et al.* 1972).

Rotational systems used in areas with livestock distribution challenges due to topography have been effective in improving plant community characteristics (Johnson 1965, Holochek *et al.* 1995). Johnson (1965) used rest-rotational grazing to reduce overall utilization by improving livestock distribution. Increases in total herbage production found in this study were attributed to increased plant vigour as a result of deferment from grazing in the spring or a year of complete rest. This study also found that range improvement is more rapid with rest-rotational systems than a simple rotational system.

One of the most consistently responsive vegetative characteristics to rest-rotation grazing is increases in litter cover for the field that is rested. Naeth *et al.* (1991) found that the height of litter is greater in ungrazed areas of the mixedgrass prairie, but there is no difference in the mass of standing or coarse litter for grazed or ungrazed sites. In grazed areas, trampling tends to reduce litter particle size and create better litter-soil contact. In the mixedgrass prairie, litter accumulation is not high enough to significantly reduce herbage productivity (Willms *et al.* 1996). However, removal of litter from mixedgrass prairie in good condition will decrease herbage production (Willms *et al.* 1993).

In the fescue prairie, excessive standing dead and surface litter (>11,000 kg/ha) may lower the production potential for the grassland (Sinton 1980 Willms *et al.* 1986). Litter accumulation generally does not negatively impact range condition, but there is a decline in forage nutritional value in the rested field due to the presence of standing dead plant material.

Litter is vital to the production of grasslands. Soil water is mostly recharged by rainfall, but all rainfall does not infiltrate into the soil. Water may run off or be intercepted by dead or live vegetation. The amount of water taken up by the plant and evaporates from the surface is determined by nature and availability of soil-water, and has drastic effects on both short-term and long-term vegetation production (Willms *et al*. 1993). Plant litter intercepts rainfall but also reduces evaporation from the soil surface by buffering the soil from radiation and air movement. On grassland where the biomass of litter is 5,000 kg/ha, the first 1 mm of precipitation could be absorbed by litter and never reach the soil (Willms, unpubl. data). However, the beneficial effects of reducing evaporation and making more water available for the plant outweigh this small loss of water to the soil.

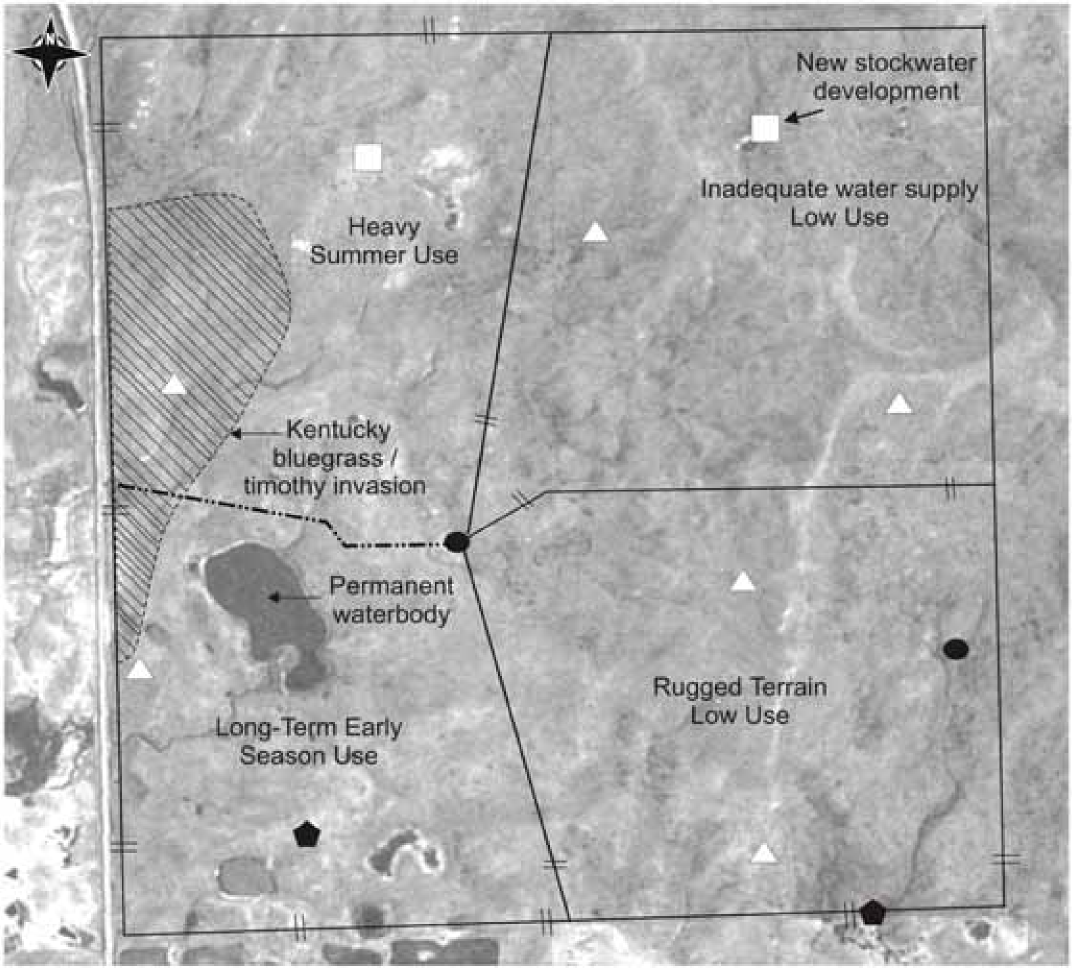
Reductions in livestock numbers may have to be made initially to account for the loss of grazable area with the field that is being rested for the year. However, with improved plant vigour and production, increases in stocking rates may be attainable. Table 4.3 provides a description of how a rest-rotational grazing system may be implemented with four fields. The same cycle is repeated starting on year five.

Table 4.3 Rest-Rotational Grazing System

Field	Year 1	Year 2	Year 3	Year 4
A	Graze 1st	REST	Graze 3rd	Graze 2nd
B	Graze 2nd	Graze 1st	REST	Graze 3rd
C	Graze 3rd	Graze 2nd	Graze 1st	REST
D	REST	Graze 3rd	Graze 2nd	Graze 1st

To implement rest-rotational grazing additional investments may be required. Increased fencing is one of the biggest investments in this grazing system. To reduce high costs associated with permanent fencing, cross fencing may be a single strand, high tensile electric fence. Stockwater may be the major limiting factor in establishing a rotational grazing system. To improve the quality and quantity of drinking water available to livestock surface water supplies should be fenced. Fencing out stockwater may also be an effective way to improve livestock distribution within a grazing unit. Furthermore, keeping livestock out of the water and mud helps prevent disease and protects the water from being contaminated. Reducing sediment load in the stockwater will keep the water temperature lower and reduce evaporation, maintaining higher water levels through the summer. Areas around water troughs should be excavated and filled with gravel, especially in moist areas, to allow spilled water to drain away and reduce the possibility of disease. Figure 4.5 provides an example of a rest-rotation grazing system.

REST-ROTATION GRAZING



GRAZING NOTES

A. Range Improvements

Cross fencing was used to create three new fields, but the east side was still heavily used. An electric fence was added to improve livestock distribution. A spring was developed in the northeast.

B. Management Practices

Livestock are rotated through each field based on target utilization rates. One field is rested completely from grazing each year. Salt locations are placed in the area of abandoned cultivation to encourage livestock use and limit encroachment of exotic grasses. A control program has been implemented for areas of noxious weeds.

C. Benefits

Better livestock distribution has led to an improvement in overall range condition. More carryover exists at the end of the growing season due to longer rest periods. Although the system is management intensive it has improved monitoring of noxious weeds and heavily utilized areas.

An improvement in the condition of ephemeral wetlands is evident and an increase in nesting ducks. Increased wildlife use has also been observed.

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LEGEND

- Fence line
- Electric fence
- Gate
- Abandoned cultivation
- Salt
- Developed spring
- Undeveloped spring
- New stockwater development

FIGURE 5

REST-ROTATION GRAZING USED IN THE FESCUE PRAIRIE

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Figure 4.5 Rest-rotation grazing used in the fescue prairie

6.6 Intensive Grazing

Most intensive grazing systems are based on the Savory grazing method (Savory 1988). They are known as high-intensity-low-frequency (HILF) grazing, short-duration grazing, time-controlled grazing and holistic resource management (HRM). All these systems follow the general concept of very high stocking rates and utilization followed by long periods of rest. High stock densities increase competition for feed between animals, forcing each to spend more time eating and less time wandering. Competition also forces animals to be less selective when grazing. They will eat plant species that would be ignored in other grazing systems. This may result in a reduction of less desirable plant species in the field. The system enables more rigid control of animal distribution with the use of numerous smaller grazing units. This concept was introduced with the objectives of improving the chemical and physical properties of the soil and promoting grassland succession (Savory 1983).

HILF grazing is based on high stocking densities that force the animal to use the available vegetation. Relatively long grazing periods are then followed by long recovery periods. HILF grazing is used most successfully in regions characterized by high rainfall and long growing seasons (Fraser 1993).

Short duration grazing involves relatively high stock densities and short grazing periods. Grazing periods are fixed according to the estimated time needed by key forage species to recover from grazing events. An example or short-duration grazing is provided in Table 4.4. The number of days of grazing in a field is determined by the number of fields available to use in the system and the recovery time required for the particular plant community the grazing system is applied in.

Table 4.4 Days of Grazing and Recovery Time for Short-Duration Grazing Based on Number of Paddocks*

No. of Paddocks	Days of Grazing	Recovery Time
6	1	5
6	3	15
6	6	30
6	14	70
9	1	8
9	3	24
9	6	48
9	14	112
31	1	30
31	3	90
31	6	180

*Adapted from Fraser 1993.

Time-controlled grazing is similar to short-duration grazing in that stocking densities are high, but this system recognizes that both recovery grazing times vary with the growth rate of key forage species. Grazing periods are short (1-3 days) during rapid growth and longer (7-14 days) during periods of slow growth or dormancy (Abouguendia and Dill 1993). Recovery times vary from 14 to 90 days for this type of system depending on forage growth (Fraser 1993). Time-controlled grazing requires an understanding of the time needed for plant recovery.

Heavy stocking rates under rotational grazing systems, with repeated high intensity of trampling, reduces infiltration rate and increases erosion (Warren *et al.* 1986, Pluhar *et al.* 1987). In the Northern Great Plains this effect may be temporary since the freezing-thawing effect over winter generally results in a recovery of the hydraulic conductivity (Dormaar *et al.* 1989). Heavy grazing has not been shown to increase bare ground in the mixedgrass prairie in terms of any practical significance (Naeth *et al.* 1991). However, mixedgrass prairie soils tend to be very fragile and have little resistance to ecological change in terms of organic matter (Dormaar *et al.* 1977). Even slight grazing pressure may set off immediate change in the soil organic matter system.

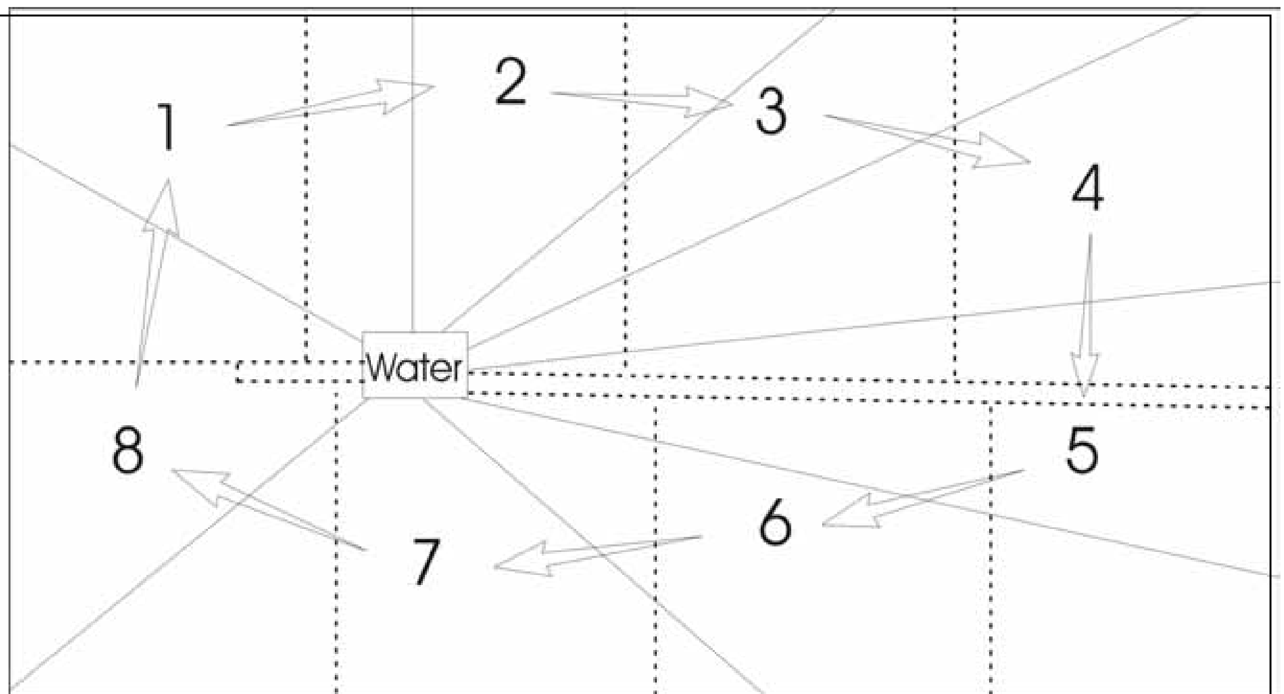
On fescue prairie high stocking rates have been shown to decrease range condition due to the loss of desirable species such as rough fescue (Johnston *et al.* 1977, Dormaar *et al.* 1989). Dormaar *et al.* (1989) demonstrated that short-duration or HILF grazing (approximately 70-80% utilization, 2-3 times the recommended stocking rate and an average grazing period of 4.5 days) resulted in retrogression (return to an earlier seral stage) in fescue prairie. This system also caused less desirable soil conditions by decreasing soil moisture and increasing soil bulk densities indicating reduced infiltration rates. Negative effects of this type of grazing system have also been shown in the mixedgrass prairie (Willms *et al.* 1990). High stocking rates with high levels of utilization tend to result in grassland deterioration despite the short periods (1-3 days) of grazing. High stocking rates on mixedgrass prairie have also resulted in declines in range condition, lower root mass, and lower vegetation densities (Clark *et al.* 1947, Schuster 1964, Willms *et al.* 1990). Continuous grazing appears to create effects similar to HILF grazing, but there is no evidence that these similarities will exist at lower stocking rates (Willms *et al.* 1990).

It may be beneficial to implement an intensive grazing system where control of problem weeds or undesirable species is the management objective. Intensive grazing systems may also be best suited for seeded pastures in more humid climates. Bork (2003) found that control of Canada thistle (*Cirsium arvense*) in seeded pasture was possible through the implementation of a HILF grazing system. High utilization rates (80%) and herd density during each grazing period reduced thistle abundance through grazing (thistle plants are non-poisonous and can be relatively high in forage quality) and trampling.

Intensive grazing systems, such as short duration grazing, generally involve a wagon-wheel arrangement of fences with water and livestock-handling facilities located in the center of the grazing area (Figure 4.6). Ideally, using an 8-field grazing system, the rest period would be 7 times as long as the grazing period (e.g. 5 days grazing followed by 35 days rest). Livestock return to pastures only after plants have regrown adequately.

Division of grazing units with corridors is considered superior to a star or wagon-wheel shaped arrangement (Grazing and Pasture Technology Program 1995). Grazing tends to be more evenly distributed in the former system with livestock use concentrated in the corridors whereas a star-shaped system will concentrate livestock distribution towards the centre with less use at the ends.

The implementation of intensive grazing systems relies on flexibility and a high degree of management input. Continual monitoring is required to make adjustments to grazing periods, stocking rates and densities and to match the prevailing growing conditions.



--------- Good method of division with corridors

______ Bad method of division (star-shaped)

*Adapted from Grazing and Pasture Technology Program 1995

Figure 4.6 Example of an intensive grazing system*

<u>6.7 Riparian Area Grazing</u>

There are several options for improving riparian area health through the implementation of livestock grazing systems. These may include controlling the way livestock access riparian areas or implementing grazing systems that provide adequate rest from grazing or exclusion of grazing during critical periods for riparian vegetation. Healthy, functioning riparian areas may provide improved habitat for wildlife and aquatic organisms, more stable channels, improved water quality and a shift toward perennial streamflow (Elmore and Beshcta 1987 *as cited in* Fitch and Adams 1998).

Livestock access to water can be focused by providing graveled or hardened access points that livestock prefer to use. This minimizes the impact on the entire riparian area and access points are easy to monitor for deleterious effects (*e.g.* addition of sediment, weeds). Off-stream watering sites may also be used. Cattle demonstrate a high preference for drinking from a water trough and will often walk further to drink from a trough rather than drink from a stream when given free access to both (Veira 2003).

Restricting livestock access to the riparian area may be necessary to benefit the health of the system (Fitch and Adams 1998). By controlling the timing of grazing, vulnerable periods when the stream banks are soft or key species are adversely affected may be avoided. Periods of rest will enhance plant vigour, allow for bank building and allow tree seedlings to grow and reach a more grazing resistant stage. Reducing grazing intensity in riparian areas results in better plant vigour and composition of desirable native species. Grazing systems involving several fields can provide adequate rest and deferment periods at appropriate times to enhance riparian area vegetation. This can increase the control over the grazing in the riparian area through regulating animal numbers, season grazed, length of grazing and rest periods. Riparian areas may be fenced into separate pastures, with separate management objectives and strategies. In high risk or chronic problem areas corridor or exclusion fencing may be the only option for mitigating riparian grazing problems.

Grazing system options must address the needs of key vegetation for maintaining or restoring riparian areas due to the complex and unique character of these ecosystems (Platts 1991). Several types of vegetation are required to establish riparian function. Species with deep, fibrous roots provide sod mats and woody species provide roots and large woody debris. Along with a diversity of multilayered vegetative cover, the presence of these species lends stability to the system. Vegetation cover and residue must be present in adequate amounts to attenuate high flows when they occur. Grazing systems must also provide rest during vulnerable periods when banks are saturated and easily damaged and in autumn when woody species are most vulnerable to browsing.

The effectiveness of using livestock distribution tools to protect riparian areas without fencing is generally dependent on the homogeneity of the landscape. In environments where there is little resistance to the distribution of livestock in the upland (*e.g.* flat prairie), off site watering systems and salt placement may be sufficient. In other terrain additional measures such as herding, upland vegetation manipulation (fertilization, burning, reseeding) and permanent or temporary fencing may be required (Kinch 1989). Depending on the time of year the riparian area may be used and the type of terrain, shade and/or shelter facilities in the upland may also effectively distribute livestock. The entry point of the livestock herd may also impact the riparian area. Turning cattle into a field away from the riparian area will delay the impact to the system if water is provided off-stream.

Most environments require some form of grazing system to maintain riparian function and health. Season-long grazing can be successful in a homogenous mixedgrass prairie landscape where riparian areas are mostly ephemeral if applied at the proper stocking rates and through effective livestock distribution tools (Fitch and Adams 1998). In more complex range landscapes with well developed riparian areas, season-long grazing will adversely affect riparian vegetation. The tendency for livestock to congregate in riparian areas creates unequal grazing pressure in these areas and will result in overgrazing despite using moderate stocking rates that are based on the entire field.

Recommended utilization rates in riparian areas fall in the range of 25 to 65% to ensure that the necessary amount of vegetation remains to provide adequate cover to protect banks during high runoff periods, to filter or trap sediment and dissipate stream energy (Fitch and Adams 1998). Where overgrazing occurs in the riparian area, plant species with deep, binding root mass are replaced by shallow or tap-rooted species that have poor bank stabilizing characteristics. This results in a widening of the stream channel, and shallower and warmer water. The system is less capable of capturing and holding water through the growing season and riparian vegetation is no longer supported.

6.7.1 Rest-Rotation Grazing

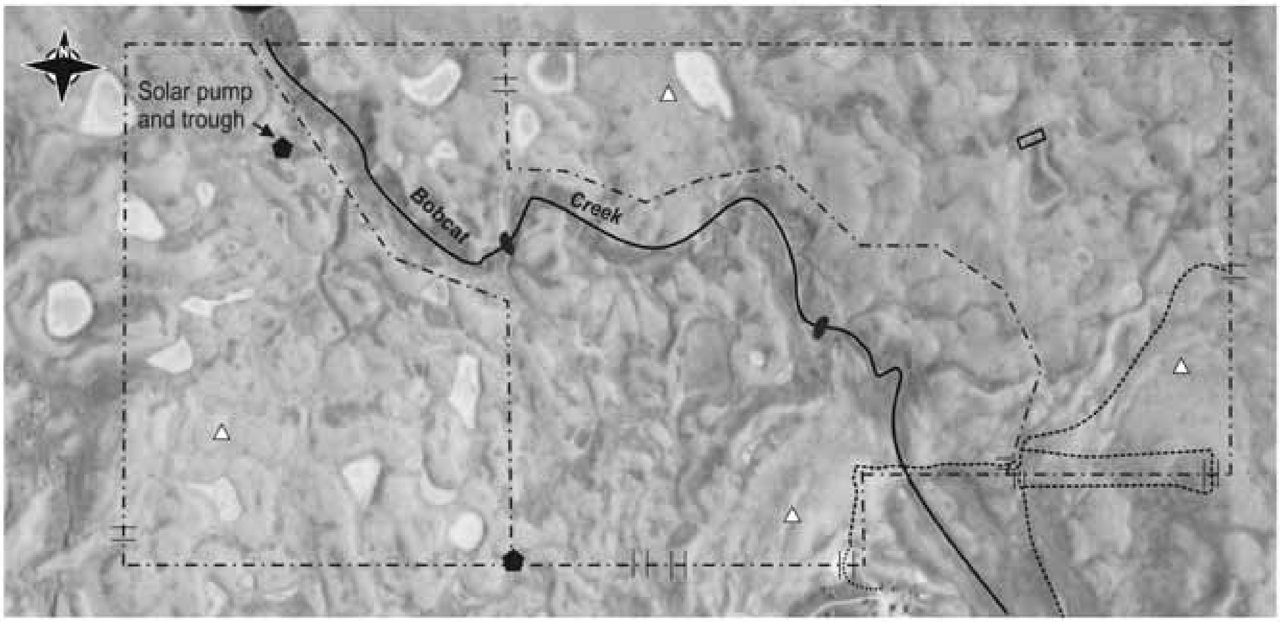
Incorporating a year of rest into the grazing rotation may be necessary for some degraded riparian areas to recover. Sufficient rest will restore fragile stream banks or allow woody species to be maintained. Rest-rotation grazing will generally better facilitate the recovery and maintenance of preferred shrubs, such as willows (Salix spp.). Where the goal is to regenerate new trees like cottonwoods, several years of rest may be required (Fitch and Adams 1998). The amount and sequence of rest periods will depend on the species of trees and shrubs that are or have the potential to exist in the riparian area.

Rest-rotation applied in fields with rugged terrain and riparian systems increases utilization 20 to 30% on upland areas compared to deferred-rotation or season-long systems (Holechek *et al.* 1995). Although livestock may still heavily utilize low-lying areas in this type of landscape, the riparian vegetation recovers well when given periodic non-use during the growing season. Figure 4.7 provides an example of rest-rotation grazing used for a riparian area in the fescue prairie. Prior to the construction of cross fences the riparian area was heavily favoured by livestock with little use in the adjacent upland areas. The health of the creek was declining, indicated by a loss of riparian vegetation (*e.g*. sedges, willows) and severe down-cutting of the creek inhibiting the creek from accessing the floodplain during high water events.

6.7.2 Deferred-Rotation Grazing

Using rotational grazing in riparian areas requires that grazing units be divided into fields comprising both upland and riparian areas. Fields may have the riparian area excluded from the uplands, and in this instance off-stream water development would be required. Dividing the grazing unit into smaller fields provides better control over livestock movements and encourages more even use of the field. In this way livestock are forced to utilize a greater extent of the upland, to distribute grazing pressure more evenly and reduce livestock selectivity, especially in riparian areas. More effective rest will be achieved by shortening the grazing period, providing a longer rest period and reducing the regrazing of plants to improve their vigour. Although the field is subject to higher stocking density, the field is utilized for a shorter period of time deferring use of the riparian area early in the growing season or providing periods of rest following grazing.

REST-ROTATION GRAZING STRATEGY FOR RIPARIAN AREA MANAGEMENT



GRAZING NOTES

A. Range Improvements

Cross fencing was constructed to make three fields and implement rest-rotation grazing. Created gravelled livestock access points for creek crossings. Developedstockwater along the south fence line and added portable solar pump and trough system.

B. Management Practices

A deferred rest-rotation system was necessary in this field to allow new woody seedlings to establish and provide sufficient rest from grazed to reach a grazing resistant stage.

The upland fields are grazed in a switchback manner each year beginning in May. The riparian field was rested from grazing the first two years and is now grazed at the end of the summer in most years. The amount and sequence of rest periods will vary with the rate of recovery in the riparian area.

Once the riparian area reaches a healthy and stable state and depending on the yearly climatic conditions, it may be possible to graze one upland field, the riparian field and rest the other upland field.

C. Benefits

Improved livestock use of adjacent upland area in riparian fields. Occasional rest from grazing in the riparian field has promoted stream-bank building and the growth of riparian vegetation. Improved stability of riparian area and better vegetation cover has decreased suspended sediment in the water as well as lowered the potential for downstream damage during high water events. The stream has become less intermittent during the growing season

The overall wildlife habitat has improved and fish are found more frequently in the stream.

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Alberta SUSTAINABLE RESOURCE DEVELOPMENT

Alberta Conservation Association

LEGEND

Fence line	Salt
Trail	Stockwater
Gate	Access point
Dam	Creek

FIGURE 7

REST-ROTATION GRAZING STRATEGY FOR RIPARIAN AREA MANAGEMENT

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Figure 4.7 Rest-rotation grazing strategy for riparian area management

Figure 4.8a provides an example of two ways to manage riparian areas within the mixedgrass prairie. The first is using deferred-rotation grazing to manage the riparian area. The grazing unit was previously divided into two fields which were grazed in the same sequence every year during the spring and summer. Degradation of the riparian area in the field grazed in the spring every year was evident. An additional cross fence was constructed to divide the field into three units which are grazed in a deferred rotational sequence. Smaller grazing units have provided greater control over livestock distribution and have promoted utilization of the upland areas. Deferring grazing in the riparian area and longer periods of rest from grazing has resulted in a positive trend in riparian health.

6.7.3 Riparian Pasture

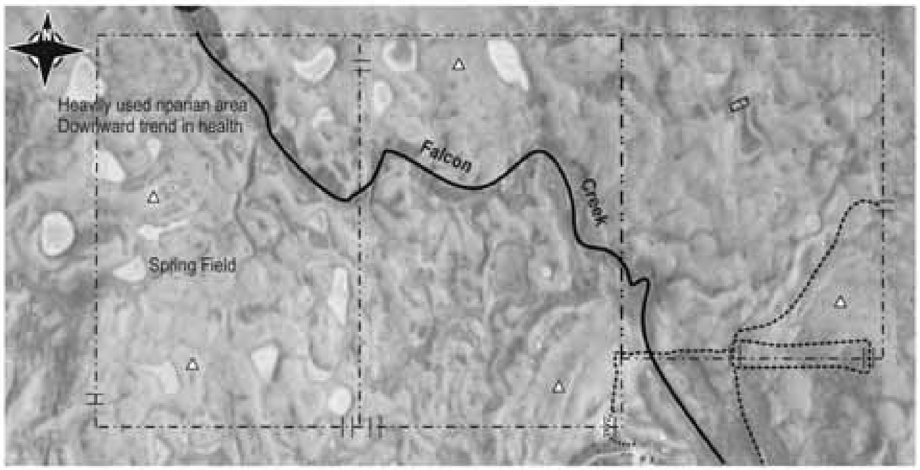
Riparian pastures reflect variation in the landscape and fencing occurs along the boundaries of vegetation units rather than section lines. The riparian area is fenced off from the upland and grazed as a separate unit. Livestock distribution is easier to control when the grazing unit is homogenous. Control over livestock grazing during vulnerable periods allows for optimum recovery or maintenance of riparian health and function. Periods during which riparian areas are most vulnerable to degradation from livestock grazing include spring when stream banks are soft and autumn when riparian vegetation is more palatable than upland vegetation.

Figure 4.8b demonstrates how this grazing unit could be managed to maintain or improve riparian health with the use of a riparian pasture. This enables control of livestock grazing in the riparian areas to best meet the needs of riparian vegetation. The optimum period for grazing the riparian pasture would be during the summer after spring runoff and stream banks are no longer soft, and before the dormant season. Grazing during the dormant season will progressively set back woody species that are essential for stabilizing stream banks and provide shelter for livestock. Healthy riparian areas tend to remain green for a longer period after upland vegetation has senesced and also retain higher nutrition through the dormant season. Grazing riparian areas during this period results in high livestock preference for the types of vegetation in riparian areas that are vital to maintaining healthy streams and banks.

6.7.4 Corridor Fencing

Generally, complete exclusion of livestock by fencing the area immediately adjoining the stream or river system is considered a measure of last resort. Corridor fencing may be feasible in landscapes where topography and vegetation patterns are complex, where land holdings are small and fragmented, or where stream banks are very fragile or severely degraded (Adams and Fitch 1998). Fencing out livestock from the riparian area may facilitate rapid recovery of degraded riparian areas, but often fails to deal with grazing problems on all of the landscape units in the operation. With the elimination of impact from livestock, riparian areas quickly advance to the climax vegetation for that ecological site. Within many prairie ecosystems, lack of grazing in these corridors often leads to a build up of grass that can become a management concern. Other alternatives are available, such as those previously discussed, that are not as costly and when properly applied may be as effective as corridor fencing.

A. DEFERRED-ROTATION GRAZING



C. Benefits

In the spring grazed field, areas of low vegetation cover and damage to stream banks have been recolonized by deep-rooted sedges and woody species. These riparian species have encouraged rapid rebuilding of banks as waterborne sediments have been trapped and held.

Greater vegetation cover has improved wildlife habitat and water quality.

GRAZING NOTES

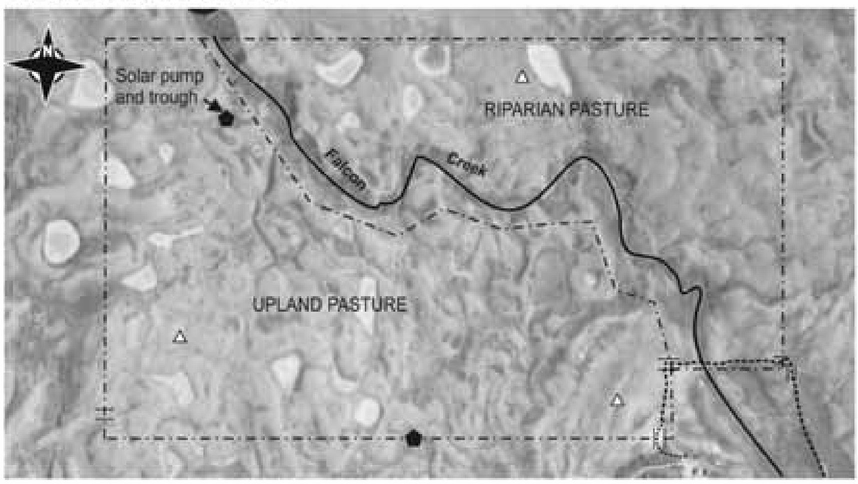
A. Range Improvements

Only the addition of an electric fence was required to implement deferred-rotation grazing for these fields. The most significant change was in livestock management; moving cattle from field to field as grazing use and the deferral sequence requires.

B. Management Practices

In years of above average forage production, a second, late-season graze also occurs. An additional graze in autumn may be risky if it exposes young woody plants to browsing by cattle and prevents recovery of desirable plants like willow.

B. RIPARIAN PASTURE



B. Management Practices

The field is divided into an upland and riparian pasture to create more homogenous vegetation units. The upland field is grazed early in the season and the riparian pasture is grazed in late summer. In years when alternate forage is available (seeded pasture) the uplands field is deferred from grazing until fall.

C. Benefits

Fencing and deferring use of riparian pastures can be beneficial to vegetation, stream banks and livestock. Cattle are restricted from grazing the riparian area until mid summer by the time which most nesting birds and small mammals have completed critical activities associated with reproduction.

The majority of vegetation growth has been completed so the negative impact on plant vigour is minimized.

GRAZING NOTES

A. Range Improvements

A greater capital investment is required to use a riparian pasture approach for this grazing unit. Fencing and additional stockwater development is needed to create a riparian pasture that can be used as part of the livestock grazing system.

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Alberta Conservation Association

LEGEND

-·-·-	Fence line	⬟	Stock water
-··-	Electric fence		Dam
········	Trail	△	Salt
=	Gate	∿	Creek

FIGURE 8

DEFERRED-ROTATION AND RIPARIAN PASTURE GRAZING SYSTEMS USED IN THE MIXED PRAIRIE

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Figure 4.8 Deferred-rotation and riparian pasture grazing systems used in the mixed prairie

PART III

7.0 BENEFICIAL MANAGEMENT PRACTICES FOR SHARP-TAILED GROUSE

7.1 Background

Increased agricultural production, the loss of native prairie habitat, and intensive livestock grazing have contributed to a decline in sharp-tailed grouse populations in Alberta and across their range in North America (Millar 1999, Giesen and Kobriger 1997). By the mid 1990's, population trend data for sharp-tailed grouse in Alberta indicated population declines ranging from 50 to 70 percent in some areas over the last 30 years (Goddard 1995, Jones and Lee 2000). Sharp-tailed grouse is listed as a "sensitive" species in Alberta that may require special attention in the future to prevent it from becoming at risk of extirpation (Sustainable Resource Development 2001). The subspecies plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi)* occurs within the Milk River Drainage (Roersma 2001).

The following subsections summarize the ecology and habitat needs of the plains sharp-tailed grouse. Based on this information and supporting scientific studies, seven grazing systems are compared in terms of their potential implications to grouse ecology or habitat. Lastly, a summary of the beneficial management practices to enhance sharp-tailed grouse habitat in the Milk River drainage in Alberta is presented.

7.2 Sharp-tailed Grouse Ecology: Breeding, Nesting and Brood Rearing

During the spring breeding season, male sharp-tailed grouse gather and perform ritual courtship displays on "leks" or "dancing grounds". According to research conducted in the aspen parklands of Saskatchewan, late April to approximately May 15th is described as the period of female lek visitation, highest male visitation, and greatest activity on the lek (Pepper 1972). Breeding displays typically occur for about 2.5 to 3.5 hours in the morning, beginning 30 to 40 minutes before sunrise, and again for about 1.5 hours before sunset (Pepper 1972).

Female grouse begin to construct a nest scrape at approximately the same time or before visiting dancing grounds in the spring (Millar 1999). The timing of nesting and breeding is affected by snowfall, with earlier nesting dates recorded in years of little snow in March and April, and later nesting dates found when snow persists into April (Bergerud and Gratson 1988). Sharp-tailed grouse have an average clutch of 12 eggs (Amman 1957 in Millar 1999). Eggs are laid daily and the 23 to 24 day incubation period begins after the last egg is laid (Millar 1999). Hatching occurs from the first of June to the middle of July, with peak hatching occurring during approximately the second or third week of June (Pepper 1972). Grouse chicks are precocial and hens leave the nest shortly after hatching in search of brood rearing habitat. Chicks are capable of flying to some degree by 10 days of age, and disperse from the brood when they become fully independent at six to eight weeks (Millar 1999).

7.3 Sharp-tailed Grouse Critical Habitat Needs

7.3.1 Lek (Dancing Ground) Site

Sharp-tailed grouse leks or dancing grounds are commonly characterized by low, sparse vegetation that allows for good visibility and uninhibited movements (Millar 1999). Leks are most often located on a slight rise such as a low ridge or knoll or in open flat areas that provide "wide-viewing horizons" in all directions (Baydack 1988, Millar 1999). The stability and availability of surrounding suitable nesting habitat is also an important factor in the establishment and consistency of use of leks (Bergerud and Gratson 1988). Availability of food, roosting, loafing, and escape cover in the vicinity are other determinants of lek location and occupancy (Pepper 1972, Millar 1999).

7.3.2 Nesting

Roersma (2001) found that sharp-tailed grouse nests were an average distance of 1.1 km from the lek in the Milk River Ridge area. Preferred sharp-tailed grouse nesting habitat includes lush and dense residual growth of grass-sedges in association with short shrubs such as rose (*Rosa* spp.) and snowberry (*Symphoricarpos occidentalis*) (Pepper 1972, Millar 1999, Roersma 1999). Treed bluffs are not typically used as nesting habitat (Millar 1999). Vegetation heights greater than 24.5 cm but less than 6 m are used for nesting (Christenson 1970 in Millar 1999, Pepper 1972). A minimum cover height of 30.5 cm, a high percentage of overhead cover (75%) and a minimum average Visual Obstruction Reading (VOR)[1] of 1.5 dm have been noted as spring sharp-tailed grouse nesting requirements (Amman 1957 in Millar 1999, Christenson 1970 in Millar 1999, Kobriger 1980). Roersma (2001) noted that sharp-tailed grouse nests on the Milk River Ridge contained more woody (shrub) cover and less graminoid cover than random sites. More research is needed to assess the effect of litter cover thresholds and sharp-tailed grouse nesting success. Thresholds of less than 25% litter cover and greater than 25% grass cover have been identified as predictors of increased nest success in greater prairie chickens in Missouri (McKee *et al.* 1998 in Millar 1999).

7.3.3 Brood Rearing and Forage Requirements

Grouse chicks require a high-protein diet of primarily insects during the first two weeks of their lives (Bergerud and Gratson 1988). During this critical period chicks cannot thermoregulate and must find optimal foraging habitat within close proximity of the nest site (Bergerud and Gratson 1988). To accommodate the high protein dietary requirements of chicks, broods use a greater variety of plant cover types than nesting hens and prefer warm, more open areas with a higher percentage of forbs and insects (Pepper 1972, Bergerud 1988). During the day, broods typically use less dense cover in the early morning and evening but seek areas of taller vegetation and more dense grass or woody cover at midday (Pepper 1972, Christenson 1970 in Millar 1999, Moyles 1981). Broods benefit from a mosaic of cover types including non-use grasslands, edges of heavily grazed pastures and woody draws (Christenson 1970 in Millar 1999). Roersma (2001) noted that brood rearing sites in the Milk River Ridge area had greater grass cover

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[1] A Visual Obstruction Reading is determined using a Robel pole by recording the lowest 0.5 dm mark visible on the pole. Readings are taken north, east, south and west of the pole at a distance of four meters and at an eye level of one meter (Robel *et al.* 1970).

and reduced litter cover than random sites. After two weeks of age, sharp-tailed grouse are omnivorous and consume fruits, green leaves, buds and insects (Millar 1999). Food is not considered limiting to grouse populations or breeding densities (Bergerud 1988).

7.3.4 Roosting and Winter Cover

When snow conditions permit, sharp-tailed grouse will tunnel into snowdrifts to shelter from strong winds and severe winter temperatures (Millar 1999). Woody cover including aspen bluffs and shrubby or riparian hardwood draws also provide essential thermal cover for grouse during cold winters as well as concealment from predators (Swenson 1985, Giesen and Connelly 1993). Moyles (1981) concluded that a mosaic of plant communities including native grassland –shrub mixtures with extensive ecotone, provides optimum sharp-tailed grouse habitat.

7.4 Grazing Management and Sharp-tailed Grouse Habitat Enhancement

Several studies have examined the effects of various grazing systems on the habitat needs and reproductive success of sharp-tailed grouse (Kobriger 1980, Mattise *et al.* 1981, Nielsen 1981, Grosz 1985, Sedivec *et al.* 1990, Kirby and Grosz 1995). No one grazing system was unanimously preferred. Stocking rate and the timing and distribution of cattle are considered decisive factors influencing the potential benefits or detriments of each grazing system (Table 4.5).

Table 4.5 Grazing Systems and Sharp-tailed Grouse Habitat Enhancement: A Comparative Evaluation

Grazing System	Discussion
Continuous (Season-Long) Grazing	
Advantages:	Under moderate stocking rates, continuous grazing often leads to patch grazing effects in fescue prairie and to a lesser extent in mixedgrass prairie, with areas that are consistently reused and areas that receive little use. Patch grazing is typically the result of continuous grazing where forage supply exceeds livestock demand (Spedding 1971). Variably grazed patches help to create a heterogeneous habitat mosaic. Ungrazed or less used patches offer suitable nesting, roosting and escape cover. Grazed patches will typically stimulate increaser forb growth and may offer microsites for insect production. Studies have shown that grasshoppers are more numerous in more heavily grazed areas as most grasshopper species prefer ranges with sparse grass stands and a high forb component (Holmes *et al.* 1979, Holecheck *et al.* 1995). The shorter vegetation of grazed patches near to taller thicker cover is ideal foraging habitat for grouse chicks that may otherwise be inhibited by dense vegetation or thick litter. Roersma (2001) noted that brood rearing sites had less litter cover than random sites in the Milk River Ridge area. Kobriger (1980) recommended season-long grazing at moderate stocking rates that allow a 50% utilization rate as a strategy to prevent uniform grazing and promote vegetation heterogeneity for sharp-tailed grouse in mixedgrass prairie of North Dakota. Nesting hens in this study demonstrated a preference for grassy upland habitats. When quantity and quality of surrounding grasslands was low, grouse were observed to nest in shrubby lowland draws. Mattise *et al.* (1981) noted that the average height and density of vegetation was significantly greater in their season-long gazing system compared to their deferred-rotation system. In this study, conducted in the mixed grasslands of North Dakota, grazing rates averaged 2.3 acres per animal unit month, and pasture sizes averaged approximately 605 acres (Mattise *et al.*1981).

Table 4.5 Continued

Grazing System	Discussion
Continuous (Season-Long) Grazing	
Disadvantages:	Continuous grazing under intensive stocking rates can have obvious detrimental impacts to sharp-tailed grouse habitat by creating uniformly heavily grazed conditions. Lack of adequate carry-over and uniform grazing decreases nesting, foraging and escape cover for grouse. In addition, riparian areas are often heavily impacted by persistent cattle use under continuous grazing systems particularly if alternate water supplies or fencing is not in place. Persistent use of riparian areas can eliminate deciduous trees or shrubby vegetation that form an important part of sharp-tailed grouse winter habitat.
Deferred Grazing	
Advantages:	Deferred spring grazing has the obvious advantage of minimizing possible grazing or trampling disturbance to nesting or breeding grouse during a critical time of year. Deferring grazing early in the season, particularly in fescue prairie, would have the added advantage of improved plant vigour and sustained productivity (Willms and Fraser 1992). Pepper (1972) suggests that the carrying capacity for sharp-tailed grouse is limited by the availability of large acreages of ungrazed grass-shrub and hayland within 1.6 km of a lek. Deferred spring grazing would therefore provide grouse with ungrazed or lightly grazed areas within proximity to the lek during the nesting season (Millar 1999). Deferred spring grazing was found to be mutually beneficial to livestock, waterfowl and sharp-tailed grouse production in a study conducted at the Central Grasslands Research Center in south central North Dakota (Kirby and Grosz 1995).
Disadvantages:	The potential advantages of deferred grazing for enhancing sharp-tailed grouse habitat depend on the period of deferment, the intensity of grazing and the degree of carry-over that remains after the grazing season. Grazing later in the season could affect the amount of cover available to grouse early the next season if grazing is intense and residual carry-over material is not retained.
Complementary Grazing	
Advantages:	As with deferred grazing systems, complementary grazing allows for undisturbed residual nesting cover and limits disturbance to grouse during nesting and brood-rearing. Deferred grazing pressure early in the season, as mentioned, can improve the health, productivity and sustainability of fescue grasslands in particular. Based on the results of a six year study, Prescott and Wagner (1996) concluded that complementary grazing in combination with rotational grazing improved range condition, grass yields and litter reserves in native prairie. These improvements were noted to provide a mosaic of habitats suitable for a wide spectrum of upland nesting birds.
Disadvantages:	Complementary grazing is particularly beneficial if existing cropland or hayland can be converted to permanent cover grassland pasture. However, if a complementary grazing system is established by converting native prairie, the benefits of this system may be outweighed by the loss of higher quality native habitat (Pepper 1972, Prescott and Wagner 1996). The value of seeded pasture as sharp-tailed grouse habitat is dependent on the size of the pastures in relation to surrounding native prairie and the amount of woody vegetation that is retained (Pepper 1972, Moyles 1981, Swenson 1985).

Table 4.5 Continued

Grazing System	Discussion
Season-of-use Grazing	
Advantages:	Season-of-use grazing has good potential to enhance sharp-tailed grouse habitat for ranching operations that encompass mixedgrass and fescue prairie. The best season-of-use for mixedgrass prairie is in late spring and early summer, while fescue grassland benefits from later season grazing in late summer, early fall or winter. This type of grazing operation would likely result in improved range condition and would have the potential to provide good quality undisturbed residual nesting cover early in the season (Pepper 1972, Giesen and Connelly 1993, Millar 1999).
Disadvantages:	As with all other grazing systems, the stocking rate and percentage of vegetation utilization will influence its benefit to range condition improvement and grouse habitat enhancement.
Rotational Grazing (General)	
Advantages:	Rotational grazing systems including switchback, deferred-rotation and rest rotation grazing allow for timed sequences of grazing and rest periods in smaller sized pastures (Holecheck *et al.* 1995). Rotational grazing reduces selective grazing by encouraging use of plant groups differing in their season of growth and allows for seed production, seedling establishment and restored plant vigour (Adams *et al.* 1991). Enforcing periods of rest allows undisturbed areas with residual vegetation to be retained and thereby promotes nesting habitat for sharp-tailed grouse. Periods of rest are also beneficial to minimizing disturbance to grouse during critical periods. Rest periods and periodic deferred early-season grazing can also promote the recovery of riparian areas and riparian plant communities that would otherwise receive consistent heavy grazing pressure. Riparian plant communities are important foraging, winter and escape cover for sharp-tailed grouse.
Disadvantages:	A noted disadvantage due to rotational grazing, is the creation of uniform grazing effects due to improved cattle distribution. Uniform grazing effects are accentuated when high stocking rates are used, forcing cattle to use the entire area available for grazing. As sharp-tailed grouse favour a mosaic of vegetation structure to provide them with suitable shelter, nesting and foraging habitats, uniform grazing effects can be detrimental to their productivity and survival. The creation of uniform grazing effects can be controlled if stocking rates are reduced.
Deferred and Rest-Rotational Grazing	
Advantages:	Deferred-rotational grazing was recommended over other types of grazing systems as an effective means of providing upland bird nesting cover while also optimizing beef production per acre in two comparative studies in the mixedgrass prairie of North Dakota (Sedivec *et al.* 1990). Sedivec *et al.* (1990) found the greatest number of grouse nests (51%) in the twice-over deferred-rotation grazing system. (Twice-over refers to All nests that were found during this study were initiated before the grazing season began (fourth week in May) or were in ungrazed pastures during rotations (Sedivec *et al.* 1990). Deferred-rotation pastures were grazed at a stocking rate of 2.7 AUM/ ha in this study. Sedivec *et al.* (1990) recommended deferred-rotational grazing as a means of promoting the maximum amount of undisturbed cover available for nesting upland birds until early July. In a similar study, Grosz (1985) also recommended twice-over deferred-rotational grazing to promote nesting cover for grouse. Twice-over deferred-rotation pastures promoted nesting habitat as they had 60 percent of the vegetation in Visual Obstruction Readings (VOR's) of 1.5 dm or greater (Grosz 1985). Grosz (1985) found 70 percent of the nests in his study were located in vegetation with a VOR of 1.5 dm or greater.

Table 4.5 Continued

Grazing System	Discussion
Deferred and Rest-Rotational Grazing	
Disadvantages:	Kobriger (1980) suggests that deferred-rotational grazing contributes to uniform grazing effects as cattle are often grazed beyond the 50 percent utilization point. This occurs when movement between pastures is based on calendar dates and not vegetation utilization. Nielsen (1981) noted that at high stocking rates, rest-rotational grazing can concentrate grazing effects and reduce the cover value of woody draws and reduce nesting cover close to leks. Nielsen noted that despite heavy grazing pressure, grouse did not move from their traditional use areas. Nielsen concluded that despite the benefits of better quality habitat in the rest pasture, these benefits may not exceed the harmful effects of the intensive grazing on the other three pastures as grouse did not adjust their use areas in relation to changing grazing pressures.
Intensive Grazing	
Advantages:	Seasonal intensive grazing can be beneficial if it occurs in an area of low quality or low use sharp-tailed grouse habitat (such as seeded pastures), and it is used to defer spring use of other native fields with lek sites.
Disadvantages:	The negative impacts of overgrazing and intensive grazing by cattle on sharp-tailed grouse habitat are well documented (Sisson 1970 in Millar 1999, Pepper 1972, Nielsen 1981, Giesen and Connelly 1993). Intensive livestock grazing for prolonged periods or early in the season is harmful to sharp-tailed grouse habitat by reducing necessary cover for nesting, shelter, roosting and winter foraging. Excessive trampling, grazing and browsing near to leks and riparian areas is especially detrimental to grouse habitat. High stocking rates are particularly damaging to fescue grasslands.
Riparian Area Grazing	
Advantages:	Grazing systems that are designed to control and minimize livestock impact of riparian areas will have benefits to improving sharp-tailed grouse habitat (Refer to Section 6.7). Reduced pressure on riparian areas with forests and shrubs will provide higher quality fall and winter cover and foraging habitat for grouse. Pepper (1972), Moyles (1981), Nielsen (1981), Swenson (1985) and Giesen and Connelly (1993) all comment on the importance of protecting riparian areas from excessive overgrazing by livestock due to the importance of riparian area shrubs and trees as grouse habitat. Grazing systems that benefit riparian health limit cattle use of riparian areas during their most vulnerable periods, including spring when stream banks are soft, and autumn when riparian vegetation is more palatable than upland vegetation.
Disadvantages:	Riparian grazing systems depend on planning fencing and placement of alternate water sources concentrate cattle use close to leks or in suitable nesting habitat early in the season.

7.5 Beneficial Management Practices Summary

Final decisions regarding the type of grazing system and calculation of suitable stocking rates that would best benefit sharp-tailed grouse need to be made on a case by case basis. Local conditions need to be considered including vegetation type, range condition and health, distribution of valued habitat components, and dispersion of lek sites across the landscape. No one grazing system can be universally applied, and each must be tailored to local environmental conditions (Guthery 1995 in Millar 1999). Control and flexibility over stocking rates and dispersion of livestock use are two key properties of an optimum grazing system (Guthery 1995 in Millar 1999).

All grazing systems designed to enhance sharp-tailed grouse habitat should recognize the importance of native grass and shrubs as critical habitat components for maintaining viable grouse populations. In addition, monitoring and managing lek sites and surrounding nesting habitat should be a priority. A "breeding complex" encompassing all land within a 2 km radius of a lek was recommended as the management unit for Columbian sharp-tailed grouse (*T. p. columbianus*) (Giesen and Connelly 1993). For the Milk River Ridge, Roersma (2001) suggests a management unit referred to as the "total nesting area", an area that encompasses all nests associated with a lek. Roersma (2001) calculated the average total nesting area for five leks to be 148.1 ha.

The beneficial management practices summarized below are recommended to protect critical sharp-tailed grouse habitat components in the Milk River Drainage area and prevent disturbance to grouse during critical periods.

- Limit disturbance within a minimum 148 ha total nesting area around leks during the breeding and nesting season (March to June) (Baydack1987, Giesen and Connelly 1993, Roersma 2001).
- Defer grazing during the spring breeding and nest initiation periods (March to late May) (Sedivec *et al.* 1990, Kirby and Grosz 1995). Where possible, a grazing commencement date of mid-June is recommended to avoid grazing disturbance during breeding, nesting and peak hatching (Pepper 1972).
- Provide sufficient residual grass and shrub cover within the breeding complex (Roersma 2001, Giesen and Connelly 1993, Millar 1999).
- Use an appropriate stocking rate and proper percentage of vegetation utilization to ensure sufficient carry-over and maintained plant vigour and range condition (Pepper 1972, Kobriger 1980, Mattise *et al.* 1981). Apply light to moderate stocking rates, and a proper use factor of 40% and 50% for fescue and mixedgrass prairie, respectively (Willms pers. comm.).
- Make seasonal adjustments in stocking rates based on fluctuations in precipitation and time of use and range condition.
- Avoid intensive, high stocking rate grazing systems and discourage uniform utilization of pastures (Pepper 1972, Sisson 1975 in Millar 1999, Kobriger 1980, Mattise *et al*. 1981).

- Create heterogeneous habitat with areas of varying range condition, species diversity and a gradation of short to tall and dense to light residual vegetation and litter cover (Sisson 1975 in Millar 1999, Kobriger 1980).
- Encourage periods of rest and defer early-season grazing in fescue prairie to improve range condition (Grosz 1985, Sedivec *et al.* 1990).
- Base rotational grazing systems on percentage of vegetation utilization and not scheduled calendar dates (Kobriger 1980).
- Convert cropland to permanent cover seeded pasture and implement complementary grazing where practical (Prescott and Wagner 1996).
- Manage livestock grazing in riparian areas to protect riparian shrubs and deciduous trees (Pepper 1972, Moyles 1981, Nielsen 1981, Swenson 1985 and Giesen and Connelly 1993); Refer to Section 6.7.
- Retain shrubby and woody draw vegetation mosaics across fields and within the total nesting area (Moyles 1981, Roersma 2001).
- Fence out or minimize livestock use in woody vegetation considered to be critical grouse wintering habitat (Goddard 1995).
- Develop strategic permanent salting locations away from leks, stockwater and woody draws. Continuously move salt throughout the grazing season.
- Monitor and maintain records of active leks and range condition as well as yearly grazing records including livestock numbers, class, breed, take-in and take-out dates.
- Reclaim disturbed native vegetation where possible and revegetate heavily impacted riparian corridors or woody draws.
- Use flushing bars and delay mowing of haylands within 1.6 km of active leks until mid-July to allow nesting hens with broods to fledge successfully (Goddard 1995).
- Practice zero tillage of croplands and retain stubble fields within 1 km of woody draws or breaks to provide grouse with an alternate winter food supply (Giesen 1985, Goddard 1995).

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

1.0 CONCLUSION

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Year 1 of the Milk River Basin Species at Risk Project has been completed. The project began as a concept within Alberta's Habitat Stewardship Program Committee, and was designed jointly by Alberta Fish and Wildlife and Alberta Conservation Association biologists. It has been delivered through a concerted effort involving permanent and project staff of Alberta Conservation Association and Alberta Fish and Wildlife Division, plus private biologists in the disciplines of wildlife, fishery, and range science. Certain components of the project have been subjected to review in the developmental stage, but this report represents the first distribution of comprehensive project results.

Conceptually, the Milk River Basin Species at Risk Project strives to demonstrate a practical approach to management of multiple species at risk on a definable landscape. The selection of the Milk River drainage basin was appropriate due to its being a workable sized land unit, defined using an adequate geographic criteria. The presence of a large number of species at risk (At Risk, May be at Risk, and Sensitive designations) on the landscape, plus the presence of significant blocks of natural habitats, combined to provide an attractive demonstration area for Alberta's first multi-species initiative for species at risk.

From the April 2002 scoping phase it was evident that data on many important species was lacking, and this information led to the design of an inventory component for immediate use in the project. Species at risk surveys initiated in spring 2002 and continued until late fall. Fisheries inventories included continuation of a Milk River fish species at risk survey (western silvery minnow, St. Mary sculpin, stonecat, sauger), and a fish refugia inventory (brassy minnow). There were also surveys for amphibians (great plains toad, plains spadefoot, northern leopard frog), reptiles (prairie rattlesnake, bullsnake, western painted turtle, eastern short-horned lizard), and birds (aerial survey for raptors, ferruginous hawk quadrats, loggerhead shrike). Many interesting and useful results are summarized in the preceding chapters, including range extensions for amphibian and fish species, valuable information on raptor nesting habitat, and critical data on amphibian habitat associations.

Through a species selection process that recognized the importance of habitat structure, ecological tolerances, species assemblages, keystone species, and affiliation with native habitats, a total of 17 project management species were selected. These species included 7 birds, 5 mammals, 2 reptiles, 2 amphibians, and 1 invertebrate.
HSI models have been developed for 15 of the 17 project management species, 5 of which are displayed in this report. The models' variables are based upon digital map databases available for the Milk River Basin. While this presented a disadvantage in that some variables were not represented in digital map databases (*e.g.* individual trees for the ferruginous hawk model), it enabled the production of GIS maps showing categorized areas of suitability across the Milk River Basin. The availability of draft maps demonstrating preliminary models was very useful for review by the project team, some

of whom had a working knowledge of landscape characteristics and the modeled species' distribution across the basin. This, combined with consultation with experts on each species and a team HSI modeling workshop, allowed for an iterative model building process. Five of the HSI maps are displayed in this report.

In managing for species at risk, it is important to understand land management practices that are compatible with them. This requires a review of natural processes existing on the landscape, plus a summary of management systems available, and evaluation of them for application to each species or species group. This summary of "beneficial management practices" was scheduled for year two of the project; however, resources were attained to initiate a pilot demonstration late in year 1. The review was carried out on sharp-tailed grouse, a prairie species categorized as sensitive in Alberta. A wide array of possible range management systems was demonstrated and insight was provided into the relative effectiveness of each for sharp-tailed grouse. This pilot project has been expanded to develop beneficial management practices for the burrowing owl, which will be completed and circulated for an expert review early in year 2.

In conclusion, year 1 of the project has demonstrated that a multi-species approach to species at risk is feasible on a drainage-basin landscape. Year 2 will concentrate on completion of species inventories, model and map refinement, use of the information for prioritization of the landscape, and initiation of stewardship activities.

2.0 RECOMMENDATIONS

A number of recommended activities have been derived from year 1 of the Milk River Basin Species at Risk Project. These include tasks to be performed in year 2 and beyond; some recommended activities which will be delivered through means other than the project, and extension activities such as the development of guidelines and educational materials. A summary of project recommendations follows.

1. Priority areas for conservation and stewardship of species at risk should be identified in 2003-2004. This will be achieved by:
    - Completion and refinement of habitat suitability models for the 17 project management species.
    - Continued search for, and compilation of, observation records for At Risk, May be at Risk, and Sensitive species.
    - Completion of the Milk River drainage basin maps showing potential habitat for each project management species.
    - Overlay of maps to determine landscape "hot spots", representing areas of relatively high potential habitat for several species at risk.
    - Inclusion of areas already identified as high priority for species at risk through other projects (*e.g.* sage grouse, western blue flag, soapweed, pronghorn).
    - Mapping and inclusion of identified fish refugia areas as critical habitat for aquatic species.

2. Stewardship implementation should begin in prioritized areas. This will be achieved through increased activities during fall-winter 2003-2004 to influence land and resource activities in the Milk River Basin, including:
   - Presentation of priority landscape areas and beneficial management practices to conservation organizations active in the area, including (but not necessarily limited to) Alberta Conservation Association, Nature Conservancy of Canada, Ducks Unlimited Canada, and the Cows and Fish Program.
   - Information exchange at multi-stakeholder forums including the Grassland Conservation Working Group, Prairie Conservation Forum, and the Northwestern Great Plains Conservation Initiative.
   - Participation in development stages of cooperative voluntary stewardships, where these opportunities arise (*e.g.* range management plans, more detailed beneficial management for specific lands).
   - Increased notification and involvement of public lands managers in the Milk River Basin, in particular, the Public Lands Division of Alberta Sustainable Resource Development, and Provincial Parks Service of Alberta Community Development.
   - Increased communication with private land managers (landowners, grazing associations), through individual contacts, distribution of the Year 1 Project Report, and possibly through direct public information approaches such as a media release and an open house information session.
   - Production of a small booklet summarizing the Milk River Basin Species at Risk Project, and encouraging voluntary participation in cooperative stewardship activities.

3. The reviews and summaries of "beneficial management practices" should be completed for the remaining 16 project management species. In order to complete this component of the project within time and budget constraints, some remaining species may be grouped based on overlapping habitat associations, as follows:
   - Ferruginous hawk, prairie falcon, Richardson's ground squirrel, and American badger
   - Prairie rattlesnake and eastern short-horned lizard
   - Western small-footed myotis and Weidemeyer's admiral butterfly
   - Long-billed curlew and Sprague's pipit
   - Great plains toad and plains spadefoot
   - Olive-backed pocket mouse
   - Loggerhead shrike
   - Swift fox
   - Burrowing owl
   - Fish refugia areas along tributary streams

4. In addition to "beneficial management practices", a summary of existing "land use guidelines" will be initiated for the 17 project management species or groups of these species, plus for fish refugia areas. This will be used towards a Year 3 summary of existing guidelines, plus, where needed, recommendations for additional land use

guidelines to protect Milk River Basin species at risk from direct and secondary impacts of various land use developments (*e.g.* roads, oil and gas wells, pipelines, water diversions).

5. A general land use guideline reflecting the importance of ephemeral wetlands to plains spadefoot and great plains toads will be prepared. It will recommend avoidance of excavation activities on, or adjacent to, ephemeral wetlands. In the Milk River Basin these are dry and difficult to identify during most years, but they represent a dormant habitat of high biodiversity and a priority area for species at risk management on the prairie landscape.

6. Fish and Wildlife inventories of species at risk for which data is lacking should continue in 2003-2004. These should include:
   - BIRDS:
     - Spring 2003 monitoring of ferruginous hawk nesting success in the North Milk and Milk River valley upstream of Milk River townsite, plus monitoring of provincial ferruginous hawk quadrats within the Milk River Basin.
     - Spring 2003 surveys of loggerhead shrike in quadrats established in 2002, plus completion of roadside surveys as part of the North American loggerhead shrike inventory.
     - A spring inspection of three historic peregrine falcon nest sites.
     - Completion of spring long-billed curlew provincial monitoring transects located within the Milk River Basin.
     - A spring shoreline search of the Milk River Ridge Reservoir for nesting piping plover.
     - Sage grouse and sharp-tailed grouse lek surveys in spring 2003 (these are carried out as management activities by Alberta Fish and Wildlife and Alberta Conservation Association, and are independent of this project).
   - MAMMALS:
     - A survey, using call-playback, of Richardson's ground squirrel, on newly established provincial monitoring blocks within the Milk River Basin.
     - A spring-summer-fall collection of owl pellets, and subsequent laboratory analysis of small mammal remains to help determine occurrence of olive-backed pocket mouse and other small mammals in the Milk River Basin.
     - Education of project staff, through consultation with University of Calgary researcher Corey Lausen, on basic inventory techniques for western small-footed bat, and initiation of opportunistic surveys, in cooperation with Ms. Lausen, in areas identified to be HSI Suitable/Highly Suitable.
   - FISH:
     - Summer-fall field inspections to locate and map fish refugia in the Milk River Basin.
   - REPTILES:
     - Summer surveys of eastern short-horned lizard at historic observation sites and areas identified as HSI Suitable/Highly Suitable.

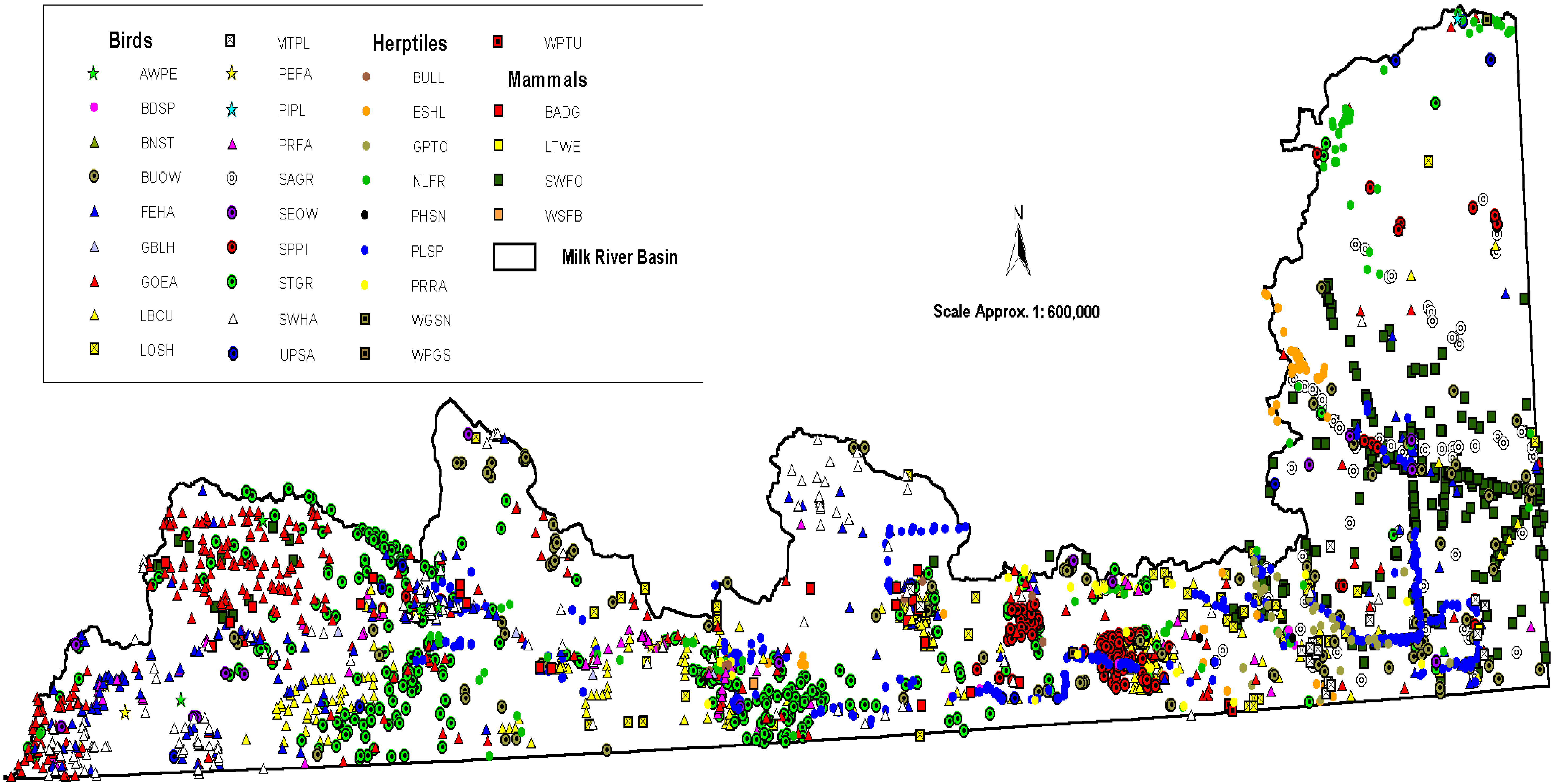
    - A prairie rattlesnake and bullsnake hibernacula inventory in spring and fall 2003.
    - A late-spring inventory to determine occurrence of western painted turtle in oxbow ponds adjacent to the lower Milk River.
- AMPHIBIANS:
    - Spring 2003 call surveys for great plains toad and plains spadefoot on a small subsample of the ponds identified in 2002, plus, if precipitation conditions are suitable, at locations at the west end of the basin where neither species was found in 2002.
    - Spring 2003 searches for northern leopard frog egg masses, and late summer frog inventories in existing and historic habitats.
- INVERTEBRATES:
    - Sponsorship of a field entomologist to carry out summer searches for Weidemeyer's admiral butterfly in areas identified to be HSI Suitable/Highly Suitable.

7. HSI models that have been prepared, some of which are displayed in this report, should be considered preliminary for one year, during which they will be subject to review and potential amendments. Each model will be circulated to experts for scrutiny during this review period.

8. Each HSI model will also be reviewed to identify potential research activities that could verify assumptions regarding selection of variables, thresholds, and formulas. These potential research activities will be prioritized and provided to interested researchers to encourage improvement of knowledge of habitat associations of species at risk. Anticipated projects could include studies on distribution and habitat associations of individual species, responses of species and species groups to changes in land management practices, and the development of resource selection functions based upon wildlife habitat use studies.

Appendix T

Summary of Species at Risk in the Milk River Basin


Birds
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SEOW
SPPI
STGR
SWHA
UPSA
Herptiles
BULL
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NLFR
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PLSP
PRRA
WGSN
WPGS
WPTU
Mammals
BADG
LTWE
SWFO
WSFB
Milk River Basin
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Scale Approx. 1: 600,000

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