

DO SAGE-GROUSE HAVE A FUTURE IN CANADA? POPULATION DYNAMICS AND MANAGEMENT SUGGESTIONS

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Abstract: Sage-Grouse (*Centrocercus urophasianus*) populations have declined by 45 to 80% throughout their North American range. The species currently exists at the northern fringe of their range, on the mixed grass prairie of southeastern Alberta and southwestern Saskatchewan. The population decline in Canada has been the most severe, with declines ranging from 66 to 92% over the last 30 years. There has been relatively little research in Canada to address the population decline. I used radio telemetry to monitor Sage-Grouse survival and measure productivity in southeastern Alberta in 1998 and 1999. Survival of both females and males was low. Reproductive effort was high, with all females attempting to nest and clutch size within the expected range. Nest success was also within the normal range, and 55% of all females were successful breeders. Chick survival was only 18%; less than half of that required for stable and slightly declining populations. I used these data to develop a preliminary population model to predict the long-term viability of Sage-Grouse in Canada. My model predicts that by 2018, the Canadian Sage-Grouse population will decline to fewer than 190 birds, which may not be sufficient to maintain a viable population. I quantified habitat characteristics to understand how habitat variables might influence these parameters, and thus, the population decline. Sage-Grouse selected nest areas based on sagebrush stands that provided greater amounts of tall cover, specifically sagebrush, with nests located under the tallest and densest sagebrush within these stands. Brood rearing sites were also selected for based on sagebrush characteristics, but not based on forb availability, as has been demonstrated for other populations. High quality mesic areas containing lush forbs important in the diet of chicks are limiting in southern Alberta. Management practices need to focus on the fact that small fluctuations in chick survival can have profound implications on population trends. Efforts should be made to maintain, or preferably, enhance suitable breeding and nesting habitat, while attempting to enhance brood rearing habitat through the protection and creation of mesic habitats with high forb availability.

INTRODUCTION

In this manuscript, I review some of the recent literature dealing with understanding the reasons for the decline of Sage-Grouse (*Centrocercus* spp.) populations throughout

North America. I provide an overview of currently submitted publications dealing with my recent research to address population declines in Canada, and then bring together data from these studies to develop a population model. I discuss the inherent parameters, and use the model to

make predictions about the viability of Sage-Grouse in Canada.

Sage-Grouse (*Centrocercus urophasianus*) across their range have experienced declines ranging from 45 to 80% since the 1950s (Braun 1998) with declines averaging 33% from 1985 to 1995 (Connelly and Braun 1997). The historical declines are attributed to human induced reductions in sagebrush (*Artemisia* spp.) habitats, with the sagebrush steppe ecosystem being reduced by 2.5 million ha since the early 1900s (Braun 1995, Braun 1998, Schroeder et al. 1999). However, many other factors have altered and fragmented current habitat and may also have contributed to recent population declines. These include domestic livestock grazing, construction of roads, highways, fences and power lines, and a variety of natural changes [reviewed by Braun (1998) and Schroeder et al. (1999)]. Although these changes affect all aspects of Sage-Grouse life history, variation in productivity has been proposed as the most important factor regulating all grouse populations (Bergerud 1988). In some populations, survival has remained relatively constant, while productivity has declined; as for Sage-Grouse in Oregon (Crawford and Lutz 1985). Thus, most research on grouse has focused on the relationship between measures of productivity and population dynamics (Bergerud 1988, Schroeder 1997, Schroeder et al. 1999). More recently, there have been attempts to relate productivity to measures of habitat quality (Schroeder 1997; Sveum et al. 1998a, 1998b; Schroeder et al. 1999).

Research has shown that Sage-Grouse population declines are related to reduced nest success (Schroeder 1997, Braun 1998, Schroeder et al. 1999), with stable populations having high nest success (35-86%) (Dalke et al. 1963, Schroeder et al.

1999). However, the same factors that affect nest success, may also affect chick survival and juvenile overwinter survival (recruitment). Little research has been conducted to address issues such as chick survival, primarily due to difficulties in estimating brood size, and technological limitations making it difficult to affix radio transmitters to juvenile birds.

Sage-Grouse are associated with big sagebrush (*A. tridentata* sspp.) throughout most of their range; however, the dominant species in Canada is silver sagebrush (*A. cana*) (Aldridge 2000). Silver sagebrush is not as tall or as dense as big sagebrush and, thus, does not provide the same extent of cover for nesting or escape from predators. Nest success is higher in areas containing big sagebrush (Wallestad and Pyrah 1974, Connelly et al. 1991, Gregg et al. 1994, DeLong et al. 1995). As a result, the apparently lower quality habitat at the northern fringe of the species range in Canada may limit the population, which might cause larger fluctuations in productivity than in core populations.

Greater Sage-Grouse (*C. urophasianus*; here after referred to as Sage-Grouse) in Canada have declined by 66-92% from historical numbers recorded over the same area in the late 1960s in Alberta and the mid 1980s in both Alberta and Saskatchewan (Aldridge 2000). The 1999 spring population for Alberta is estimated at 420-622 individuals, and the Canada population at 813-1204 individuals (Aldridge 2000). With the current rate of decline, the population will reach non-viable levels, increasing the threat of extinction in Canada.

I compiled productivity (Aldridge and Brigham 2000b) and survival data (Aldridge 2000) for Sage-Grouse from southern Alberta in 1998 and 1999 to develop a

preliminary population model to predict future population trends (Aldridge 2000). Below, I discuss the parameters inherent in this model, and discuss some of the key intrinsic factors (i.e. density dependence and genetic heterogeneity) and extrinsic factors (i.e. climate) that may be regulating this population. From the model, I predict the long-term probability of extinction of Sage-Grouse in Canada. I discuss some potential management options that might elevate some of the most limiting parameters in the model, and potentially reverse the population decline.

THE MODEL

Population estimates were determined for historical lek counts performed on the Alberta Sage-Grouse population (Aldridge 2000). These estimates are based on spring counts of males at leks, and the low estimate assumes a spring sex ratio of two females for every male (Schroeder et al. 1999, Aldridge 2000); whereas the high estimate assumes the same sex ratio, but also takes into account the potential that only 90% of all leks are located and that only 75% of

males attend leks at any given time (Aldridge and Brigham 2000a).

The parameters incorporated into this model include estimated survival rates from radio-marked males and females (Aldridge 2000), clutch size, egg viability, breeding success (includes nesting success, and renesting attempts), and chick survival (Aldridge and Brigham 2000b; Table 1). The female survival estimate is only from spring to fall, and annual survival may not be as high if overwinter mortalities are considered. In addition, survival estimates for this population are also likely slightly underestimated due to the biases associated with radiotelemetry studies (Aldridge 2000). Since there are no data for juvenile overwinter survival in this population, I have assumed that it is 100%, which is unlikely, but conservative. To simplify the model, I have not incorporated any stochastic measures. Thus, all parameters are fixed and do not vary between years when the model is simulated, even though these will likely change from year to year. For any given year (N_t), the subsequent year's population can be predicted as follows:

$$N_{t+1} = EN_{t+1} + \Gamma N_{t+1}.$$

Where: $\Gamma N_{t+1} = (N_{t\Gamma} \times \Gamma_{\text{surv}}) + ((N_{t\text{ recruit}})/2)$ and

$$EN_{t+1} = (N_{tE} \times EB_{\text{surv}} \times E W_{\text{surv}}) + ((N_{t\text{ recruit}})/2) \text{ and}$$

$$N_{t\text{ recruit}} = N_{tE} \times EB_{\text{surv}} \times EW_{\text{surv}} \times Cl_{\text{size}} \times H_{tc} \times Br_{\text{succ}} \times ChFl_{\text{surv}} \times ChW_{\text{surv}}$$

See Table 1 for an explanation of model parameters. $N_{t\text{ recruit}}$ is annual recruitment.

Table 1. Parameters used in population model. Overwinter survival of females and chicks was not measured and was set at 100%. Based on 1999 lek count data, low spring population estimates of 140 males and 280 females and high estimates of 207 males and 415 females were used as starting population numbers for the model.

Population Parameter	Variable	Measure
Annual Male Survival	ΓA_{surv}	31.0%
Female Survival (breeding season to fall)	EB_{surv}	56.5%
Female Overwinter Survival (assumed)	EW_{surv}	100%
Clutch Size	Cl_{size}	7.75 eggs/nest
Egg Viability	Htc	92%
Breeding Success (successful nest: 1 st or 2 nd)	Br_{succ}	54.5%
Chick Survival to Fledge (50 days)	$ChFl_{\text{surv}}$	18%
Chick Overwinter Survival (assumed)	ChW_{surv}	100%

To test whether the model reflects the actual population trend over the past 30 years in Alberta, I ran the model using the 1968 high and low population estimates as the starting point (Fig. 1) (see Aldridge and Brigham 2000a for a detailed description of how population estimates are derived). I let the model run from 1968 to 1999. Assuming that the measured population parameters represent the mean for each of those parameters over the course of the population

decline (≈ 30 years), predicted population numbers from the model should closely follow the actual population estimate based on lek counts for each year (Fig. 1). Actual population estimates fluctuate consistently around the model generated population numbers, suggesting that the population parameters that I measured in 1998 and 1999 are generally representative of the population over the last 30 years.

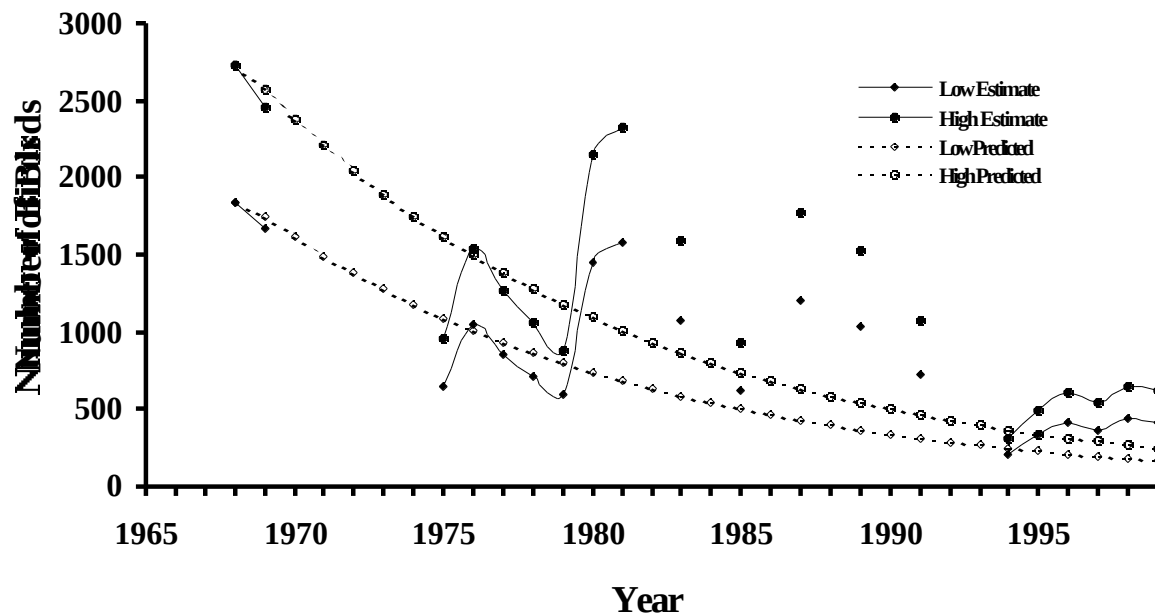


Figure 1. Actual Sage-Grouse population size in Alberta based on lek counts for 1968 through 1999 shown with the predicted population superimposed. Predicted population size is based on survival and productivity data measured in 1998 and 1999. Years when sampling efforts consisted of less than eight leks surveyed are not included. This model starting point is based on the population size in 1968. Lines are drawn to illustrate trends between years with consecutive lek counts, and to show the predicted population trend.

I iterated the population model 31 years into the future, from 2000 to 2030, to examine future Sage-Grouse population status for Alberta (Fig. 2). I used both high and low population estimates in 1999 as starting points. From these data, I predict the Alberta spring population will decrease from between 420 and 622 individuals in 1999 to

between 397 and 589 individuals in 2000. Thus, lek counts should decrease from 140 males in 1999 to approximately 132 males in 2000. I have chosen to just show Alberta data here, for ease of interpretation. However, this model can also be applied to the entire Canadian population by combining 1999 lek counts from both Alberta and Saskatchewan.

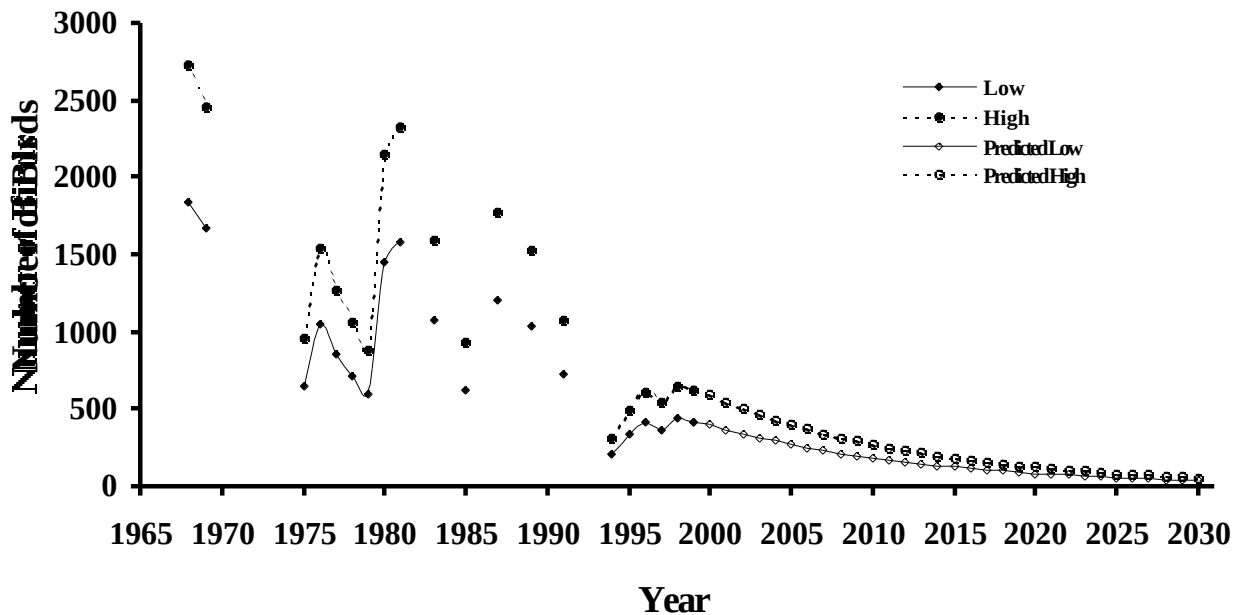


Figure 2. Actual Sage-Grouse population in Alberta based on lek counts for 1968 through 1999 and predicted population from 2000 to 2030. Years when sampling efforts consisted of less than eight leks surveyed are not included. Lines are shown to illustrate trends for years with consecutive lek counts, and to show the predicted population trend.

The model predicts that the Alberta population will fall below 300 individuals by 2004 (Fig. 2). Similarly, the Canadian population will fall below 300 individuals in 2013. By 2018 the Alberta population will decline to less than 100 individuals and the Canadian population will be below 190 individuals.

Based on 1999 productivity and survival estimates, yearlings should represent approximately 49% of the 2000 spring population. However, only 25% of the birds captured over the course of this research were yearlings (Aldridge and Brigham 2000b). To improve the predictive capabilities of my model, some parameters need to be refined, including both adult and chick survival rates. If juvenile overwinter mortality is considered and all other parameters remain constant, juvenile

overwinter survival would have to be as low as 40% to obtain a yearling to adult ratio close to 25%. There currently are no data available on juvenile overwinter survival. However, given that adult mortality is high, 40% juvenile overwinter survival may be a reasonable estimate. If I reiterate the model using 40% overwinter juvenile survival, both the Alberta and Canadian populations will be extirpated in less than 20 years.

Even though the cause(s) for the population decline in Canada are not definitively known, I suggest the most likely bottleneck is poor chick survival and low recruitment (see Aldridge and Brigham 2000a). Only 24 of 96 Sage-Grouse captured in 1998 and 1999 in Alberta were yearlings (Aldridge 2000), suggesting that recruitment is low, about 25%. Several long-term studies based on capture data show that about 45% [(44%,

$n = 440$, Dalke et al. 1963) (45%, $n = 3680$, Braun and Beck 1985) (46%, $n = 506$, Wallestad 1975) (48%, $n = 1317$, Beck and Braun 1978)] of birds captured on or around leks in the breeding season are yearlings. This suggests that recruitment is low in Canada, possibly due to low chick survival and/or high overwinter mortality (Aldridge 2000).

It is possible that a lack of genetic diversity due to such low population numbers could be adversely affecting the population. It has been suggested that to maintain genetic diversity, individual populations should consist of at least 500, and maybe even 5000 individuals (Franklin 1980, Lande 1988, Braun 1995). These estimates assume that random mating is occurring and that all individuals in the population obtain mating opportunities. However, with a lek mating system, Sage-Grouse mating is not random. While most, if not all females breed, as few as 10% of males in the population obtain successful mating attempts (Anonymous 1997; C. E. Braun, pers. commun.). This would mean that as few as 14 males would obtain mating opportunities each year in Alberta (based on 140 males counted on leks in 1999, Aldridge 2000).

At any given lek, one dominant male typically performs about 75% of the matings at that lek, and one to three other males will obtain the majority of the other 25% of the matings (Simon 1940, Scott 1944, Wiley 1973, Gibson 1996). Thus, with eight active leks remaining in Alberta, approximately 24 males likely obtain all of the successful mating opportunities. Assuming that 100% of all estimated 280 females mated, the effective population size [$N_e \approx 4(\Gamma \times E)/(\Gamma + E)$] (Ewens et al. 1987) for Alberta would be 88 Sage-Grouse. Similarly, based on 18 active leks and an estimated 542 females in 1999, the effective

population size for the Canadian population would be approximately 196 individuals. Braun (1995) suggested that populations with less than 500 breeding individuals in Colorado were at risk of extirpation. The Canadian population is far below these suggested minimum levels and genetic diversity may be confounding the problem. However, Sage-Grouse have persisted in Alberta with a population likely below 5000 individuals for over 30 years.

Bouzat et al. (1998) found that a population of Greater Prairie-chickens (*Tympanuchus cupido*) in Illinois experienced a decrease in genetic diversity due to recent geographic isolation. This decrease in genetic diversity was associated with a reduction in population fitness, through reduced hatching and fertility rates. This population was below 50 individuals, compared to larger populations with greater than 4,000 individuals that have not experienced decreases in genetic diversity or reductions in population fitness.

Given the current population estimates, the potential exists for a reduction in population fitness due to decreased genetic diversity. Sage-Grouse populations appear to cycle every 7-10 years (Fig. 1) (Patterson 1952, Rich 1985, Aldridge 1998, Braun 1998). Populations in the low part of the cycle may be more susceptible to extinction events, and genetic bottlenecks could easily occur. Egg hatching success for Sage-Grouse in Alberta is relatively high (92%), and suggests that genetic diversity may not presently be a problem in the Canadian Sage-Grouse population. However, low genetic diversity may potentially affect population fitness in other ways, such as reducing chick survival, or make the population particularly sensitive to stochastic events. Sage-Grouse populations in Alberta and Saskatchewan may not be distinct, but a genetic bottleneck

may already be in place, as there is relatively little contiguous habitat between southern populations in Montana, making movements between populations unlikely. Even without considering these potential negative effects related to low genetic diversity, my model predicts the population will approach zero over the next 20 to 30 years.

The cause of the population decline appears to be linked to reduced recruitment as a result of poor chick survival (Aldridge and Brigham 2000b). Mesic habitats that provide protective cover and lush forbs and insects as food resources for chicks are limiting in southern Alberta and this likely related to low chick survival rates (Aldridge and Brigham 2000c). Thus, without suitable habitat management, I predict that the Canadian Sage-Grouse population will continue to decline.

Sage-Grouse productivity appears to be positively correlated with increasing spring (April to June) precipitation (June 1963, Gill 1966, Aldridge 2000). Aldridge (2000) found a correlation between productivity and spring precipitation in Alberta, although the trend is not statistically significant ($P \geq 0.05$). Years with below average spring moisture result in less vegetation growth, likely reducing Sage-Grouse nest success, as well as limiting the availability of lush vegetation important as food for chicks (Martin 1970, Peterson 1970, Johnson and Boyce 1990, Pyle and Crawford 1996, Sveum et al. 1998a). Spring precipitation from 1994 to 1999 in southeastern Alberta was above average and, thus, it has been suggested that Sage-Grouse productivity was above the long-term average. Thus, when spring precipitation is below average, productivity will be adversely affected, further reducing recruitment.

Management practices need to focus on the fact that given normal reproductive effort and reproductive success by Sage-Grouse in Canada, small fluctuations in chick survival can have profound implications on recruitment, and, the population trends. Important mesic habitats are limiting, and competition with cattle for already limited resources may compound the problem, especially in dry years, when abundance of forbs may be even more limiting. Efforts should be made to maintain, or preferably, enhance suitable breeding and nesting habitat, while attempting to enhance brood rearing habitat through the protection and creation of mesic habitats with high forb availability and insect abundance.

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PLAINS ROUGH FESCUE GRASSLAND COMMUNITIES OF THE ALBERTA PARKLAND

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Abstract: The Aspen Parkland is a region essentially restricted to the Canadian Prairie Provinces, reaching its widest point in Alberta. The Parkland is a mosaic of aspen groves in a grassland matrix in the south, grading to aspen forests with restricted grasslands in the north. Prevalent moisture conditions, soils, and topography are conducive to agriculture and much of the Parkland has been converted to cultivated land. Estimates are that between 5 to 10% of native vegetation remains in the region. Plains rough fescue (*Festuca hallii*) grassland communities were a major component of the Parkland matrix. These have been identified by the Alberta Natural Heritage Information Centre (ANHIC) as plant communities of conservation concern due to the restricted nature of their range and the levels of development within it. A project was initiated in 1998 to better define the plains rough fescue plant communities that might be present in the Parkland, where they occur and how much remains. First, existing information was evaluated to develop a preliminary classification of the plains rough fescue community types of Alberta, resulting in eight preliminary community types being identified. Using aerial photographs, native vegetation polygons in the Parkland were mapped, noting any with a significant grassland component. Grassland polygons are now being systematically field checked to document the grassland communities present. Preliminary results of the field checks show that the majority of the remnant grassland communities are not plains rough fescue types, even on sites with habitat and soils that appear to be appropriate. In some cases, an inappropriate grazing regime may have caused a species shift, as plains rough fescue (*Festuca hallii*) is a species that is sensitive to early season grazing. In other cases, the remnants inspected were largely composed of non-native invasive species including smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*).

INTRODUCTION

The Parkland is a Natural Region essentially restricted to the Canadian Prairie Provinces, reaching its widest point in Alberta. Here, the Parkland is a mosaic of aspen groves in a

grassland matrix in the south, grading to aspen forests with restricted grasslands in the north. Prevalent moisture conditions, soils, and topography are conducive to agriculture and much of the Alberta Parkland has been converted to cultivated

land. Estimates are that only between 5 and 15% of native vegetation remains in the region (Alberta Environmental Protection 1997).

Plains rough fescue (*Festuca hallii*) grassland communities are thought to have been a major component of the Central Parkland matrix (Achuff 1994). These have been identified by the Alberta Natural Heritage Information Centre (ANHIC) as plant communities of conservation concern based on the restricted nature of their range and the extensive level of development within it. A project was initiated in 1998 to better define the plains rough fescue plant communities present in the Parkland, their distribution and geographic extent.

PLAINS ROUGH FESCUE COMMUNITY TYPES

Existing information was evaluated to develop a preliminary classification of the plains rough fescue community types that occur within Alberta. The evaluation included a literature review and discussions with knowledgeable individuals. A difficulty that was encountered is the taxonomic changes that have been made to the rough fescue complex. Once often considered varieties or subspecies of rough fescue (*Festuca scabrella*), the complex is now generally accepted as including three separate species (*Festuca altaica*, *F. campestris* and *F. hallii*).

In Alberta, the three species are largely geographically distinct, although there is some overlap in places like the Cypress Hills (Aiken et al. 1996). Northern rough fescue (*F. altaica*) is an alpine and subalpine species of the mountains, generally distributed north of the North Saskatchewan River drainage. Mountain rough fescue (*F. campestris*) is normally found at lower

altitudes, south of the North Saskatchewan River drainage and associated with the mountain front, or with uplands such as the Cypress Hills plateau. Plains rough fescue (*F. hallii*) is the rough fescue most likely to be found in the Grassland and Parkland Natural Regions.

Making the assumption that rough fescue communities documented in the grassland or Parkland are most likely plains rough fescue communities, seven preliminary community types (CT) were identified through the information review. These are briefly discussed below. The first four CTs are upland types and last three essentially slope types. The following brief description of each is taken from Weerstra and Holcroft Weerstra 1998.

1. The Plains Rough Fescue (*Festuca hallii*) CT has been well documented and represents an ungrazed community on mesic sites with Dark Brown or Black Chernozemic soils. Fescue is by far the dominant species, although western porcupine grass (*Stipa curtisetata*) is also usually present.
2. The Plains Rough Fescue - Western Porcupine Grass (*Festuca hallii* - *Stipa curtisetata*) CT occurs on similar soils but slightly drier sites than the plains rough fescue CT. On slopes it is often found above the plains rough fescue CT. Depending on moisture conditions, it can be found on upper, mid or lower slopes. The two main species are co-dominant, although fescue generally has the higher cover. With grazing, western porcupine grass may become dominant.
3. On Dark Brown Chernozems or Solonchic soils, a Plains Rough Fescue-Western Porcupine Grass-Sedge (*Festuca hallii* - *Stipa curtisetata* - *Carex obtusata* - *C. pensylvanica* - *C. stenophylla*) CT occurs. In addition to the main species listed, June grass

(*Koeleria macrantha*) and wheat grasses (*Agropyron* spp.) are always present.

4. On some of the sandy soils in the Central Parkland a Plains Rough Fescue - Sand Grass (*Festuca hallii* - *Calamovilfa longifolia*) CT has been documented. Other prominent grasses are green needle grass (*Stipa viridula*) and early bluegrass (*Poa cusickii*). Creeping juniper (*Juniperus horizontalis*) may have significant cover.
5. Plains Rough Fescue - Green Needle Grass / Forbs (*Festuca hallii* - *Stipa viridula* / forbs) has been documented from only a few locations. It occurs on steep slopes, south-facing in the northern part of the range and north-facing further south. It seems to require submesic to subxeric conditions, and well-drained soils. Prairie sagewort (*Artemisia ludoviciana*) is the most common forb.
6. Plains Rough Fescue – Sedge / Bearberry (*Festuca hallii* - *Carex obtusata* / *Arctostaphylos uva-ursi*) CT is reported to occur, but has not yet been documented in the literature. A similar community dominated by mountain rough fescue is documented for the Montane Natural Region, and it's equivalent with plains rough fescue is thought to occur in the Central Parkland on shallow soils of hilltops and slopes.
7. Plains Rough Fescue - June Grass / Creeping Juniper / Forbs (*Festuca hallii* - *Koeleria macrantha* / *Juniperus horizontalis* / forbs) is found on steep subxeric south to southwest facing coulee slopes and on sandy sites. The dominance of creeping juniper combined with the lack of sand grass or green needle grass separates this CT from the other slope and sand types.

LOCATING PLAINS ROUGH FESCUE COMMUNITIES

The next step in the project is to locate fescue communities and document their composition. This information would be then used to verify or modify the community classification.

Vegetation polygons in the Parkland that appear to be uncultivated were identified through aerial photographic interpretation. Although more automated options were investigated, such as using filtered Landsat 7 coverage, no alternate process was found that could as reliably separate cultivated fields from native grasslands. The uncultivated vegetation polygons were then mapped on a mylar with the IRS satellite imagery as the base. Mapping on the imagery allows more accurate polygon lines and much quicker mapping, as orientation between the aerial photographs and the IRS base is much easier than with a topographic base.

Minimum polygon size was set at 65 ha. The pattern of development in the Alberta Parkland tends to be on a quarter section (approximately 65 ha.) basis, and a test of several map sheets found no significant grassland remnants were missed using this minimum size. Not surprisingly, the main remnant native vegetation occurs in areas with rough topography, such as along steams and rivers and on hummocky moraine, or in areas with less fertile soils such as sand-dominated landscapes.

Polygons with a significant grassland component are now being systematically field checked to document the grassland communities. Few plains rough fescue communities have been located to date. Those that have, seem to confirm the presence of the upland types. Occurrences of the slope types have yet to be confirmed.

Preliminary results of the field checks show that the majority of the remnant grassland communities are not plains rough fescue types, even on sites with habitat and soils that appear to be appropriate. In many cases, the remnants inspected were largely composed of non-native invasive species including smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*).

While there is some evidence that appropriate grazing levels and timing may be beneficial to plains rough fescue by stimulating tillering, studies on the plains rough fescue grasslands of Riding Mountain National Park (Trottier 1986) found that grazing practices can be inappropriate for fescue grassland maintenance. On ungrazed sites, plains rough fescue was the dominant species with dense cover and associated species were almost exclusively native. As grazing levels increased, the cover of plains rough fescue declined and the cover of Kentucky bluegrass increased. On heavily grazed sites, plains rough fescue was either no longer present, or the cover was reduced to less than one third of that on ungrazed sites. Sites denuded of vegetation did revegetate once cattle were removed, but, depending on the site, came back as Kentucky bluegrass, smooth brome, western wheat grass (*Pascopyrum smithii*) or willow-leaved dock (*Rumex mexicanus*).

The preliminary results from field checks of grasslands identified as non-cultivated from aerial photographs indicate that a similar shift from fescue dominated grasslands to others dominated by invasive species or species more tolerant of the predominant grazing patterns may be occurring in the Alberta Parkland.

GETTING AN OVERALL PICTURE OF THE PARKLAND

The polygons of the remnant native vegetation blocks are being digitized and will be used as a data layer in a GIS environment for a project to develop a view of the current state of the Central Parkland. Other data layers include:

- A hydrologic layer developed using filtered IRS satellite imagery in combination with an existing access and hydrography layer.
- A tree layer developed using filtered Landsat 7 technology.
- An existing data layer that has information on urban areas, roads and other developments.

The result will be a more complete picture of the remnant blocks of native vegetation, including the percentage and location of trees and wetlands. Information outside of the mapped blocks on locations of small isolated wetlands or treed pockets would also be included. This will give a more accurate picture than is currently available of the pattern and amount of native vegetation remaining in the Parkland.

CONCLUSION

Remnant polygons of native vegetation have been identified through aerial photographic interpretation and are being digitized. These will be used in a project to document the extent of native vegetation, including wetlands, in the Central Parkland of Alberta. Remnants are being field checked to locate plains rough fescue communities. Fescue communities that are located will be documented to increase our understanding of their composition and improve our preliminary classification of the community types. It is known that something less than 15% of native vegetation remains in the Central Parkland. Preliminary results from this project suggest that, for significant portions of the remnants, plains rough fescue

communities are no longer present, perhaps due in part to grazing regimes that select against plains rough fescue.

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IMPACT OF FIRE SEASON ON DEGRADED TALLGRASS PRAIRIE IN SOUTHERN MANITOBA

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Abstract: Tallgrass prairie is one of the most endangered ecosystems in North America and, today, less than 1% of the original land cover remains. The largest intact tallgrass prairie in Manitoba occurs west of Winnipeg, within the St. Charles Rifle Range (SCRR). While protection is important, it will not guarantee the survival of the tallgrass prairie as it continues to be degraded by fire suppression, over grazing, and invasion by exotic species. Degraded prairie habitat is increasingly being rehabilitated in southern Manitoba. In 1997, a four-year study was initiated that examined the impact of burn season on plant communities found within SCRR. Spring, summer, and fall burn treatments, and a control, were randomly assigned to each side of a central refuge. Three replicates were located in intact prairie, and the other located in a previously plowed area. All treatments were conducted in 1997 and plant community composition was monitored thereafter. Percent cover was recorded for herbaceous plant species using eight 1m x 1m quadrats. Dominant native species found throughout the study area included *Symphoricarpos albus* (snowberry), *Galium boreale* (northern bedstraw), and *Rosa* spp. (rose), while the dominant exotic species were *Poa pratensis* (Kentucky blue grass) and *Bromus inermis* (smooth brome). *Andropogon gerardii* (big blue stem) and *Sporobolus heterolepis* (prairie dropseed) were dominant in intact prairie, but disappeared from plowed areas over time. The greatest overall diversity occurred in fall-burned plots. Woody species including *Populus tremuloides* (trembling aspen), *Salix bebbiana* (beaked willow), and *Amelanchier alnifolia* (saskatoon) were strongly associated with control and spring-burned plots. Graminoid species had the greatest percent cover and diversity in summer burns, while forb species were greatest in fall-burned plots. The similarity in plant species composition among burn treatments increased over the duration of the experiment, but the fall-burned treatment remained distinct. These results suggest that late season burns are effective in rehabilitating degraded tallgrass prairie.

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THE NARCISSE SNAKE TUNNEL PROJECT; CONSERVATION THROUGH CO-OPERATION

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Abstract: The Narcisse Snake Den Area, with its four active hibernacula, is internationally renowned as a unique natural phenomenon representing the world's largest concentration of snakes. In the spring, following breeding, the population of red-sided garter snakes (*Thamnophis sirtalis parietalis*) disperse to spend the summer feeding in marshes and meadows and return to the dens in the fall. A significant migration crosses Provincial Trunk Highway (PTH) # 17 immediately to the west of the Narcisse Snake Den Area. Each fall passing motorists run over and kill as many as 20,000 snakes within this migration corridor. Manitoba Conservation embarked on a program of testing various mortality mitigation techniques with only limited success. In December 1998, the Narcisse Snake Mortality Advisory Group was formed to further study the snake mortality problem and develop a plan to deal with it in an effective and feasible manner. Shortly after the fall 1999 season, the Advisory Group was approached by a group of Manitoba Hydro employees who were familiar with the snake mortality problem and felt that a solution might be achieved by installing 25 B 30 centimeter tunnels under the highway using the Corporation's horizontal boring equipment. After considerable discussion and planning, a co-operative partnership was foraged to test the effectiveness of these smaller sized tunnels. Manitoba Hydro staff, with the assistance of a number of businesses and organizations, installed 4 pipes at various locations in the snake migration corridor. Drift fences were erected to direct snakes to 3 of these tunnels. Their effectiveness was monitored by capturing and counting snakes as they migrated through the tunnels. During the period of September 7th to October 11th, a total of 1387 snakes migrated through the 3 smaller tunnels. The success of the project has prompted Manitoba Hydro and the other project partners to give their strong support for future tunnel installation initiatives.

RED-SIDED GARTER SNAKE DIE-OFF AT NARCISSE SNAKE DEN AREA, NARCISSE, MANITOBA

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Abstract: The red-sided garter snake (*Thamnophis sirtalis parietalis*) hibernacula located in the Narcisse Snake Den Area, are internationally renowned as the largest concentration of snakes in the world. During the spring mating and the fall pre-denning periods in excess of 65,000 snakes congregate at the area's 4 major wintering dens. Each spring, snakes emerge from hibernation and breed in and around the den sites. Prior to emergence in the spring of 1999, several thousand snakes were found dead on the surface of two of the dens. As the spring progressed, only a limited snake emergence was observed, with population numbers well below normal levels. After the normal emergence period had passed and further evidence of a die-off became available, the minor excavation of two of the den bottoms was undertaken. More dead snakes were found below the surface, down to a depth of 0.5 meters. It is believed that these snakes died during the winter of 1998 - 1999 because of a failure to descend below the frost line. While this phenomenon is not well understood, it is speculated that the very high snake population may have exceeded the carrying capacity of these dens. Management of the Narcisse snake population requires a greater understanding of the characteristics of the den structures, as well as an increased knowledge of how environmental conditions influence den carrying capacity.

ECONOMIC VIABILITY OF THE GRAINS INDUSTRY AND IT'S RELEVANCE TO PRAIRIE CONSERVATION

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Abstract: Following a presentation on Settlement and Land Use Policy made by the Author at the 5th PCAESC in Saskatoon some members of the agricultural community challenged the authors statements on the impact of agricultural subsidies by countering that these subsidies were nothing more than “noise in the system.” The author conducted a macro economic evaluation of the impact of subsidies on profitability and land values in Saskatchewan to verify that subsidies to the grains sector ensure its profitability. This paper reviews the original paper and expands on it.

The history of Saskatchewan is steeped in the legend and romance of taming the prairies and creating the “Bread Basket of the World”. The settlement and infrastructure development of the Province of Saskatchewan were largely based on the grain economy. The grain economy has been stimulated by federal government policies and programs. Over the past 100 years federal government subsidies have had a dramatic impact on land use. The removal of almost all of these grain subsidies, the export freight subsidy in particular, resulted in hardships. Current low grain prices have resulted in some demands to reintroduce the transportation subsidy. It begged the question, “Has the grains sector of the Saskatchewan agricultural economy ever been viable? “ The Question is of course rhetorical and meant to perk ones’ interest. The answer is, “Yes it has been but not in much of recent history.”

The author reviewed the historical implications of subsidies and settlement in western Canada and international treaties that forced the removal of subsidies. They then reviewed Canadian Agriculture Census, Saskatchewan Agriculture and Food Statistics and international data from the Organisation for Economic Co-operation and Development (OECD) to determine the real value of the grains sector and its profitability over time (data beginning in 1979) and juxtaposed it with the value of the subsidies paid. The relationship between grain prices and land values was explored. For a 9 year period in the 80s and 90s the grains sector would have been in a negative position if subsidies had not been paid. Land prices were maintained at higher levels than unsubsidised prices would have supported.

The prolonged low levels of profitability observed in recent history indicate that the industry has not been viable without subsidy support. Profitability is related to input costs, a principal one is the cost of land. The author hypothesise that traditional beliefs held by immigrant farmers and their heirs that owning land was a very real form of security has resulted in the capitalization of the value of the subsidies into land values. However, the analysis indicates that the value of land is highly correlated to the value of the commodities produced. High capitalization in land during and following high grain prices makes profitability difficult as the industry restructures in a subsidy free economic environment. The impacts of this new economic reality on habitat conservation in western Canada are discussed and action plans hypothesised.

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1. INTRODUCTION

1.1 Profitability Of Wheat Farming Prior To The 70s

Human activity has always been a part of the prairie landscape. Until European discovery, human populations lived in relative harmony with natural systems. With the settlement of the prairies, radical new views of land use impacted the prairies. Implementation of concepts of private ownership, resource development, wealth generation, majority-rule and nation building resulted in the creation of the country we know as Canada and there is no question that the prairies were changed forever by government policies. Grain farming has been part of the landscape since European settlement began. There is little evidence to

the actual profitability of grain farming early in the settlement period as poor records and statistics were kept. However, one can surmise that it was very profitable. Land was essentially free and input costs very low. Annual weeds were recently introduced

were not widespread and easily controlled with the cultural practices of the time and perhaps most importantly fertility was very high in the virgin soils. Figure 1 graphically depicts the value of wheat (the principal crop) since statistics were kept. Over the past 80 years there appears to have been a general downwards trend in the real value of wheat. Wheat prices have never been higher in fixed dollars than they were early in this century. Early in the century the federal government could have concluded that assistance for prairie farmers was not required. A review of the history of settlement indicated that this was not the decision made.

1.2 Historical Perspective On The Settlement Of The Canadian Great Plains

Canada as part of the British Empire of the 1800's viewed its right to develop the interior of the nation as it saw fit. This view was and still is commonly held throughout much of the world.

During the mid 1800's the government in Ottawa did not originally know what to do with the western portion of Canada then known as Rupert's Land. For the most part these "fur trading lands" were viewed as of little value. The first investigation into the potential of western Canada began with John Palisser who surveyed the Great Plains to assess their agricultural value from 1857 to 1860. His reports were published in 1859, 1860 and 1863. His travels through western Canada took place during a period of drought. Possibly as a result of this he determined that the limitations to agricultural development were very restrictive and he recommended against settling farmers on the Great Plains. This area of the Canadian Great Plains is still known as "Palisser's Triangle."

STATUS OF WOODLAND CARIBOU (*RANGIFER TARANDUS CARIBOU*) IN THE MID-CONTINENT TAIGA OF CANADA

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Abstract: I examined and compared research and efforts to maintain viable populations of Woodland Caribou (*Rangifer tarandus caribou*) in Ontario, Manitoba and Saskatchewan. Some marked differences between provinces in approach, concepts and research are evident, although basic research procedures are similar. More cooperation is urged.

A SURVEY OF YELLOW AND VIRGINIA RAILS IN ALBERTA USING NOCTURNAL CALL PLAYBACKS

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Abstract: The Yellow Rail (*Coturnicops noveboracensis*) and Virginia Rail (*Rallus limicola*) are inconspicuous and apparently rare species in Alberta. Targeted surveys have never been conducted for either species, and virtually nothing is known about their distribution, populations, or other traits in the province. We conducted province-wide surveys for both species as a first step towards understanding their status. Historical records were compiled to help guide field surveys. We conducted over 400 point surveys for both species across the entire province of Alberta except the far north and the mountain parks. Surveys were nocturnal and were all conducted using a standardized call play-backs. An estimated 42 individual Yellow Rails and 59 individual Virginia Rails were detected at 18 and 35 locations, respectively. Multiple records of Yellow Rail at Hay-Zama Lakes in northwestern Alberta extend the known range of this species by roughly 450 km. Occupancy of historic sites was low for both species (3/42 for Yellow Rail, 7/39 for Virginia Rail), and most records were at new sites. Call playbacks increased the number of birds and the number of occupied sites detected for both species, but had marginal benefits for detecting Yellow Rails. Yellow Rails were found more often on nights with little or no moon and during the darkest time of the night, and Virginia Rails were found more often with a moon more than half full and a relatively clear sky. Even with high survey effort, both Yellow Rail and Virginia Rail were found to be sparsely distributed in Alberta. Additional work will be required to clarify their status in the province, but ongoing research on their calling behaviour and response to environmental conditions could help minimize the survey effort required.

ABORIGINAL TREATY ENTITLEMENTS AND THEIR IMPLICATIONS FOR PRAIRIE CONSERVATION

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Abstract: The majority of First Nations in Manitoba and the Prairie Provinces of Canada have signed a Treaty with the Crown. The Treaties are important because they provide a foundation for the mutually bound relationship between Canada and First Nations. However, the First Nation understanding of the Treaties and the Treaty process is different from that of Canada. Through the Treaty process, Canada was trying to remove the First Nation title to land, which flowed from their original occupation, in order that the land could be used for the purposes of immigration, settlement and resource exploitation. First Nations used the process to protect their rights, to provide for the future well being of their people and to define the on-going relationship between First Nations and the Crown. Because of the oral tradition, much of the First Nation Treaty understanding is based upon the negotiations and discussions rather than the strict written text. Among other things, First Nations understood that the Treaties were negotiated to share, but not surrender, the land and resources and to protect the First Nation culture and way of life forever. Generally, the Crown has offered interpretations that minimize its own obligations and base these almost exclusively on the written text of the Treaties. Some of the main written Treaty provisions were the establishment of Reserve lands, the protection of hunting, fishing and trapping rights and per capita "Annuity" payments provided each year, ranging between \$3.00 and \$12.00, depending upon the Treaty. The Treaties have not yet been fully implemented, nor fully defined. As examples, there are still some outstanding entitlements to land, questions regarding jurisdiction over natural resources and challenges to the Natural Resource Transfer Agreements, which impact First Nation Treaty rights. As a result of the Constitution Act 1982, Treaty rights have been recognized and affirmed, and are constitutionally protected. Recent Supreme Court decisions have provided further legal definition and also confirmed that interpretations of Treaties must include input from First Nations on their understanding of the nature of those agreements, at the time of their negotiation and signing. Treaties have also been held to be evolving in nature over time to provide shape for the ongoing relationship between First Nations and Government. To First Nations, the Treaties are sacred, solemn documents meant to last forever. They were entered into by previous generations with the guidance of the Creator and using the distinct traditions and ceremonies of each First Nation to validate their directions and decisions for the future. There was no deadline for the Treaties to expire, nor any termination process. "According to First Nation understanding, the Treaties were meant to last for as long as the grass grows, the rivers flow and the sun shines." Continuing Treaty implementations, negotiations and discussions must include the full, real and meaningful participation of First Nations so that their views and positions can

be given equal weight as those of the Crown. First Nations have been an integral component of the prairie landscape for thousands of years, evolving with the environment. The First Nation relationship to the land and its resources is thought of as sacred because of the belief that the "Creator" placed all things on earth. The formation of First Nation peoples as distinct societies, cultures and economies was based upon the type of lands they lived on and secured their livelihoods, eg. people on the southern prairies subsisted on buffalo, which contrasted with people in northern woodland areas who subsisted upon other game, for example moose, deer and fish. First Nation decisions regarding resource use have always been directed by conservation and impacts upon future generations. The Treaty and Aboriginal rights, perspectives and spirituality of First Nations have and will continue to influence their use of the prairie environment and act as an influence to the overall health of the related ecosystems. In addition, the future definition of Treaty rights will affect First Nation jurisdiction and use of the land and resources of the prairie region and will ultimately impact upon the success of conservation initiatives. It is important to fully consider and include First Nation knowledge, use, occupation, jurisdiction and influence within the prairie environment when planning for the future. This will greatly increase opportunities for success in the conservation of the prairie landscape.

Woodlot Management: Promoting Ecological Conservation and Economic Diversification in Manitoba

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Abstract: Since European colonization of the prairies, the development and expansion of agricultural lands has resulted not only in the loss of native prairies but also riparian forests and prairie woodlands. The bulldozing and burning of forests to create marginal agricultural lands continues today, resulting in the growing fragmentation of the forest-prairie transition zone. This forest fringe contains some of the highest density of breeding birds in North America, and also provides watershed protection, carbon storage, and aesthetics. The management of privately owned forested lands within this zone provides opportunities not only for economic diversification, but also for the retention of biodiversity and protection of habitat.

Since 1991, the Woodlot Association of Manitoba has been working with private landowners to promote the management, sustainable development, and conservation of small-scale forest resources in Manitoba. The Association works to inform woodlot owners of the benefits which may be derived from the management of their forested lands, including the provision of: wildlife habitat, soil conservation, micro-watershed protection, retention of biodiversity, recreational opportunities, improved aesthetics, and improved spiritual well-being. Woodlot management also provides opportunities for economic diversification on the prairies, through the development of both timber and non-timber enterprises. Examples include ecotourism, maple syrup production, provision of cones, moss and birch sleeves for the craft industry, and timber felling for personal use and to supply micro-sawyers.

This paper discusses the role that woodlot management can play in prairie conservation, reducing forest fragmentation, and encouraging economic diversification. It also describes the goals of the Woodlot

Association of Manitoba, the diverse management interests of our members, and the tools we use to promote woodlot management.

INTRODUCTION

When we envision the Canadian prairies, our minds conjure up images of rolling grasslands and the stateliness of the wooden grain elevator. Trees and wooded lands typically are not part of this picture. Yet the prairie ecoregion contains a wealth of both naturally occurring and planted forest landscapes. In Manitoba and across the Canadian Prairies, many farms and other rural landholdings contain some areas of natural tree growth; most farmyards also have some form of surrounding shelterbelt. From the southern prairies where trees and shrubs are confined to water courses and steep coulees, to the rich diversity of the boreal forest fringe, wooded landscapes provide habitat for a variety of plant and animal species, watershed protection, and a range of economic opportunities which are only beginning to be realized.

There are approximately 25,000 woodlots, or privately owned parcels of forested lands, in Manitoba which cover an estimated 11,650 km² of land (Dietz 1995). These forested lands range in size from less than a hectare to more than 1,000 ha., with the average Manitoba woodlot being 128 acres (52 ha.) in size (Rounds *et al.* 1995)¹. Often these woodlots are located in some of the most productive forest lands in the prairie region.²

¹ These woodlots form part of the estimated 2.35 million ha. of "other land" (lands not developed for field crops or improved pasture) owned by the province's 23,400 farmers (Manitoba Agriculture 2000).

² In Manitoba, approximately 85% of the privately held forest lands is classified as 'productive' by the Forestry Branch (MNR 1996).

Private woodlot management is widely recognized as being the best system of forest tenure for promoting forest stewardship, generating substantial revenues, encouraging local employment, and contributing to the stability and quality of life in many rural communities (Reed 1988; M'Gonigle and Parfitt 1994; Ross 1995). Private woodlot owners are more likely to engage in sustainable forest management for the benefit of the next generation, undertake income earning activities in balance with conservation, and recognize the benefits of biodiversity (Ross 1995). For these and other reasons there has been a resurgence of interest in woodlot management across the prairie region in recent years. Sustainable woodlot management provides opportunities for:

- the maintenance of a diverse prairie landscape;
- habitat for a variety of species, particularly within the ecologically rich forest-prairie transition zone; and
- the diversification of rural livelihoods through the creation of local forest-based enterprises.

Preserving and enlarging the wooded areas on a rural landholding may have positive results not only for the natural environment by increasing biodiversity and conserving soil and water, but also aesthetic and economic benefits for the landowner.

THE EMERGENCE OF WOODLOT MANAGEMENT IN MANITOBA

During the early colonization of Manitoba, settlers were granted lands containing wooded parcels of land. These woodlots were sources of firewood, timber and foods such as berries and mushrooms. They were

also a source of supply for Manitoba's early commercial forestry sector, as timber companies habitually purchased wood from settlers' woodlots (Gillis and Roach 1986). Up until the 1950s, private woodlots were viewed as being "very important to the owner, to the forestry industries, and to the whole province" (Kastrukoff 1951, 213). In the 1960s, though, the Government of Manitoba began to promote the development of large-scale commercial forestry within the province. Forest companies were granted increased access to provincial forests in return for low stumpage fees,

which led to a decline in the proportion of wood drawn from private lands. Accompanying this change came an altered perception of the value of private woodlands; by the early 1960s "the proper care and management of patented forest lands" in Manitoba was viewed as being "not economically attractive" (Schortinghuis 1963, 26). While at the beginning of that decade 45% of the roundwood harvested in Manitoba came from either private or Federal Crown land, by the 1980s this proportion had declined to less than 1% (Ondro and Williamson 1984 – see Table 1).

Table 1: Comparison between three decades of estimated volumes of roundwood harvested in Manitoba by land classification (Ondro and Williamson 1984, 29; converted from cubic feet).

	1961-62		1971-72		1981-82	
	Volume Harvested (m ³)		Volume Harvested (m ³)		Volume Harvested (m ³)	
Provincial Crown Land	585,271	55.0%	1,338,194	84.3%	1,780,947	99.1%
Private and Federal Crown Land	478,858	45.0%	249,861	15.7%	15,990	0.9%
Total	1,064,129		1,588,055		1,796,937	

The early 1960s also saw the growing domination of mechanized agricultural production in Manitoba. Combined with the decline in demand for woodlot products, private forested lands became less valuable to their owners. Landowners increasingly found it more economically attractive to bulldoze and burn a woodlot in order to convert it into agricultural land than retain it for its environmental benefits. Subsequently introduced agricultural programs such as GRIP served only to accelerate this process by encouraging the development of 'marginal' lands (Anon. 1982).

The late 1980s saw a resurgence of interest in woodlot management within Manitoba. The Forestry Branch was receiving more requests for tree seedlings and inquires

about woodlot management and the growth of Christmas trees. At the same time, the federal government was increasingly coming to see the potential of woodlots to soften the impact of an impending shortage of easily accessible timber from Crown lands (McKinney and Rounds 1990). Farmers were also becoming more interested in exploring new opportunities to diversify their incomes in response to changes in agricultural policy such as the elimination of the Crow Rate (Dietz 1995). Technological changes in the form of new portable sawmills had also made private woodlot management more economically viable (MHHC 1998). These changing dynamics led the Forestry Branch to undertake a survey of woodlot owners in southeastern Manitoba in 1998. The survey found

considerable interest on the part of woodlot owners in forest management and the establishment of a woodlot management program (Hreno 1992).

In the early 1990s, Manitoba Natural Resources introduced two woodlot programs under the 1990 Manitoba-Canada Partnership Agreement in Forestry. The province began to provide funding to the Manitoba Habitat Heritage Corporation (MHHC) to establish its Agro-Woodlot Program in the southwestern portion of the province. This program was responsible for promoting woodlot management and delivering technical services. Funding was also provided to the Manitoba Forestry Association (MFA) to establish a second Woodlot Program which provides similar services in the southeast, Interlake and Swan River areas of Manitoba. MFA also provides funding and in-kind support to the Manitoba Christmas Tree Growers Association and the Woodlot Association of Manitoba. Since 1995, funding for both of the province's woodlot management programs has been provided solely by Manitoba through the Forestry Branch. At present, continued funding of MHHC's Manitoba Agro-Woodlot program is uncertain.

The reasons why Manitobans decide to maintain and manage their forested property differ with each individual. Most woodlot owners manage their forests for the shelter they provide to their homes, the wildlife habitat they contain, the recreation opportunities they provide, and because of their value in soil and water conservation (McKinney and Rounds 1990; Rounds *et al.* 1995). Unlike other parts of Canada where woodlot management is an integral part of rural livelihoods, prairie woodlot owners often view the economic potential of their

woodlots as being secondary to their aesthetic and conservation benefits.

THE ROLE OF WOODLOTS IN THE MAINTENANCE OF PRAIRIE BIODIVERSITY

More than a century of agricultural development has greatly reduced and fragmented the land available to wildlife on the prairies. The progressive conversion of prairie grasslands from the Red River Valley to the aspen parkland belt has led to increasing rates of deforestation and reduction of wildlife habitat as wooded landscapes (primarily aspen and mixed wood areas) are cleared for grain production and cattle grazing. In farming areas, birds and mammals are now largely confined to abandoned yards, weedy roadside ditches and areas too wet, steep or heavily treed to profitably farm (Environment Canada 1981).

It is estimated that 90% of Manitoba's prairie wildlife lives on privately-owned land (MHHC 1996). Prairie landowners can often enhance and preserve important habitat without expensive or complicated projects by taking advantage of existing cover and encouraging natural regeneration. Particularly in the southern prairies, shelterbelts and planted habitat are important to wildlife. A North Dakota study reported 92 species of birds using farmstead shelterbelts in the summer with nesting densities of up to 17 nests per acre (DPF n.d.). In heavily modified areas, wooded coulees and valleys may be the only natural travel corridors available to wide-ranging species such as black bears and cougars, as well as a range of other mammals (PFRA n.d.b). Well-vegetated stream banks also improve habitat for fish by filtering impurities from runoff water, reducing siltation from soil erosion, and lowering

water temperatures by providing shade (PFRA 1999b).

Within the prairie ecozone, land classified as “natural land for pasture” and “all other land” is of greatest importance to wildlife. Together, these two land classifications comprise 29% of the 41.85 million hectare of prairie lands with agricultural potential (AAC 2000b). A comparison between type of farmland and wildlife usage is presented in Table 2, and reveals that by far the most productive wildlife areas in the prairie ecozone are wooded landscapes (especially those containing interior riparian areas) and

wetlands, along with the transition areas around them. As these critical areas have been destroyed or altered by surrounding agricultural practices, the remaining habitat has become fragmented. Some species such as white-tail deer, coyotes and raccoons can survive or even thrive in small, disconnected areas of habitat. However, many mammal and bird species require large areas of suitable habitat for foraging or escape cover. Neotropical birds are particularly vulnerable to habitat fragmentation because they are often subject to nest parasitism or predation while nesting in restricted areas (LandOwner Resource Centre n.d.).

Table 2: Percentage of total wildlife habitat usage units by classification of farmland in Manitoba (from AAC 2000b).

Class of Farmland	Percentage of Total Land Area	Percentage of Total Wildlife Habitat Usage Units
Cropland	53%	17%
Summer Fallow	13%	<1%
Tame and Seeded Pasture	5%	4%
Natural Land for Pasture	24%	19%
All Other Lands	5%	59%

Separated areas of cover or trees can be enhanced for wildlife with “bluff extensions”, which are multi-row, multi-species shelterbelts containing both trees and food-producing shrubs which connect two or more existing areas of habitat. These bluff extensions provide additional sources of food, shelter and escape cover and can act as travel corridors connecting the blocks of habitat (PFRA 1996). Establishing field shelterbelts to act as wildlife travel corridors is part of the Canada-Manitoba Agreement for Agricultural Sustainability delivered through the Manitoba Agro-Woodlot Program. Since 1994, 10 conservation groups and 159 landowners have planted about 600,000 trees and shrubs to create 185 km of wildlife corridors equivalent to 555

km of single-row plantings (Manitoba Agriculture n.d.).

THE MULTIPLE VALUE OF SHELTERBELTS

The loss of permanent grass cover caused by the introduction of agriculture to the prairies resulted in reductions of soil moisture and organic content, and led to massive soil erosion during the drought of the early 1930’s. For nearly a century, prairie landowners have established shelterbelts to reduce wind erosion, conserve soil moisture and provide wildlife habitat and snow control. Shelterbelts may be established around farmyards and residences to provide winter shelter, or along the edges of fields to

stabilize erodible soils and trap snow for moisture augmentation, increasing crop yields.

The Dominion Forestry Branch began testing and distributing shelterbelt trees at Brandon, Manitoba, and Indian Head, Saskatchewan, in 1901 (Briere 2000). It established tree nurseries at Indian Head (1904) and Sutherland (1914), Saskatchewan from which, between 1901 and 1923, over 50 million young trees were distributed to prairie farmers at the cost of transportation. At least 40,000 shelterbelts and woodlots were established as a result of this program. By 1920, private woodlots were providing a significant proportion of Manitoba's wood products (Kitto 1925).

The dustbowl of the 1930's led to the establishment of the Prairie Farm Rehabilitation Administration (PFRA) in 1935. Originally, PFRA was mandated to assist farmers in the prairie provinces in controlling soil erosion and securing sources of water and pasture for livestock. Later, its mandate was expanded to include agricultural crop diversification and the enhancement of wildlife habitat. The most important component of PFRA for prairie woodlot owners continues to be its Shelterbelt Centre program in Indian Head. From an initial production of 1 million trees in 1902, the centre now ships an average of about 7 million seedlings per year (PFRA n.d.a). Until the early 1990's, most trees distributed by PFRA were used for farm site and field shelterbelts. Now, about 40% are for multipurpose use including wildlife habitat and specialty crops such as berries and maple syrup production (PFRA n.d.a). In 2000, there were 5.5 million trees of 29 species shipped to 7,589 clients, with about 1 million used for wildlife habitat development (Briere 2000). PFRA

estimates that wildlife plantings³, riparian buffer zone plantings and wildlife travel corridor plantings by conservation groups and government agencies total about 300 ha. per year (AAC 2000a).

Shelterbelts can present significant direct economic benefits to landowners, as well as provide indirect ecological and economic benefits by reducing petroleum-based inputs such as fuel and fertilizer. It is true that the area occupied by a shelterbelt is lost to agricultural production and that competition from shelterbelt species may reduce nearby crop production. There may also be a significant cost in preparing for and establishing the shelterbelt. Once established, however, it is well-demonstrated that shelterbelts increase agricultural yields. First, crops are sheltered from wind damage early in the growing season and are protected from lodging and swath movement at harvest time (Benjaminson n.d.). Field crops also benefit from the additional moisture derived from snow trapping and by reduced evaporation during the growing season resulting from lowered wind velocity and increased shading (Kock 2000).

Yield increases vary depending on the species of the crop and the design of the shelterbelt system. Crops within an area of 5 times the height of the shelterbelt upwind and 15 times the height of the shelterbelt downwind benefit from the protection provided by the trees. Drought-sensitive species such as fruits, vegetables, lentils and other broad-leafed crops benefit the most from the presence of a shelterbelt

³ Trees are supplied free of charge (except shipping costs) to individuals for wildlife projects provided that the specific purpose is habitat development, the area planted exceeds 1 acre in size or 1/4 mile of field belt and the planting is not part of a farmyard (PFRA 1999a).

(Benjaminson n.d.). For example, a two-row spruce shelterbelt in Ontario improved soybean yields by 28.6% (Kock 2000). More drought-resistant crops such as wheat show less improvement, with average net productivity increases of 3.5% for fields in two states and two provinces (PFRA 1999c). These figures include the loss of crop area and competition caused by the shelterbelt. Using this simple method of increasing yields might reduce farmers' urge to drain or clear existing habitat in an effort to boost production.

Shelterbelts also benefit livestock producers by increasing forage yields, controlling snow which interferes with livestock feeding, and by reducing wind velocity in farmyards, thereby reducing feed requirements and calf losses (DPF n.d.). Wooded areas and field shelterbelts may also harbour beneficial pollinating insects which improve forage and fruit crops (Ritchie n.d.) and provide needed shade for livestock in summer. A more recently discovered benefit is the use of dense shelterbelts to control dust, noise and odour emissions from intensive livestock operations such as hog and chicken barns (NCSU 1998). As well, water for livestock, crop irrigation and human use can be trapped as snow and routed into dugouts for later use (PFRA n.d.). A well-designed caragana shelterbelt around a dugout may capture up to 300,000 L of meltwater for every 100 m of length (PFRA 1999d).

Another use for tree plantings is to manage snow around farmyards and along rural roads. Since 1994 the Canada-Manitoba Agreement for Agricultural Sustainability has encouraged landowners along the Trans-Canada Highway between Winnipeg and Portage la Prairie to plant field shelterbelts parallel to the highway to reduce the effect of blowing snow on motorists. To date 75

landowners who comprise the Trans-Canada Shelterbelt Association have planted about 80,000 trees and shrubs, totaling about 160 km of protection (Manitoba Agriculture n.d.).

WOODLOTS AND SUSTAINABLE ECONOMIC DEVELOPMENT

Landowners engage in woodlot management or tree planting activities when they recognize the ability of their forested areas to fulfill an economic, spiritual and/or political need (Menzies 1994). For most prairie woodlot owners, the production of industrial wood is not of primary interest (Reed 1988), as they view their forest lands as more than solely sources of timber for commercial extraction. Yet, the income generating opportunities provided by woodlots have proven to be strong catalysts for engaging in management activities. Many woodlot programs, therefore, put an emphasis on helping private woodlot owners realize the income benefits of their wooded lands (Dietz 1995). These economic benefits are of greatest importance to woodlot owners with few alternative sources of income (Hyberg and Holthausen 1989).

Most prairie woodlot owners are unaware of the value of their woodlots (FWAS 1993). Providing landowners with this information is a key ingredient not only in encouraging the management of forested land, but also in preventing further conversion of these areas into agricultural or pasture land. For this reason, both of Manitoba's woodlot management programs are working to raise landowners awareness of the economic benefits which may be derived from their "bush." They also are working towards the development of an integrated, local, forest-based economy which emphasizes diversification of farm incomes, promotion

of value-added opportunities and the creation of new jobs.

With the difficulties recently experienced by traditional agriculture and the resulting decline in the rural economy, privately-owned woodlots and shelterbelts offer the chance to diversify the income of rural landowners. In some cases, owners may be able to produce their own lumber and fuel; in others, new crops such as berries, maple syrup or mushrooms may be harvested from wooded areas of the farm and processed into new products. Within a well-managed woodlot, all of these activities can serve to augment the forest's productive capacity and encourage biological diversity while maintaining soil and water conservation properties.

In Manitoba, the economic development opportunities available to woodlot owners may be divided into three broad categories:

- Timber-based enterprises
- Non-timber forest products
- Landscape based enterprises.

Timber-based Enterprises

Woodlot owners utilize a variety of techniques to harvest trees, including selective cutting, shelterwood cutting, and clearcutting of even aged stands. Woodlot owners are encouraged to leave cavity trees, avoid riparian areas, and minimize soil compaction and damage to seedlings and smaller trees. The small size of woodlots enables landowners to become intimately familiar with their land. They are aware of the small changes in topography which may influence water run-off patterns, the favorite paths of wildlife, and nesting grounds. With this knowledge, and their long-term interest in ensuring the health of their forests for future generations, informed woodlot owners are more likely to engage in

sustainable harvesting practices than their industrial forestry counterparts.

Woodlot owners harvest trees from their lands for a wide-range of purposes. By far the most common reason is to gain firewood for personal use; about 60% of Manitoba's woodlot owners' harvest trees from their own lands for this purpose. A smaller proportion (45%) also sell a portion of the firewood from their woodlots. Thinning to improve the quality of a woodlot, either for timber production or for wildlife habitat, is undertaken by about 40% of Manitoba's woodlot owners (Rounds *et al.* 1995).

Prairie woodlot owners also harvest oak, ash, maple, pine, poplar and other tree species for use in products ranging from rough boards for fencing or posts, to finished flooring and high quality furniture. Logs harvested from the woodlot are cut to the dimensions desired, and then may be kiln dried, planed and refined to create a value added product. All of these tasks may be undertaken by the landowner themselves, depending on their level of interest and whether they own their own portable sawmill, kiln and/or planer. Each step may also be contracted out to a local expert, or the timber may be sold to a nearby micro-sawyer, kiln owner, or woodworker, creating an integrated local economy based on private forestry.

By harvesting timber from their own woodlots, farmers are able to create construction grade lumber for use in building fences and sheds. Excess timber may be sold to neighbours and local sawmillers. For many woodlot owners, harvesting timber for building material has proven to be less expensive than purchasing wood through a lumber yard, reducing off-farm expenses. In addition, the quality of locally produced timber is often higher than

what may be available otherwise. For instance, one member of the Manitoba woodlot community has transformed eight cords of Manitoba black ash into flooring worth \$20,000 at a cost of about \$3,000. A portion of the wood from this single cut has also been used to create moldings, trim, firewood, and stimulate the development of a new side business building outdoor wooden chairs (WAM 2000b).

Some members of Manitoba's micro-forestry community specialize in the provision of specialty wood products. Basswood, for instance, is widely desired by carvers because it is light, soft and easy to work with. One Manitoban has developed his own business specializing in providing clear, white basswood to carvers. He also supplies lower quality basswood (which contains shades of brown, gray or green) for use in woodburning (WAM 2000c). Quality Manitoba hardwoods may also be used by woodturners to produce bowls and other wares.

A small proportion of the woodlot community (estimated to be less than 10%) are cutting timber for pulpwood or oriented strand board (OSB) production. While some woodlot owners in the Swan River area are cutting timber for Louisiana-Pacific, in the southeastern corner of Manitoba most wood from private lands is sold to mills in northern Ontario and Minnesota. The low price for pulpwood combined with the relatively high cost of transportation to these markets makes participation in industrial forestry economically unattractive for most woodlot owners. To partially overcome this problem, some woodlot owners sell to local dealers who in turn transport the pulpwood to the mill. For instance, a woodlot owner who harvested five acres of overmature poplar in the winter of 1996 found that selling his 123 cords of wood to a nearby

buyer in Sprague for about half the price he would have received at the mill gate provided him with a higher profit margin (WAM 1997).

Non-Timber Forest Products

In addition to traditional timber-based economic opportunities, woodlot owners are able to earn income through non-timber forest products such as maple syrup, mushrooms, berries, medicinal plants, barks, and lichens. Most of these special forest products rely on the presence of a whole forest ecosystem. It is estimated that there are as many as 500 non-timber forest products currently being used in Canada. These products can play a critical role at the regional level and contribute greatly to rural economies by providing seasonal employment and enabling families to increase their annual disposable income by \$5,000 to \$10,000 (Duchesne *et al.*, 2000). Their economic development in Manitoba is currently limited and generally oriented towards personal consumption. Yet, as they cause less damage to the forest and are specialized in nature, non-timber forest products are particularly well suited for use by small-scale forest operators, particularly when done in combination. Some special forest products have strong niche market potential and may be more valuable than the timber surrounding them.

Perhaps the greatest economic opportunities may be found with the production of maple syrup. A traditional industry in Eastern Canada, where there are an estimated 13,000 maple syrup producers (Agriculture Canada n.d.), maple syrup production has a long history in Manitoba as well. Undertaken by prairie Aboriginal communities and adopted by the early European colonists, maple syrup production continues to be a traditional activity in pockets around the

province, most prominently in St. Pierre-Jolys and by the Trappist Monks near Holland. Stimulated by the woodlot programs in the province, maple syrup production is becoming a more common spring time activity for families interested in producing syrup for their own consumption, and by a few entrepreneurs interested in establishing their own woodlot-based businesses.

The Manitoba maple from which syrup is produced is widely found on the prairies, with the largest number of trees in Manitoba being located in the Aspen Parkland Forest Section (MNR 1996). Manitoba maple syrup has a similar taste and sugar content to that produced by the sugar maple used in Eastern Canada (McKinney n.d.; Kort and Michiels 1997). Manitoba maple syrup is therefore as competitive within the specialty gift product market as its Eastern counterpart, and may have a greater comparative advantage due to its distinctiveness and novelty. Most of Manitoba's maple syrup is currently sold through farmers markets, trade fairs, festivals and farm gate sales, with a smaller amount being sold in health food stores and gift boutiques (Parry 1998). One woodlot owner within the province has established a successful maple syrup business and is currently tapping about 3,000 trees, as well as purchasing syrup from other tappers (WAM 2000a).

Mushrooms provide a second potential income source for woodlot owners. A study in Ontario, for example, found that a harvest of wild mushrooms would generate \$80 per hectare, while the same area used for pulpwood would generate \$56 per hectare (Wildlands League n.d.). Many edible wild mushrooms grow on the prairies, the most common of which are chanterelles, boletes, morels, false morels, and pine mushrooms.

The harvesting of these wild mushrooms for commercial purposes is difficult due to the unreliability of production (FWAS 1993). To overcome this problems, woodlot owners can engage in log culture of mushrooms, particular shiitake and oyster mushrooms. Through this process, mushrooms grow on inoculated logs of either white oak or bur oak. While most mushroom sales currently take place at the farm gate, there is the potential for growing them for larger commercial sale.

Berries and fruit from woodlots may be used to produce syrups, jams, jellies, chocolates and juices. While these may be obtained from the wild, the limited growing season, low returns to labour, travel time requirements and problems with storage, purchase and distribution make it more attractive for woodlot owners to establish woodlot orchards. Commercial plantations of saskatoons, raspberries, chokecherries, strawberries, blueberries and other fruits have already been established on the prairies (FWAS 1993).

Wildcrafting, which involves collecting products such as balsam fir branches and lichens for the floral and craft industry, is one of the most promising of the minor special forest products in terms of markets and abundance (Mater Engineering 1993). Other special forest products include herbs, botanicals and plants used in natural foods such as fiddlehead fern, wild mustard, dandelion, seneca root, and calamus root. Labrador tea, white spruce, cedar and jack pine can also be used as sources of essential oils.

Whole Landscape Based Enterprises

Some economic opportunities for woodlot owners rely upon the presence of the entire, intact forest land. These include recreation

and eco-tourism. Recreational activities include hunting, fishing, wildlife viewing, hiking, nature walks, trail rides, sleigh rides, picnics, camping, snowmobiling, and cross-country skiing. While these opportunities are widely enjoyed by woodlot owners for their personal pleasure, they may also provide the bases for a new business based on eco-tourism. Eco-tourism is the fastest growing sector of the worldwide market, and is expected to double between 1994 and 2005 (Wildlands League n.d.). It refers to non-consumptive use of natural areas, and emphasizes undertaking nature-based activities within the natural, social and economic limitations of the environment, retaining economic wealth locally, and providing educational opportunities (Weaver *et al.* 1995). In Manitoba, a review of listings for farm vacation and rural bed-and-breakfast operations for the year 2000 shows that 36 of 116 specifically mention nature-related attractions like wooded areas, hiking, hunting, bird watching, and trail riding (MDCHT 2000). Most existing ecotourism operations are found in the forest-fringe and boreal areas, and are usually associated with an aquatic environment (Weaver *et al.* 1995). These include a woodlot owner who has built two cottages and established a bed and breakfast operation serving skiers in the winter and cyclists in the summer. Another has established a hayride business, with tours through his woodlot which highlight local wildlife (WAM 1997).

Summary

One of the key characteristics of all economic opportunities associated with woodlot management is their ability to be utilized in an integrated manner while maintaining and enhancing the forest itself. For example, lichens and moss to be sold as special forest products may be removed prior to harvesting to create needed building materials. Similarly, the establishment of a

sugar bush for maple syrup production requires continuous thinning of competitive species and removal of older Manitoba maple, providing timber for use in furniture building and firewood. This diversity of income-earning opportunities provides woodlot owners with the basis for greater economic stability, and encourages holistic management practices.

In Manitoba, while there are a wide variety of opportunities for woodlot owners to earn some income from their woodlots, this sector remains underdeveloped. At the moment, nearly all woodlot related businesses serve to augment the income gained by landowners through other means; the income generated is insufficient to be a sole livelihood strategy⁴. This additional income, though, may be extremely valuable to the landowner and is in addition to the non-monetary benefits provided by woodlots in terms of water, soil and wildlife protection. As well, there appears to be a strong basis for future expansion of the micro-forestry sector. Many people within the woodlot community feel that there are opportunities for growth as individuals become more aware of the potential uses of their woodlots and increase their marketing abilities.

MAINTAINING THE MOMENTUM

In order for woodlot management to continue to provide ecological and economic benefits, there is a need for strong support to landowners. Assistance from technicians is the primary external motivator for woodlot management; without this type of support, interest in woodlot management declines

⁴ A recent study, though, has indicated that, due to lower input costs, as well-managed full-time milling operation can provide a net income comparable to an average family farm (MHHC 1998).

(Bliss and Martin 1990). In Manitoba, where historically there has been the absence of a strong and vibrant culture of woodlot management similar to what may be found in the Maritimes and Quebec, the need for this assistance is even more acute. Here, one of the main constraints to the success of woodlot management is owners' lack of forest management knowledge and many of the basic skills needed for proper woodlot management and development. Currently, the woodlot programs offered by the Manitoba Forestry Association and Manitoba Habitat Heritage Corporation provide educational extension activities which teach people how to avoid making critical management mistakes. Since 1993, the forest technician at the MFA has developed 641 woodlot management plans, while MHHC's technicians working in southwestern Manitoba have developed 134 management plans. Their activities are also supported by an Association of woodlot owners which seeks to strengthen the woodlot movement within the province of Manitoba through the sharing of ideas and the provision of information.

The Woodlot Association of Manitoba (WAM) was formed on May 1, 1991. A non-profit organization lead by a volunteer board, the Association works to:

- facilitate the education of private landowners and the management of their woodlots; and
- encourage the sustainable development of small-scale forests on private lands.

To promote these goals, the Association publishes a bi-monthly newsletter entitled *The Manitoba Woodlot*, sponsors Field Days, and helps deliver seminars and workshops. WAM has also established a comprehensive library of books, videos and information sources of interest to woodlot owners. Most recently, the Association has

also established a website which seeks to inform Manitobans about the benefits of woodlot management and provide an opportunity for small woodland operators to exchange information about the services they are able to provide. The Woodlot Association receives strong support from the Manitoba Forestry Association through its Woodlot Program, and from the Provincial Forestry Branch. It has also worked in conjunction with Oak Hammock Marsh Conservation Centre, the Manitoba Wildlife Federation, the Manitoba Model Forest, and Manitoba Hydro on a variety of projects.

The Association currently has about 250 members, approximately 40% of whom own woodlots which are part of a farm operation. The majority of these members own property in the Interlake and southeastern corner of the province, particularly in the Rural Municipalities of Piney, Brokenhead, Reynolds, Rockwood and Bifrost (reflecting the WAM's close link with the MFA's Woodlot Program). The median size of the woodlots owned by members is between 40 and 50 acres (WAM 1999).

The long-term objectives of WAM's members focus primarily on managing their woodlots to enhance wildlife habitat, provide recreation and environmental stewardship; about half of the woodlot owners view timber harvesting as being an important management objective. About 80% of the woodlot owners who harvest timber from their woodlot do so to supply themselves with firewood. About one-quarter harvest to support a woodlot-related business (WAM 1999). Many members engage in tree planting activities; a 1999 survey of the Association's members revealed that during the previous 10 years, the average woodlot owner had planted about 250 trees per year. WAM supports

this activity through facilitating the bulk order of trees.

Many of the landowners the Woodlot Association of Manitoba comes into contact with have a vision for the future which includes giving their children and grandchildren the opportunity to experience and enjoy the outdoors in a healthy ecosystem with an abundance of wildlife and other amenities provided by the forest. These individuals realize the pressures that their woodlots and the environment as a whole are experiencing, such as climate change, increased urban sprawl, land clearing due to increased agricultural pressures, liquidation of forest resources, and tax pressures, to name only a few. They are aware that the choices they make today will ultimately reflect what occurs in the future. That is why many woodlot owners are taking responsibility now to gather the information they require to make informed decisions on how to manage their woodlots and ensure that future generations have access to renewable resources, healthy ecosystems and an unspoiled wilderness.

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NATIVE PRAIRIE STEWARDSHIP: IT IS WORKING IN SOUTHWESTERN MANITOBA

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Abstract: The Mixed-Grass Prairie Stewardship Program grew out of concerns by local people for the long-term survival of native mixed-grass prairie in south western Manitoba. Continued agricultural expansion and unsuitable land management practices have reduced the native prairie to less than 18 percent of its pre-settlement range. The program is centred on the area bounding the Carberry Sandhills, the largest area of mixed-grass prairie remaining in Manitoba. It has three major components - an inventory of native prairie remnants; an innovative, broad-based awareness program and a voluntary land stewardship initiative. It has been underway for almost two years and has enlisted help from 12 groups with conservation, agricultural or special interests. It has been successful in increasing general awareness and enlisting voluntary land stewards within the area and is poised to move into other areas with significant native prairie remnants.

INTRODUCTION

The Mixed-Grass Prairie Stewardship Program started almost two years ago, borne out of a need to slow down the loss of native mixed-grass prairie in the Carberry Sandhills area. The sandy soils helped slow down some agricultural activities for many years, allowing it to become the largest area of remnant prairie left in southwestern Manitoba. The introduction of potatoes in 1962, followed by irrigation in recent times have lead to an acceleration of the loss of prairie. Expansions in cultivated acreage are now focused on the Class 4 and 5 soils. The results are most evident but the trend fails to slow down.

Livestock producers hold the largest amount of remnant prairie in private ownership or under crown land lease. An ongoing inventory of this area during the last five

years by the Critical Wildlife Habitat Program, has revealed that almost all of the

prairie has been altered by poor grazing management or other forms of negative human activity. Only about 18 percent of the mixed-grass prairie remains in Manitoba, a drop of about seven percent since 1989, when the World Wildlife Fund estimated there was about 25 percent remaining. There is still an opportunity to improve or maintain about one third of it at good quality. Through changes in attitude and management, there is potential for improvement.

HISTORY

To understand why the attitudes of land management prevail today, one needs to understand its evolution.

As a way to secure the 49th parallel against American intrusion, the Canadian government of the day initiated a plan to attract settlement across southwestern Canada and to build a trans-continental railway. Manitoba was the first of the prairie provinces to experience the influx of European settlers.

The Scottish Red River settlers established a foothold at the doorstep of the west that was to serve as the springboard for thousands of new people who followed in the 1870's and 1880's during the government-sponsored "land boom".

Each new arrival came with hopes and dreams to find a place where they could have a better lifestyle, call home, and make a living. These people came with expectations formed by government propaganda that promised "the New Eldorado" - prosperity beyond imagination, protection, and fertile, virgin prairie soils.

They were bound by the Dominion Lands Act of 1872, to "improve" five acres of prairie each year for three years, as well as add buildings, so as to receive their free quarter section of land. (For those not from the west, that is 160 acres.) This was changed in 1884 requiring the homesteader to break 10 acres in year one and 15 in each of the next two. By 1908, this was modified so that one had to break 50 acres and crop 30 acres per year for three years before applying for a patent. Production was the key focus.

A report out of Saskatchewan echoed federal government policy quite well, stating that "homesteaders have little use for grassland. ...the first task of the farmers is to destroy

native plants in order to prepare for cultivated plants to grow".

Again the government pushed expansion, calling for the Canadian west to feed the world with their wheat. The prairies were to become the "breadbasket of the world". This pronouncement is still heard throughout "small town" agricultural areas and has been the driving force for expansion of cultivated acres since the first settlers arrived. So, its little wonder, that the native landscape has undergone such radical changes in a mere two generations.

The attitudes seen in the system of land survey, adopted from the U.S. - by section, township and range, challenged the landscape. They went over hills, through wetlands and sloughs, and through coulees and over banks, slicing the prairie of such vast diversity into square blocks and straight lines.

The other factors that dictate how attitudes of land use came to be are ethnic backgrounds and people's country of origin.

What is Land Stewardship?

"A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity..."

A Sand County Almanac,
Aldo Leopold

Modern society is based on economy, and it is economic interests that will always dictate land use. It's a tough sell trying to convince

a landowner that there may be important reasons other than money why he/she might want to hold onto their native prairie, such as wildlife habitat, or that someone might discover the cure for cancer in some native plant or the one that's really difficult to sell is "intrinsic value" - something that is that is "hard to explain".

One meets the purely practical people who are totally driven by "the bottom line". These people can sometimes make you wonder why you're out there. It has been however, a pleasant surprise to discover that there are people holding title to remnant native prairie, who understand those intrinsic values we talk about, who derive great pleasure out of watching wildlife, and are the ones who seek out the first crocus of spring or the return of the bluebirds. They are also the people who try to marry economic issues and ethical land use and come up with innovative ways to use the land in a sustainable way. Sustainability is the key to making it work.

Many of these producers either know or are beginning to recognize the value of having native prairie as part of their livestock production base. These people give me hope that we conservationists are not alone in both our concern for the long-term survival of native prairie and that while they may not be raising the cry, they are doing what they can with their own small plot.

Many are in fact conservationists themselves, torn between the heavy weight of making a living in a world dictated by international trade issues and sky-rocketing production costs and land conservation. They feel forced to maximize production on every square foot of their land, to get bigger

to survive, not smaller, which is what most want.

What they require are the tools and support to help make changes. Education, sharing of information and demonstration are the most powerful tools we have to effect desired changes. Both government and non-government agencies are saying the same message. This makes it more consistent and many producers have heard it more than once, so it's not completely new when we go knocking on their door. Reinforcement goes a long way to drive a message home.

MIXED-GRASS PRAIRIE STEWARDSHIP PROGRAM

How does it work? It is divided into three parts - the inventory; a broad-based awareness component as well as a voluntary land stewardship component. The awareness part tackles the population on a broad basis. Information is passed on through presentations, participation and demonstration to all sectors of the population within the designated target area.

The voluntary land stewardship program recognizes landowners who are concerned about their native prairie and interested in maintaining it in a healthy state. Landowners are identified through an ongoing inventory carried out by the Critical Wildlife Habitat Program of Manitoba Conservation. Once the plant inventory of the land is complete and reports have been sent to the landowners, they are contacted by a

During the home visit, an explanation of the inventory results is delivered as well as an introduction to the native prairie ecosystem.

Management information such as rest-rotation grazing systems, multi-species grazing, weed and aspen control is also presented. The project provides landowners with ongoing practical information on land and/or pasture management which helps enhance productivity and long-term health of native grass systems. Other forms of recognition to participants include an attractive gate sign which is placed at the site and a certificate of participation is presented to each landowner. They continue to receive a newsletter bi-annually and are invited to participate in any tours and workshops sponsored by the program. To date, there are 30 participants in the program including a land base of approximately 54,000 acres.

Information about the projects and/or land stewards is sent to the seven newspapers in the project target area as well as the Manitoba Cattle Producers Association “Cattle Country” newsletter and provincial agricultural papers. The web site carries information about the program as well as a wide variety of educational material.
(www.escape.ca/~mxdgrass/)

Most recently, the MGPSP and MCPA, have joined forces to obtain some financial assistance on a cost-share basis, for the land stewards, to help initiate projects designed to enhance native prairie. These projects are just getting underway, however the interest by producers, is very encouraging. The projects are designed by the producers, and are chosen both on their educational value and on sustainability.

Is the stewardship movement working?
Land stewardship is an uphill battle. There is a long history that goes back several

generations, all pointing away from conservation of wild lands. Evidence indicates the tide is beginning to turn in its favour. If the message can continue to get out to those people who control the native grasslands, and the tools to make the changes, continue to be available, then there will be a positive outcome for our grasslands.

LYNX OF RIDING MOUNTAIN NATIONAL PARK OF CANADA: AN ASSESSMENT OF HABITAT AVAILABILITY AND POPULATION VIABILITY

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Excerpts from:

Nysten-Nemetchek, M. 1999. Lynx of Riding Mountain National Park: An assessment of habitat availability and population viability. Master's Thesis. University of Manitoba - Natural Resources Institute. 140 pp.

Abstract: An assessment of lynx (*Felis lynx*) habitat availability and population viability was performed for Riding Mountain National Park (RMNP), Manitoba, Canada from 1997 to 1999. The purpose of this study was to demonstrate and verify a methodology for estimating the viability of lynx as a part of the ecological assessment of RMNP. Verification of a lynx Habitat Suitability Index (HSI) model was performed for RMNP. Site specific lynx home-range-level attributes were obtained for three components of lynx habitat; foraging, denning, and interspersions, and a home-range-level habitat map was generated for RMNP. Snow-tracking was used as a practical means of verifying the HSI model. Lynx forage habitat availability appeared to be the limiting factor on lynx viability in RMNP based on home-range-level foraging, denning, and interspersions habitat maps. Habitat manipulations are recommended to increase the quality and quantity of lynx forage-type habitat in RMNP through means such as prescribed burns. Population viability for lynx was assessed for RMNP using a modelling framework. This framework was used to develop a map of viable, marginal, and non-viable home ranges and to index the number of lynx in RMNP. Based on current habitat, RMNP is estimated to support 427 lynx home ranges whereby 170 are viable, 255 are marginal, and 2 are non-viable. Assuming that groups of lynx during mid-winter represented family groups, it appeared that the viability model predicted areas that favoured lynx productivity and survival in RMNP. The lynx research in RMNP continues and includes an annual lynx monitoring program that will help establish population trends and provide baseline data as part of RMNP's ecological integrity assessment.

BACKGROUND

Canada's federal parks are developing an ecosystem-based approach to management

(Department of Canadian Heritage 1994, Riding Mountain National Park Round Table 1996). Riding Mountain National Park

(RMNP), therefore, developed an Ecosystem Conservation Plan where the identification and monitoring of ecological integrity is a primary goal (Ecosystem Conservation Plan Team 1997). The plan set objectives for ecosystem management and protection which included establishing and implementing species inventories and monitoring programs (Ecosystem Conservation Plan Team 1997). Ecological integrity may be analyzed in a variety of ways, including consideration of habitat potential and species viability (Woodley 1993). Lynx (*Felis lynx*) were chosen as one species to help identify and monitor ecological integrity of RMNP for a variety of reasons. They are indigenous to the area, they require a diversity of forest successional stages for various parts of their life cycle (Koehler and Aubry 1994), and they are a top-level carnivore that closely associates with the snowshoe hare (*Lepus americanus*) cycle thus, lynx viability exhibits a strong link to the integrity of the food web.

The managers of RMNP are mandated to consider ecological integrity in their resource management plans. Part of the definition of ecological integrity includes consideration of species viability (Woodley 1993). The purpose of this study was to contribute information about lynx habitat availability and population viability in RMNP and use the information as a component of RMNP's ecological assessment. Objectives of this study were:

- 1) to verify Roloff's (1998) lynx Habitat Suitability Index (HSI) modelling framework for RMNP;
- 2) to apply and evaluate the habitat-based population viability approach of Roloff and Haufler (1997); and

- 3) to develop a process for land managers to evaluate and monitor lynx population numbers to assist in their evaluation of ecological integrity.

PART 1

VERIFICATION OF A LYNX (*FELIS LYNX*) HABITAT ASSESSMENT METHOD FOR RIDING MOUNTAIN NATIONAL PARK

INTRODUCTION

The geographic range of lynx is linked primarily to the distribution of the boreal forest region although their habitat is often varied (Koehler and Aubry 1994). General habitat structure can include species such as white spruce, black spruce, paper birch, willow, quaking aspen, poplar, balsam fir, and jack pine in Canada and the eastern United States. In the western United States, lynx often use stands of Engelmann spruce, subalpine fir, and lodgepole pine (Koehler and Aubry 1994). Some habitat characteristics are similar among these areas including low topographic relief, continuous forests, and a mosaic of forest successional stages (Koehler and Aubry 1994). Areas meeting these criteria often support snowshoe hares; the lynx's main prey (Koehler and Aubry 1994).

Habitat requirements for lynx can be categorized into three features; foraging, denning, and interspersions (Koehler and Aubry 1994). Vegetation conditions that support high prey numbers are required for foraging. Snowshoe hare habitat is quite varied but a brushy understory that provides both winter food and cover is essential (Keith et al. 1984). Denning and kitten cover is often provided by forests with certain structural components, such as many deadfalls and a

closed vegetation canopy. Roloff (1998) described a suitable denning site as consisting of inter-tangled, woody material that provide interstitial spaces under a vegetation canopy. These denning sites should also be subjected to minimal human disturbance, be in close proximity to foraging areas, and be a minimum of 1 ha in size (Roloff 1998). Vegetated conditions that do not provide forage or denning habitat may serve as travel cover for lynx. Coniferous or deciduous vegetation >2 meters in height with a closed canopy offers suitable travel cover (Brittall et al. 1989). Travel cover is not essential for lynx survival, however, these areas often link foraging and denning habitats (Koehler and Aubry 1994). Roloff (1998) quantified the foraging, denning, and interspersions components of lynx habitat into a Habitat Suitability Index (HSI) model. The purpose of this study was to verify the Roloff (1998) lynx HSI model as a habitat assessment tool for RMNP, Canada.

METHODOLOGY

A full description of the methodology, results, and discussion can be found in Nylen-Nemetchek (1999).

Lynx Habitat Suitability Index (HSI) Model

Roloff (1998) developed a lynx HSI model to help managers evaluate the effects of land management activities on lynx. Roloff's (1998) HSI model uses the limiting factor approach whereby the most limiting resource for an organism is assumed to have the greatest impact on the individual. Roloff (1998), consistent with Koehler and Aubry (1994), portrayed the quality of three features of lynx habitat; foraging, denning, and

interspersions. Part of the foraging component is a snowshoe hare sub-model.

Determination of the Lynx Home-Range-Level HSI

The quality for each lynx habitat feature (i.e., foraging, denning, and interspersions) was expressed as a home-range-level Geographical Information System (GIS) grid. Following Roloff's (1998) model, forage, denning, and interspersions habitat scores were combined into one lynx HSI value for a home-range-sized area. The overall lynx habitat quality grid represented lynx HSI scores for a 250 ha area and was termed a habitat contour map (Roloff and Haufler 1997). The use of a 250 ha home range for lynx habitat assessments is discussed by Roloff and Haufler (1997) and has a relationship to estimating the viability of the home range. The habitat contour map formed the basis for delineating viable and marginal lynx home ranges following the process outlined by Roloff and Haufler (1997). The output from the home range delineation process was a map of viable and marginal lynx home ranges for the study area (Roloff and Haufler 1997).

Classifying Ecological Units for Habitat Modelling

The 298,000 ha Park was stratified into 52 classes based upon a combination of existing vegetation and soil delineations (Walker and Kenkel 1997, Lombard North Group Limited 1976). Since forage quality and vegetation species composition is dependant upon soils combinations, a combination of the vegetation and soils map were used. These vegetation and soil combinations represent ecological land units that form the foundation of the land

classification scheme used in this study.

The filtering process resulted in a stratification that covered 85% of RMNP's area (254,000 ha). Logistics prevented us from sampling each ecological unit, thus, the 20 most common classes (in terms of area) were sampled. An additional ecological land unit was also added to represent an area that burned in 1980. The area consists of regenerating jack pine. These 21 classes account for about 74% (220,980 ha) of the Park's total area.

Vegetation Sample Design

Three replicates of each eligible ecological unit were sampled to examine lynx forage potential. The horizontal abundance of snowshoe hare browse and security cover vegetation data were collected according to Wolff (1980) and Thomas et al. (1997). Vertical browse and cover were assessed using a spherical densiometer. Thomas et al.'s. (1997) methodology was used to measure vertical browse and cover at various vegetation levels. Understory species dominance was ocularly assessed.

Other Vegetation Measures

Additional vegetative measures were required as model inputs for denning and interspersed *requisites*. A tree-level data inventory did not exist for RMNP by ecological land unit. Therefore, overstory variables for each of the ecological units were approximated by RMNP vegetation management specialist (pers. comm., Wybo Vanderschuit, Vegetation Management Specialist, Riding Mountain National Park, Wasagaming, Manitoba). These variables included the average diameter

of trees (cm), average basal area of trees (m^2/ha), percent canopy cover of the forested overstory, average height of the overstory (m), and the average density of trees >10 cm dbh.

Snow-Tracking

Snow-tracking was used as a practical means of indexing lynx habitat use to verify the performance of Roloff's (1998) HSI model. The goal of snow-tracking was to determine if lynx relative abundance varied as expected according to habitat model output. The information was also used to establish baseline data for a lynx population monitoring program for the Park. Lynx monitoring began December 7, 1997 and was completed March 22, 1998. Tracking was performed via snow machine on 833 km of trails, roads, and cutlines throughout RMNP.

RESULTS AND DISCUSSION

Roloff's (1998) lynx HSI model provided RMNP managers with a pragmatic tool to assess, monitor, and project lynx habitat in the Park with at least 80% confidence. Foraging, denning, and travel habitat components provided the basis for the lynx HSI model (Roloff 1998). Analysis of all these components is essential for examining the quality of habitat available to lynx in a given region. The goal of this study was to provide empirical verification of Roloff's (1998) lynx HSI model and to provide RMNP with baseline data on lynx abundance.

The initial step in the lynx habitat modelling project was to assess and classify the ecological land units in RMNP. This analysis entailed combining the soil and vegetation attributes of RMNP to spatially portray the Park's ecological land descriptions. Specific

attributes for each ecological land unit were then measured and modelled to determine the forage habitat potential for lynx. The best way of indexing lynx forage potential is to evaluate the quality of habitat available to snowshoe hare, the lynx's main prey (Elton and Nicholson 1942, Seton 1953, Keith 1963, Nellis and Keith 1968, Nellis et al. 1972). The vegetation sampling conducted in the Park provided data on the characteristics of horizontal and vertical cover and forage that is important to snowshoe hares. In RMNP, regenerating jack pine was classified as the most suitable (HSI 1.00) hare habitat and closed coniferous-clay, deciduous canopy/coniferous subcanopy-clay-loam, closed coniferous-sand-clay, and low shrub grassland-clay were classified as unsuitable (HSI 0.00) habitat. The 0.90+ HSI forage class accounted for only 0.8% of the total classified area. Therefore, only a small proportion of the Park provides optimal (1.00) quality hare habitat. This finding is significant since during hare population lows, it is the highest quality habitat that will continue to contribute individuals to the population. As such, these areas are vital to lynx during periods of resource scarcity.

Denning is another component of Roloff's (1998) lynx model. The majority (79%) of the classified area fell within 0.90+ HSI indicating that much of the Park currently provides high quality denning opportunities for lynx. No empirical data existed on the specific locations of lynx dens in RMNP and therefore, it is not possible to verify the denning assessment.

Interspersion is the final component in Roloff's (1998) model. The more travel barriers a lynx was apt to encounter within its

home range, the poorer the HSI rating of that home range. Again much of the Park provides suitable travel habitat for lynx. Approximately 57% of the Park currently provides optimal interspersion habitat (0.90+ HSI). The lower interspersion HSI values are found throughout the rest of the Park.

Based on data from the three components, foraging, denning, and interspersion, it appears that foraging habitat is the most limiting factor on RMNP since 79% of the classified area in RMNP is suitable denning habitat, and 57% provides suitable travel habitat for lynx. Less than 1% of the Park provides optimum lynx forage habitat. This result should be used to direct lynx management in RMNP by incorporating management practices, such as prescribed burning, that will increase the area of early successional forest in the Park providing areas of suitable hare and lynx forage habitat.

In RMNP, Roloff's (1998) lynx HSI model generated habitat maps that generally corresponded to the locations of lynx observations. *When the habitat classes were grouped in 0.30 HSI increments (i.e. 0.00-0.29, 0.30-0.59 and 0.60-0.89), the model reflected the expected patterns in habitat use and availability. Using the Bonferonni z-statistic, the 0.00-0.29 and 0.60-0.89 HSI class were both significant at the 80% confidence level where the low HSI class was used less than expected in proportion to habitat availability and the 0.60-0.89 HSI class was used more than expected in proportion to availability, consistent with model predictions. Therefore, RMNP land managers can use Roloff's (1998) lynx HSI model as a tool to assess lynx habitat in RMNP with an expected confidence of at least 80%.*

Roloff's (1998) model, as modified by *Nylen-Nemetchek (1999)*, can also be used to project lynx habitat in RMNP. As used herein, Roloff's (1998) model provided a snapshot of the quality and quantity of habitat that exists in RMNP at the present time. Data from this study suggested that lynx foraging habitat is currently the limiting factor in RMNP. Optimum snowshoe hare habitat typically occurs in early successional forest (Koehler and Aubry 1994), however, historical and present factors have influenced natural successional patterns on RMNP. Historically, logging, grazing, and fire perpetuated early seral stages. Currently, decades of fire suppression have encouraged older successional stages. As a result, the Park is slowly progressing to mid-to-late-seral stages thereby decreasing the amount of early successional habitat. This trend could be detrimental to the RMNP lynx population by limiting the habitat available to snowshoe hare, thereby limiting lynx foraging potential. During the formal tracking survey and at other sporadic times, lynx are often observed in the regenerating jack pine ecological land unit that burned in 1980. Field observations in this area also demonstrated that it supports high numbers of hares. In addition, the HSI analysis indicated that much of the high quality lynx habitat fell within this burned area, supporting the contention that lynx require early seral stages.

Park managers recognize the potential consequences of such trends and thus are examining the importance of ecological integrity and trying to find means to achieve it. Reintroduction of some natural processes, such as fire, is one way managers are trying to regain the ecological integrity of the Park.

They have begun implementing prescribed burns to attempt to restore "natural" succession since traditionally, fire played an integral role in the successional patterns of RMNP. This practice should continue to prevent the Park from becoming a region dominated by a single successional chronosequence. Late successional forest do not appear to provide the level of suitable foraging habitat for long-term population success of snowshoe hares.

Roloff's (1998) lynx HSI model should be used by RMNP land managers as a tool to assess, monitor, and project lynx habitat. It appears to be a pragmatic tool that can be used to guide land-management decisions that will affect lynx habitat and population trends within RMNP. However, the need for adaptive management in this, like every other wildlife management issue is recognized and advocated for use in assessing lynx habitat and population trends in RMNP.

PART 2:

POPULATION VIABILITY ANALYSIS BASED ON HABITAT POTENTIAL FOR LYNX (*FELIS LYNX*) IN RIDING MOUNTAIN NATIONAL PARK INTRODUCTION

A framework for examining population viability based upon habitat potential was developed by Roloff and Haufler (1997) and was used for indexing the viability of lynx in RMNP. Previously, the only quantitative means of linking habitat requirements to lynx fitness was through studies that associated lynx demographics to snowshoe hare abundance (Koehler et al. 1979, Parker et al. 1983, Koehler 1990) . Similarly, no data existed on the source and sink population

dynamics of lynx and thus, there was no means to quantitatively frame a research hypothesis regarding lynx population viability for RMNP. The lack of information on lynx population demographics and movements necessitated a habitat-based approach for addressing population viability for RMNP. The intent of the lynx HSI model (Roloff 1998) and the population viability assessment method proposed by Roloff and Haufler (1997) offered these tools.

Studies have demonstrated habitat relationships for lynx (Koehler et al. 1979, Koehler 1990, Murray et al. 1994, Mowat et al. 1996, Poole et al. 1996), however, quantitative methods to map and assess habitat conditions have not existed until recently. To that end, a lynx HSI model was developed by Roloff (1998). Roloff's (1998) model was developed with the intention of providing resource planners and managers with a tool that indexed relative fitness of lynx based on habitat. Verification of Roloff's (1998) model was presented and discussed in *Nylen-Nemetchek (1999)*. Verification tests of the lynx HSI model indicated that the model was useful for describing lynx distribution and thus is a useful tool for RMNP. Roloff's (1998) lynx HSI model provided the basis for the lynx population viability assessment. This study was performed to help managers understand the habitat potential of RMNP for lynx and how that habitat potential may relate to population viability for the species. Lynx are an indigenous species to RMNP, and thus are inherent to RMNP and its greater ecosystem. Without lynx, the Park would be missing a component of ecological integrity. The objective of this study was to index the viability of RMNP's lynx population using the approach of Roloff and Haufler (1997).

The result offers a quantifiable, repeatable index of lynx population viability that can be used to guide resource management decisions.

METHODOLOGY

A full description of the methodology, results, and discussion can be found in Nylen-Nemetchek (1999)

Lynx home ranges in RMNP based upon habitat potential

Using Roloff's (1998) HSI model, lynx habitat potential (i.e., the quantity, quality, and spatial distribution of habitat) was identified and mapped for RMNP (*Nylen-Nemetchek 1999*). The HSI modelling process generated the data required for applying Roloff and Haufler's (1997) viability framework. Using the methodology outlined in Roloff and Haufler (1997), a home-range-level representation of habitat potential for lynx (termed a habitat contour map) was delineated. Criteria and habitat unit objectives were established to evaluate the habitat contour map [see Roloff and Haufler (1997) and *Nylen-Nemetchek (1999)* for full description].

Viability Analysis

Assessing spatial viability is an important component to determine the contribution of a given habitat toward the long-term success of a population. An examination of viable home ranges depicted by Roloff and Haufler's (1997) framework on RMNP to an index of lynx productivity was performed. During the winter of 1997-1998, data on lynx abundance was collected as part of a tracking survey conducted in RMNP. These data were collected in part to verify Roloff's (1998) lynx HSI model. Information gathered for this

study included location of lynx tracks, habitat class, as well as the number of lynx found at each track sighting. The lynx home range map was overlaid with the tracking results, noting individual and groups of animals. The data gathered from this study does not provide enough information to be able to prove that groups of tracks were those of females with kittens although anecdotal evidence suggests that this is typically the case, particularly in mid-winter.

To examine whether groups of lynx were more closely associated with viable home ranges than solitary lynx, the average distance between lynx locations (groups and solitary animals) and viable home ranges was calculated using GIS. If lynx locations fell within a viable area, the distance was 0. For lynx locations external to viable habitat, the nearest straight-line distance to viable habitat was recorded. A Mann-Whitney U-test (Bailey 1995) was used to determine if there was a significant difference in distance to viable home ranges for group and single tracks. The null hypothesis was that the group lynx tracks were the same distance from viable home ranges as single lynx tracks (i.e., the grouped lynx tracks and single lynx tracks have identical distributions or an identical mean distance to viable home range).

RESULTS AND DISCUSSION

Lynx home range viability in RMNP was examined using Roloff and Haufler's (1997) population viability modelling framework. This framework appeared to be a useful tool to identify viable, marginal, and non-viable lynx home ranges within RMNP where viable home ranges are presumed to have a population growth rate >1 even during lean

resource years, marginal home ranges do not contribute to population viability during resource scarcity, and non-viable home ranges do not contribute to population viability (Roloff and Haufler 1997). The Mann-Whitney U-test (Bailey 1995) indicated that there was a significance difference in the mean distance to viable home ranges between groups of lynx and single lynx ($p = 0.005$). Groups of lynx were found significantly closer to viable home ranges than single lynx. As such, RMNP managers can use the framework to examine the past, present, and future viability of lynx for the Park.

Roloff and Haufler's (1997) framework helped estimate lynx viability for RMNP. The viability analysis suggested that based on the Park's present habitat, RMNP is capable of supporting 427 lynx home ranges where 170 are deemed viable, 255 marginal and 2 non-viable. An implicit assumption in the model (Roloff and Haufler 1997) is that lynx home ranges do not overlap. This assumption is refuted in the literature (Saunders 1963, Brand and Keith 1979, Mech 1980, Carbyn and Patriquin 1983, Ward and Krebs 1985, Koehler 1990) and therefore it is recognized that this analysis may have underestimated the number of home ranges. The amount and degree of spatial overlap of lynx home ranges varies geographically, temporally, and by the home range estimation technique (Saunders 1963, Brand and Keith 1979, Mech 1980, Carbyn and Patriquin 1983, Ward and Krebs 1985, Koehler 1990). In RMNP, Carbyn and Patriquin (1983) found inconclusive evidence that home ranges overlapped.

Lynx require a mosaic of landscape characteristics for optimum habitat conditions (Koehler and Aubry 1994). The composition of the Park's current landscape was influenced

by logging, fire, grazing, and haying (Ecosystem Conservation Plan Team 1997).

These factors have disappeared, with the exception of prescribed burning and the rare occurrence of wildfires. As a result, the Park is moving toward an old successional forest which is unsuitable for long-term lynx population persistence. *Nylen-Nemetchek (1999)* demonstrated that the foraging component of lynx habitat is the limiting factor in RMNP. Since European settlement in the RMNP area, fire suppression has resulted in the loss of a successional mosaic landscape deemed important to lynx. Further progression toward mono-aged forests, due to a lack of natural disturbances, will ultimately decrease the viability of RMNP's lynx population. As such, it is important to identify where subpopulations of lynx exist, determine the connectivity between these subpopulations, and establish what areas are viable. Provision of these viable areas is important for ensuring that the lynx population will persist during poor hare years. This information is important for making sound management decisions on landscape composition and configuration relative to lynx viability.

As a starting point to identify lynx population viability goals for RMNP, it is recognized that information is lacking on lynx productivity and fitness. These data are needed to generate a so-called reliable estimate of a minimum viable population. A persistence model presented in *Belovsky (1987)* (that ignores habitat condition), depicted the population size and area (km²) needed for a 95% chance of persistence for various sized mammals for 100 and 1000 years respectively. According to this crude model, at just under 3000 km² RMNP is large enough to ensure the

persistence of a lynx-sized animal for 100 years, but not for 1000 years. However, according to the model (*Belovsky 1987*) the Park does not contain a high enough lynx population to ensure that the species will persist over the next 100 years. *Belovsky (1987)* stated that this crude model can provide managers with a "rule of thumb" approach when designing and managing refuges. Other estimates to predict viable population sizes range from 50 to 5000 individuals (as summarized by *Roloff and Haufler 1997*), a range that is too broad for management purposes.

Based on the viability analysis presented herein and in the absence of lynx productivity and fitness data, it was assumed that the RMNP lynx subpopulation is a source area for lynx in Manitoba. This assumption was made because lynx were known to have recolonized the Park in about 1939 and have been present in varying numbers since then (*Park Resource Management Team 1979*). It is most likely that the long-term persistence of RMNP lynx require interchange with other wilderness regions such as the Duck Mountains to the northwest and the Interlake region to the northeast. This interchange is important in order to maintain genetic diversity and to provide sources of recolonization when detrimental environmental stochasities occur. In addition, lynx are vulnerable to trapping pressure, especially during periods of hare scarcity (*Brand and Keith 1979, Parker et al. 1983, Bailey et al. 1986, Quinn and Parker 1987*). Historically, trapping pressure has been extensive in areas surrounding the Park and *Carbyn and Patriquin (1983)* speculated that the Park's lynx population may become extirpated if trapping pressure was high during

periods of low hare populations. Conservation efforts, such as provincial trapping moratoriums during lynx population lows may be important to ensure the sustainability of the RMNP lynx population.

It is assumed that with these factors in place, RMNP's lynx population could be considered viable. It is therefore recommended that Park managers maintain at least the status quo in terms of lynx numbers, recognizing that the numbers will fluctuate dramatically during population peaks and falls. To maintain the existing population, a long-term monitoring project of both habitat and population numbers is needed. In time, managers will be able to relate habitat potential to the dynamics of the lynx population. If either habitat or demographics become more limiting, then adaptive management will need to be implemented.

It is recommended that managers pay close attention to maintaining or restoring viable lynx habitat to assist in maintaining a viable lynx population through low hare and lynx population cycles. The results from applying Roloff and Haufler's (1997) viability analysis approach to RMNP revealed that groups of lynx were associated with viable home ranges significantly more than solitary lynx. This finding strengthens evidence supporting the validity of Roloff and Haufler's (1997) framework. Viable home ranges are presumed to have a population growth rate >1.0 (Roloff and Haufler 1997). Marginal home ranges are presumed to not contribute to population viability during times of resource scarcity, and non-viable populations do not contribute to population viability. Therefore, it is essential that managers maintain viable home ranges on a "no-net-loss" basis to ensure that the RMNP lynx population remains stable

(relative to its natural population cycle). Roloff and Haufler's (1997) model appeared to be a useful tool for estimating viable lynx home ranges, therefore, this model should be used to assist managers in monitoring home range viability based upon habitat potential in RMNP.

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ARE WE REALLY MANAGING PRAIRIE HABITATS?

Dave Neave

Abstract: To successfully manage and plan for prairie habitats, landowners, conservation agencies, and the conservation community must all understand and be working under a comprehensive habitat strategy. Current limitations to achieving this comprehensive strategy include:

- Our inability to regularly assess measurable habitat goals and objectives;
- Our low capacity to deliver programs across the agricultural landscapes;
- Our reluctance to allow conservation programs to become mainstream within the agricultural community;
- Our inability to define thresholds, or break points on the integrity of agricultural landscapes.

These limitations are based on the conclusions of the agricultural landscape section in Wildlife Habitat Canada's recent Habitat Status Report. The report addressed five questions:

1. How much habitat have we got and where is it?
2. What is happening to habitat?
3. How are factors affecting habitat?
4. Who cares for habitat and how?
5. What programs are/will be the most effective?

As a consequence of the Habitat Status Report, the Board and staff of Wildlife Habitat Canada are currently determining the organization's priorities for the agricultural landscape for the next five years.

Clearly, Wildlife Habitat Canada wishes to address the current limitations of our existing collective strategy in managing prairie habitats. An initial priority has therefore been the preparation of a proposed set of measurable goals and objectives in a report entitled "How Much is Enough?" that is based on a series of technical workshops for different ecozones that will propose threshold points for different landscapes. In addition, the Countryside Canada program will also address these limitations by continuing to build operational capacity to deliver more meaningful conservation programs, define landowners' needs, and encourage the involvement of mainstream agricultural interests.

David J. Neave was the founding Executive Director of Wildlife Habitat Canada, a non-profit conservation organization established in Ottawa in 1984 which,

though partnership with industry, government and non-government organizations, helps to conserve wildlife habitat throughout Canada. With a background in wildlife and forest management and considerable experience in Alberta, he has helped to initiate the development of stewardship programs on private lands in every province, as well as fostering programs and policies that integrate wildlife habitat objectives into forest and agricultural programs. Over the past few years, Mr. Neave was the Chair of the National Forest Strategy Coalition and the National Forest Congress, Vice-Chair of the Sustainable Forest Management Technical Committee of the Canadian Standards Association, and Co-Chair of a national review of compensation and prevention programs related to alleviating wildlife damage to agricultural crops. Recently, he initiated Wildlife Habitat Canada's Forest Biodiversity, Forest Stewardship Recognition, and Countryside Canada Programs. This January, he established Wren Resources to continue his commitment to habitat conservation.

Good afternoon and congratulations to the organizing committee for hosting this conference in which the objective, and I quote from the brochure, "is to explore ideas and approaches to sustain landowners, as well as our rich natural heritage."

As a result of my past experiences with Wildlife Habitat Canada and previously, the Alberta Fish and Wildlife Division, I have become an advocate of:

- stewardship programs that are designed to retain the existing habitat base;
- a landscape approach; and,
- the need for habitat objectives.

And equally, like many of you, I became a disciple of Stan Rowe, believing in, and promoting, his concepts and attitudes to guide land use. Surely his efforts put the title and theme of this conference into perspective and I paraphrase from a paper of Stan's that was presented several years ago:

"Conservationists and preservationists spend too much effort on threatened species, as if (next to us, of course) they are the only important things in God's Green Earth. True, the importance of preserving wildlife habitat is more and more recognized. But "habitat" like "environment" fails to define the three dimensional ecological systems in which we

are immersed; they fail to project to the public the sense of importance of the enveloping natural world and the urgency of protecting it." (Rowe, S., 1981)

While the theme of this conference captures the challenge of retaining the ecological integrity of our prairie landscapes, does the agenda? I believe that it does and my talk attempts to address this question, and is entitled "Are we really managing prairie habitats?" In my opinion, the current answer must be "no" and I have therefore structured my talk into three parts:

- 1) What do we need to effectively manage habitats on the prairie

- landscape?
- 2) What are the difficulties that must be overcome?
 - 3) How do we overcome them?

Much of what I will say you will have heard before and I expect will hear again. But the message needs to be repeated, as we as biologists and habitat practitioners slowly evolve from our “species” focus to one that speaks to the ecological integrity of our landscape and as we work within the social and economic forces shaping these landscapes.

In reflecting on what is needed to “manage” habitat on the prairie landscape, it is important to recognize the obvious. First, while lands within Canada’s agricultural ecosystems have been altered considerably from the times of European settlement, these agricultural lands, with their complex of croplands and wetlands, rangelands and bluffs, provide extensive habitat values and are heavily used by a variety of wildlife species (Neave, E. and Neave, P., 1998). And secondly, there is a great variety of existing conservation programs across the prairies that are making a difference. But within this context, the answer to the question “are we really managing prairie habitats?” must still be “no.”

Any effective habitat management strategy requires a number of key elements:

- first and foremost, there must be a visible political commitment to habitat conservation, expressed as a vision/goal, incorporated in land use planning, and, providing adequate human and financial resources.

- secondly, there must be appropriate and quantifiable habitat objectives, built in consultation with or by land managers, to establish corresponding habitat conservation activities.
- thirdly, there must be adequate information on and use of appropriate indicators that will demonstrate progress in achieving habitat objectives.
- and finally, there must be discipline, in an adaptive management sense, to refine objectives and strategies based on the monitoring and evaluation of the objectives and any additional information, rather than constantly adjusting programs due to administrative and financial reasons.

I would be remiss not to add that there is a long list of secondary elements that are required to achieve success in habitat management, including:

- the need for strong leadership. A current weakness exists within the habitat conservation arena in which there are too few prominent leaders who are respected by the public.
- the need for effective management and institutional structures that not only allow, but also encourage, creativity and involvement by local communities.
- the need for an understanding of the current economic and social forces on the landscape so that conservation programs are designed and implemented to build onto the positive benefits of other resource sector programs.
- and the need for recognition that habitat programs can only be truly

successful when the land managers have responsibility and accountability for the delivery of conservation activities and that these habitat initiatives must become “mainstream” programs within the agricultural sector.

I doubt that many of you who compared your own programs to this checklist will disagree with my conclusion that we are not yet managing prairie habitats.

Therefore, what are the difficulties that must be overcome to really manage prairie habitats?

First, we need the courage to establish an array of quantifiable habitat objectives despite our limited information base. The importance of habitat objectives has been championed by various fora for the last two decades (Canadian Standards Association, 1997; Wildlife Habitat Canada, 1991), but there are still relatively few examples of measurable objectives that guide existing habitat conservation programs in Canada.

Secondly, we are primarily responsible for the confusion surrounding biodiversity conservation. Our programs (such as the North American Waterfowl Management Plan, endangered species recovery plans, and Partners in Flight) remain species oriented and often fail to address landowners’ and other resource sector issues (such as pest management or concern regarding pollinators and soil fauna). And our numerous approaches to managing for biodiversity are not coordinated or integrated and only embrace elements dealing with conserving species, ecosystems, and habitats. Without belabouring the point, approaches that are

based on indicators (e.g. Canadian Criteria and Indicator initiative), policies (e.g. National Forest Strategy), conservation biology (e.g. coarse/fine filters), guidelines (e.g. Code of B.C. Forest Practices), certification (e.g. Canadian Standards Association Sustainable Forest Management system), and risk and assessment (e.g. gap analysis used by the World Wildlife Fund and The Nature Conservancy) collectively have not enhanced the support for, or reduced the confusion regarding, biodiversity conservation.

Thirdly, the adoption of a landscape approach to conservation is still weak. The traditional approach of establishing protected areas, often as parks, has been expanded to include “corridors” and the need to manage lands adjacent to parks. However, to me, this is still a minimalist approach that does not recognize the need to maintain the ecological integrity with associated habitat components throughout all of the landscapes.

And fourthly, scientific knowledge is the core of any sound conservation program. The understanding of ecosystem functions and species’ relationships to their habitats is of prime importance. Unfortunately, our continued dependency on old information dealing with species inventories is limiting our ability to utilize new computer mapping technology and modelling tools and effectively work with other resource management systems.

I would also like to comment on the increase in administrative/bureaucratic structures evolving within the conservation community. I do not believe that copying the U.S. model with the North American Waterfowl Management Plan and currently

with the North American Bird Conservation Initiative for bird conservation, or the federal/provincial/territorial bureaucracy being established for endangered species and stewardship programs, are necessarily conducive to fostering partnerships, creativity in solving issues at the local level, or garnering support from land managers.

A sixth difficulty that must be overcome is also related to our cumbersome administrative structures. It is the need for sectoral integration of conservation initiatives. While this need is well known, I believe that a major and unrecognized element of our failure to manage habitat effectively is our inability to develop habitat objectives in conjunction with other resource sectors and to define the targets and thresholds in order to retain the ecological integrity of our landscapes.

And finally, while we all recognize that community support is essential for habitat conservation, how much of our limited resources is currently devoted to community awareness programs? Communication activities are essential to sustain the involvement of local communities in conservation programs. Many landowners still have insufficient knowledge to understand the fundamental linkages between habitat conservation, natural resources, and the goods and services that are provided by ecosystems.

How can we overcome these difficulties in managing prairie habitats? While at Wildlife Habitat Canada, I constantly advocated the need for measurable objectives as the fundamental requirement for strengthening wildlife habitat conservation in Canada. These objectives, to me, are far more

important than additional legislation or funding for conservation programs. But I also recognize that to develop such objectives and to sustain our achievements over the next few decades, we must develop the knowledge and skills to treat our landscapes as whole ecosystems. As habitat practitioners, we are aware that wildlife is a potent symbol of landscape health and that we are best suited to advocate landscape conservation. While we temporarily lost this role in the 1980's to environmental interests, our challenge today remains deceptively simple.

First, and I refer you back to Stan Rowe's quote, we must recognize and then advocate that ecological integrity is the foundation of sustainable land use. We need to remove the barriers to system level thinking by our profession, and cease to carve up:

- the concept of sustainability into environmental, social, and economic values;
- wildlife as species at risk, biodiversity, bird groups, or game species; and,
- forest (or agricultural) management into timber, fish, wildlife, ecosystem, and watershed management sectors.

Only those of you who have reviewed some of the federal departments' sustainable development plans that advocate environmental trade-offs can understand the fundamental importance of this step.

Preserving ecological integrity is not a management constraint or competing "use" or "value" of the land, but is the foundation of sustainability (Caza, C. and Neave, D., 2000).

Secondly, we need to develop conservation

objectives that evolve from the systems level approach. These objectives must reflect a recognition that we are not managing ecosystems, but are in fact managing human activities. As I indicated earlier, in addition to measurable objectives, I believe that the establishment of targets and thresholds is required -- targets for conservation interests and thresholds related to ecological integrity. There are good examples of habitat objectives, targets, and thresholds across Canada and I challenge you collectively, as I have challenged Wildlife Habitat Canada, to develop a prairie version of the U.S. publication entitled "How Much is Enough?" (McKenzie, D. and Riley, T., 1995).

Thirdly, the value of a landscape approach to habitat conservation is now widely recognized across Canada. However, if I asked you to describe or paint a picture of your ideal prairie landscape, how easily could you do so? Traditionally in Canada, our approach to landscapes has been sector oriented. We have not managed land to maintain ecological processes or functions, to conserve heterogeneity across landscapes, and in many cases, not even based on what it is best capable of producing. There are some excellent conservation strategy documents related to the prairie landscape, but I sense that the vision is still not connected to objectives and subsequent action. I believe that we should be able to overcome our difficulties in managing habitat when we create a vision that encompasses a landscape approach and includes measurable goals and objectives and a political commitment that is accepted by the bureaucracy of various agencies, and of course, communities/landowners. However, unless we adopt a much more disciplined approach

to our conservation programming, we will not be aware of the success of our efforts as exemplified in attempts to evaluate the North American Waterfowl Management Plan. We need to adopt an adaptive management approach and built-in learning process that explicitly recognizes the dilemma of having to manage large ecosystems with limited information. Very simply, we need to monitor progress towards achieving objectives by regularly comparing the actual outcomes to the predicted outcomes (Holling, C.S., 1978; Walters, C.J., 1986), and periodically modifying the vision, goals, and objectives based on a formal evaluation process.

And finally, we need to be more strategic in our conservation planning rather than opportunistic. As many of you know, I have been an advocate of stewardship initiatives, most recently promoting the need for maintenance funding, and program delivery by mainline agencies and communities rather than the implementation of individual initiatives. With the additional federal funds that have recently been allocated for stewardship, I have also advocated the need to be more strategic with regard to where and what form of stewardship is appropriate to employ in meeting specific objectives. For example, when the amount of native habitat in a landscape is relatively abundant, conservation programming should concentrate on retaining this habitat base through voluntary landowner recognition and extension efforts. As the amount of native habitat decreases, landowner recognition efforts need to be enhanced with financial incentives. Land acquisition, the development of protected areas, and the use of legally binding agreements, play a role in situations where native habitats represent a

small portion of the landscape. While there are examples of this form of conservation strategy being implemented at the landscape level, unfortunately, we seem to remain opportunistic in our habitat protection and enhancement activities. Government wildlife agencies continue to emphasize land acquisition programs, rather than influence policy and financial institutions that affect the landscape.

In conclusion, I have a few words of encouragement. We have a plethora of conservation initiatives across the prairie landscape and an apparent growth in conservation budgets over the next few years. At the same time, there appears to be an abundance of many forms of wildlife and an increasing recognition within the agricultural sector that wildlife and habitat are indicators of sustainable agriculture. As biologists, we have learned that we cannot “roll back the clock” and that landscapes will continue to evolve based on the social and economic needs of communities. We are also learning that we need to establish visions of conservation that are based on the concept of “ecological integrity.” And we are slowly accepting that there is a need to assess the success of our habitat programs by monitoring and evaluating progress related to measurable objectives within an adaptive management approach.

While we may never be a dominant force on the landscape, with ingenuity, discipline, and the development of true partnerships with agricultural interests, in the future, we will be able to claim that we “are really managing our prairie habitats.”

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IS THE PRAIRIE FARMER AN ENDANGERED SPECIES?

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Abstract: The coming of agriculture to the Canadian Prairies led to the decline or disappearance of several species of plants and animals, and in a remarkably short time measured in Prairie history. The number of farms and farmers peaked only about 50 years after the first major influx after the building of railways in the late 1800s. But the number of farmers has steadily declined since. In 1999 alone, over 22,000 people left the Prairie farm work force - a decline of 11 per cent. The farm population is aging, and deaths and retirements will mean over 70 per cent of Prairie farmland must change hands over the next 15 years. Meanwhile, farmers continued to be squeezed by low prices, rising input costs and competition from highly subsidized farmers in the United States and Europe. This address reviews the pressures facing Canadian Prairie farmers, and looks at ways in which they might continue to play a role in the economic, social and environmental health of the region.

John Morriss began his working career as a research assistant with the Biomass Energy Institute in Winnipeg in 1973. He moved into agriculture in 1975, running a traveling information display for the (Justice Emmett) Hall commission on grain handling and transportation. In 1976 and 1977 he worked as a freelance agricultural writer, acting as field editor of Grainews and writing for other publications. In August 1977, he was hired as an information officer for the Canadian Wheat Board, and was appointed director of the information department in 1982. In 1989, he was appointed publisher and editor of the Manitoba Co-operator, a weekly newspaper for farmers in Manitoba. John and his wife Joan live in Winnipeg with their daughter Sarah, but also have a home on Lake Winnipeg near Winnipeg Beach. John keeps a sea kayak at both residences.

You're supposed to radiate confidence when you're giving a speech, but I don't know if I can do that, particularly when the theme of this conference is finding common ground. What could a journalist possibly have in common with a group which is composed of so many biologists and other scientists? Especially a farm journalist, responsible for reporting news and opinions on agriculture, a field in which it's said that if you get two farmers in a coffee shop, you get four different opinions and two new farm organizations. This gives us farm journalists a certain amount of latitude.

But as I've recently learned, particularly when reading about biotechnology or global warming, science is a profession in which premises, procedures and methodology are universally agreed on and there is no disagreement whatsoever on conclusions — everything is cut and dried. I am therefore quite intimidated by the need to be so precise. If I fail, give me a break. After all I'm just a journalist, though biologically speaking we are an impressively efficient and stable species, said to be able to survive only by drinking each other's bathwater.

But can the same be said of the Prairie farmer? Is the Prairie farmer, like some of the plants and animals he or she has already displaced, an endangered species?

Let's start on a proper scientific basis and use the proper taxonomic name for this creature. Incredibly, I looked on the Internet, the source of all knowledge, and was unable to find one. So being a journalist, I made one up. It was a tough decision. *Agriculus desperatus*? *Tillager recreationalis*? New pickup covetous?

I settled on "*agricola expectatus*" which means "he who always thinks next year will be better." There are many clichés about these creatures, but I think I can say that this is a fair and accurate characterization — farmers are often looking one year ahead and hoping next year will be better, and the Great Plains of North America are often referred to as "Next Year Country."

I will attempt to address my topic in a biological context using appropriate scientific measurements. I'll start by assessing the current state of this creature's population in relation to past trends. I'll start by showing you this graph, which I owe to Gary Martens in the plant science department at the U of M. He sent this to us last year with a brief commentary observing that if we're worried about the farm crisis, we don't have to for much longer. He extended the trend line showing the decline in Manitoba farm numbers, and as you can see, by 2030, the number is zero.

Actually this graph is now out of date. Last fall Statistics Canada reported that the number of people employed on farms on the Prairies declined by over 22,000 in the previous year -- 6,000 of those were in Manitoba. these were farm workers, not just farmers, but many would have been. So

today we might project that graph to be down to zero by 2020.

So the farm problem could be viewed like the bottom tier of that basket we all have on our desks. There's "in," "out" and "I don't know what to do with it so I'll put in here." As you know, if you leave stuff in there long enough the need to do anything about it eventually disappears and you just turf it out. That could be said to sum up the Canadian government's attitude to this species, but more on that later.

Let's put another measurement on this creature, and that is its ability to absorb enough external energy to keep itself going. In this case we're mainly talking about money, which the farmer uses to buy food and shelter, as well as the necessary items such as fuel, fertilizer and machinery to keep his business viable.

This graph pretty much sums it up. If you're trying to put a bright face on it, you could say that farmers are doing quite well. For example, this graph shows Manitoba's farm income picture since 1989. The total figure continues to rise quite nicely. And if you are in the business of selling things to farmers to help them grow crops, you might also conclude that things are not doing too badly.

But if you're a farmer, your main concern is what's left to live on after you've paid all those expenses. As you can see, net income is going nowhere. Even annual cost of living increases of two or three percent add up after a while, and most of us would be hard pressed to be getting by on a 1989 wage, let alone a 1980 one.

In 1971 the cash cost -- excluding labor and machinery -- of planting an acre of wheat in Manitoba was about \$17 per acre. In 1981 it was \$69. This year it's \$117. Average yields have increased somewhat over the past 20 years, but the price -- estimated to be about \$4.50 per bushel this year, is less than in 1981.

Which is a problem, obviously, and one only partly offset by the increase in yield. But the point here is that farmers are not just facing a problem of low prices. It's high costs. I've oversimplified things by just looking at wheat, which is still the crop with the largest acreage. Prairie farmers, to their great credit, have diversified into a range of crops, starting with canola a number of years ago and more recently into a range of pulse crops like peas and beans and lentils. Prices are much higher, but yields are often less than for traditional crops, and costs are often much higher. It used to be that farmers could choose to plant traditional cereals such as wheat or barley and get away with using relatively little purchased fertilizer or chemical, but that's changing. Soils have been mined of nutrient reserves, and in the last few years cereals have been under ever-increasing pressure from disease, which require purchased fungicides for control. The worst is fusarium, practically unheard of ten years ago and now causing widespread damage to yield and quality, especially in the eastern Prairies. Fusarium is responsible for producing vomitoxin, which true to its name, causes vomiting in single-stomached animals. That means you can't feed it to pigs. Manitoba, which is trying to expand its hog industry, is now in the perverse situation of shipping its vomitoxin-infected barley west to Alberta, where it can be fed to cattle which can tolerate it, and then backhauling vomitoxin-free barley back to feed pigs. There is probably a cure for fusarium, mainly through breeding resistant varieties, but that cure is several years away -- unless we get a good drought to break the moist weather cycle that led to the spread of this intractable disease, and of course that brings another set of problems.

Next to my third measurement of species health, one which is near and dear to many in this audience. That's habitat protection. Farmers may be seen as despoilers of habitat for other species, but their own habitat is actually under considerable threat.

A couple of years ago, the Canadian government set a goal of capturing four per cent of world agri-food trade by value. I should briefly note that "agri-food" essentially means that it includes processed products, and on the theory that there is nothing wrong with having a bias as long as you admit it, confess my antipathy toward this term. It was invented about a dozen years ago within the federal bureaucracy and was enthusiastically adopted by politicians of both governing parties as a convenient way of distracting attention from the farm income problem. By bundling figures for sales of both primary and processed products into one, it can be made to look as the whole "sector" -- that's in quotation marks -- is doing just ducky. In other words, if there's a dime's worth of wheat or corn or oats in a three-dollar box of cereal, you count the three dollars as "agri-food" income. The price of cereal tends to rise every year in line with the CPI, so you can look at the total and say "what's the problem?" Or do what the politicians and bureaucrats have been doing, which is to say that the solution for the farm income problem is for farmers to "move up the value-added chain," again in quotes.

I don't want to say that there aren't ways for farmers to get a bigger share of the retail dollar, but the notion that's been promulgated is that they can somehow set themselves up in competition with Cargill or ConAgra or Archer Daniels Midland or Smithfields or Tyson Foods and there is just no way they can do that, much less get themselves into the even tougher battle

against General Mills and the like for space on the shelves of the big supermarket chains.

So if you ask whether the Canadian Prairie farmer is an endangered species, I could have given you a one-sentence reply, which would be "Well, given that Canada doesn't even have a federal minister of agriculture, I guess the answer is obvious."

And Canada doesn't have a minister of agriculture -- he is the "Minister of Agriculture and Agri-Food." It used to be that Canada had a minister of agriculture, and a minister of industry trade and commerce or similar title. That didn't mean that farmers got everything they wanted, but it did mean that they had a representative at the cabinet table battling it out with the minister who represented the flour millers and meat packers and so on, and the resulting process led to some kind of reasonable policy balance. We now have a minister in charge of both -- in other words, the fox is in charge of the henhouse.

So much for my rant -- I was talking about habitat, but I am getting to my point, which has to do with that rather abstract, top-down goal of reaching four per cent of world agri-food trade value by 2005. Once decided on, the feds at least had the sense to ask whether it was possible and threw the question to the PFRA, one of the best and most useful but least-recognized departments of the federal government.

Last November the PFRA released its report, called *Prairie Agricultural Landscapes -- A Land Resource Review*. I quote from the executive summary:

"The increase in production and processing of goods in the Prairie region will pose numerous challenges for the sustainable management of the land resource base."

"The land base required to meet these targets is forecast to come from improved

crop management, increased cropping intensity, reduction of summerfallow and increased pressure to cultivate environmentally sensitive lands. The implication of these changes in the agriculture and agri-food industry must be evaluated from economical, sociological and environmental perspectives."

I don't want to oversimplify a thorough and balanced 180-page report which addresses croplands, rangelands, water quality and even social issues, but while I'm on this issue of habitat for Prairie farmers, and therefore their ability to grow crops over the medium to long term, let me offer just more quote:

"It can be concluded that more than 50 per cent of annually cropped fields are exposed to erosion each year on the Prairies. The reduction of summerfallow and fall tillage, combined with the adoption of direct seeding systems, has narrowed the period during which soils are exposed. However there remains ample opportunity for erosion from fields in high-disturbance seeding systems. Severe and widespread erosion could still occur during extreme climatic events, and especially during a period of years with back-to-back droughts."

The report highlights several areas where management practices must be improved to maintain or restore a healthy soil and water resource base to ensure long-term habitat protection for the Prairie farmer. I cannot recommend this report highly enough, but I fear it is has received little or no attention whatsoever in Ottawa or in farm policy circles generally, which have become obsessed with short-term issues such as complaining about subsidies in other countries, or arguing about they could get a few cents more a bushel with or without the wheat board, or closing more grain elevators and so on. Ultimately, these arguments are simply over which is the slowest way to go

broke. Longer-term issues such as soil or water quality don't even seem to be on the radar.

Another issue which is related to habitat, and which is being largely avoided by governments, farm policy groups, financial institutions and even by the farmers themselves, is farm succession. Unlike other species, *agricola expectatus* cannot just move in to his habitat -- he must purchase it with cold, hard cash.

Like the rest of the Canadian population, farmers are aging. It's estimated that through death or retirement, about 70 per cent of Canadian farmland -- some \$50 billion worth -- must change hands over the next 15 years. Bankers and governments are fond of saying that farming is not that badly off, pointing to the value of farm assets as evidence. But they are only valuable as long as there is a willing buyer able to purchase it from mom and dad or the retiring neighbor in order to provide them with the base for a reasonable retirement. And of course, a banker willing to finance the purchase. The fact that some 40 per cent of the land farmed on the Prairies is rented suggests to me that we are already having trouble with this transfer. It's been made more difficult because the trend has been for farmers with cash to buy up nearby land as it comes available, hoping that by wrapping it into their operation they will be able to get some economies of scale by getting bigger, and creating a viable operation for the kids when they take over.

But that means the land price tends to be bid artificially high, and when it comes time to finance the whole operation the economics just aren't there. Indeed, at current prices and production costs, it's questionable whether Prairie farmland is worth anything.

My last pseudo-scientific species survival indicator is breeding success. After all, to survive, any species must be able to find mates and reproduce.

Now the 4WD pickup truck may have been able to help expand the range of young examples of *agricola expectatus* in search of a mate, but as the rural population declines and distances from prospects increase, these creatures find limited success in their local communities. They are drawn to larger urban centres where the percentages of mating success are higher. Once secured, city-bred mates, particularly the females, may not be too keen on moving out to the middle of nowhere to become a partner in a business for which there is no immediate prospect of profit, you must drive half an hour to meet the neighbor for coffee, and where the offspring must spend three hours a day on a school bus.

It has been the conventional wisdom that farms must become bigger to survive through economies of scale. That's certainly been the trend. But by any measure of fiscal, social or environmental health, I don't think we can say the trend has been positive. If we continue on this trend, the result will be that most grain farming in Canada will be done by "suitcase farmers" who will arrive in the spring to do the seeding, fertilizing and weed control, and then come back to harvest in the fall. Farmers won't live on the land they farm or even in the small communities nearby.

Which brings me to the theme of this conference: Finding Common Ground. I do not believe this outcome is the interests of farmers, conservationists or the species they are trying to protect. This will simply accelerate the tendency to look at land as capital to be exploited over the short term, rather than a long-term resource and a

birthright to be passed on in the same or better condition than we inherited it. The question we must start asking about every land management practice is "Could be still be doing this 1,000 years from now?" Clearly the answer is "no" for many current practices. But I think it goes beyond the practices themselves -- the question is which practice is appropriate for a given piece of land. I think the answers can only be found by those who are living on that land and have a unique attachment and understanding to it. I don't see a "suitcase farming" or "farming by recipe" approach simply relying on purchased inputs and hired labor as being sustainable for 1,000 years. I don't see seasonal employees hired at eight bucks an hour to pull 60-foot cultivators around as being too careful about avoiding wildlife habitat. Even if the objective was to just turn it back to the buffalo, just abandoning things is simply not an option. The land needs management, and it needs people on it to manage it properly. In other words, the best thing we can do for farmers and other species is to get more people back out there on the Prairie landscape.

This is where farmers and environmentalists have an opportunity for common ground, and the main area of agreement is that the Prairie landscape does not exist only for food production. Even ignoring the principle that there are other uses and values for the landscape, the fact is that farmers are locked into a vicious cycle. As prices go down because of the perception or reality of surplus, farmers as individuals respond by trying to produce more. If there were just one farmer in Western Canada, he or she would respond rationally to low prices by cutting production. But 100,000 farmers individually attempt to offset low prices with more volume, collectively making the surplus and prices even worse.

Every few years this cycle breaks due to the perception or reality of a crop shortage, as it did briefly for a few years in the 1970s and briefly in 1996. We then hear dire predictions of how the world is going to run short of food and so on. Farmers gear up their hopes and investments, and it invariably crashes in a heap.

We need mechanisms to smooth these boom/bust cycles, be they income stabilization, stock holding or conservation programs which take land -- especially environmentally sensitive land -- out of production.

In other words, the common ground here is that the less farmers grow, especially if it can be arranged on a national or North American scale, the more money farmers will make.

How do we get to this desirable objective?

Some attitude changes are required. I'll start with the farmers. The first notion they must discard is that their main objective in life is to feed a hungry world, and that the land exists solely to produce food and that this justifies any management practice they care to apply to it. I am tired of hearing the question "What's more important, people or (insert one; ducks, beavers, deer, etc)?" If this question is meant to justify a management practice that won't allow the farmer's grandchildren or great grandchildren to farm decades or centuries into the future, then the answer is clear. The ducks are more important.

And in discussion of the endangered species legislation, please: let us never again hear a farmer or farm group suggest that any way that it is crafted, right or wrong, would prompt a farmer to adopt this practice of "shoot, shovel and shut up" to prevent the discovery of endangered species on his land. This kind of negotiation by threat is highly

distasteful, and if there are really farmers or ranchers who would behave this way, perhaps they don't belong in the business. If I can apologize on their behalf, I must point out that some of these attitudes are the result of a bunker mentality. When you're not making much money, and you're losing your neighbors, your hospital, your school, your rail line and your elevator, you start to feel like you're being picked on, and you get a bit suspicious of outsiders who don't understand your problems. I'm not sure if farmers meet the COSEWIC definition of an endangered species, but they certainly belong in the "threatened" category, and anyone who feels threatened tends to avoid outsiders. What farmers should be doing is welcoming them with open arms.

Not that farmers don't have reason to be suspicious. They keep being fed false hopes about WTO agreements, or level playing fields, or booming world demand which is just around the corner, or fantastic new opportunities for getting through building processing plants and so on. And nothing ever happens.

I hate to bring up gun control, but it's an example of the two solitudes between farmers and other Canadians. This is an idea which I think any reasonable person can argue is for the good of Canadian society as a whole. But when it came along many farmers had this knee-jerk reaction, and the coffee shops just went crazy with talk of the best way to protect your guns when you buried them so that the feds couldn't find them when they came to seize them, and after all you need those guns to protect yourself from the fed takeover, not to mention that rampant crime that's sweeping rural Canada.

This was just totally irrational. If it came to the point of a federal takeover, may I suggest that even the Canadian army could

handle the farmers pretty easily. As for rampant crime, Brent Butt, the comedian from Tisdale Saskatchewan, says in his routine that when you're robbed in a small Prairie town and the RCMP ask you if you can describe the culprit, you say "Sure -- it was Bruce."

Knowing the views of most of my farmer-readers on this issue, I just tried to ignore it and hoped it would go away.

Until it came time to sign up personally because I have a Cooey 20-gauge single shot that I haven't fired for 20 years, and I realized what a God-awful mess this registration procedure is. And you get charged for it. The amount is really not the issue so much as the principle -- there are some services that should be user-pay and some that should be publicly funded because they are for the common good, and this should have been the case with gun registration.

But the problem couldn't be resolved because of the two solitudes. On one side there was an out-of-touch bureaucracy coming up with dumb rules. On the other was a strident rural lobby that just stuck to saying "registration is bad, period," and refusing to discuss it. The result was bad policy, a bunch of upset people and no dialogue.

I hesitate to use the term "urban environmentalists" as it may be more a label than a description, but if there are any of you out there, I hold this up as an example of how not to handle things when dealing with farmers. I will acknowledge they are excessively punchy on some matters, but when it comes to issues which concern the broad public good then the responsibility -- and costs -- should be shared, and that should be the starting point for dialogue. Farmers are simply not making enough

money to finance the research into and application of measures to restore the kind of habitat and species diversity we should have in Western Canada. But if they receive assistance -- and not just dollars, but knowledge and other resources -- they stand to benefit once the investments are made.

I will leave you with the best story I've heard in a while, and even better, it's a story that came from a conference held last fall. It was called Recapturing Wealth on the Canadian Prairies, and was one of the most encouraging experiences I've had in a while because farmers talked openly about non-monetary wealth, about taking charge of their farms and substituting knowledge and experience for purchased inputs, about having better and more direct relationships with consumers, and even about the spiritual values of living on the land.

One of the speakers was Karen Armstrong-Cummings, who had served as vice-chair of the U.S. Department of Agriculture's commission on small farms. But her day job was working for a tobacco co-op in Kentucky. She told us of how here members

were well aware of the moral issues surrounding their product, but that they were locked into producing this crop because there were simply no other options that would produce the income necessary to keep the operations going.

Along came the 1996 U.S. farm bill, and obviously there were strong interests out to gut the government program that made tobacco so profitable.

What did these growers do? They arranged meetings with the Cancer Society and the Lung Association. To make a long story short, both organizations supported the maintenance of the tobacco program in the 1996 Farm Bill.

Incredible? Not really, when you consider that letting the open market take over would have meant more growers allowed to grow tobacco. That would in turn mean more supplies, lower prices, and more cheap offshore imports. In short, more incentive to smoke.

The meetings continue, and the lung association and cancer society are even supporting the growers with funding in their attempt to find viable alternatives.

I can't think of any better example of the mutual benefits of finding common ground, and I wish you luck in coming up with some equally good ones. Thank you.

FIRST NATIONS AND PRAIRIE CONSERVATION: PAST, PRESENT AND FUTURE

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Abstract: A brief overview of the First Nations that have been part of the prairie ecosystem for thousands of years, the current conservation challenges facing First Nations and the hope for conservation by First Nations in the future. Historically, reproductive units of important medicinal plants were traded within and between First Nations, thereby affecting plant distributions and conserving these plants for future generations. Additionally, other practices, such as, plant harvesting techniques and traditional burning practices were used to conserve and renew the land that sustained these nations. Today, some First Nations people continue traditional conservation practices but to a severely limited extent. The prairie land once used to support First Nations is now mostly used for industrialized agriculture. Without the land to practice the traditional lifestyle the First Nations culture has been transformed. The loss of the land and the transformation of First Nations culture, the colonization of Canada, and the effects of residential schools may have eroded traditional conservation practices from the minds of many First Nations people. Clearly, the effects of colonization alone have had a devastating impact on the First Nations identity. It may take many generations yet to recover. The result is First Nations struggling to meet basic societal needs. These struggles make conservation a luxury few First Nations can afford. Young people and all those who remember the traditional ways are integral to future conservation efforts in First Nations communities. The Centre for Indigenous Environmental Resources (CIER) has developed an innovative approach to educate First Nations people in environmental sciences and Indigenous knowledge. The program is called the Environmental Education Training Program (EETP). The collaboration of Western and Indigenous knowledge systems will enable these students to return to their communities and make conservation efforts more affordable. Furthermore, the EETP facilitates the dissemination of Indigenous knowledge from one generation to the next. Additionally, CIER is in the process of developing a green roof garden focused on conserving prairie plants of importance to First Nations. The garden will be a resource to the EETP and provide habitat to native birds and insects.

ECOREGIONAL PLANNING AND THE NATURE CONSERVANCY OF CANADA: CONSERVATION BLUEPRINTS FOR THE PRAIRIE ECOREGIONS

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Abstract: The Nature Conservancy of Canada's conservation goal is the long-term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions. Conservation blueprints, or ecoregional plans, will become a foundation of the long-term conservation work of The Conservancy, directing how we approach our work, set our priorities for action, build effective partnerships, and act on best implementation strategies. The Conservancy and its partners will focus on all viable native community types and all viable and vulnerable native species. In each of the four ecoregions defined for the Canadian prairies, we will design a conservation blueprint B a portfolio of sites that, if conserved, could collectively sustain all of these elements of biodiversity. Each site in the portfolio will be an area within which we or our partners can work at sustainable levels to conserve, or where necessary restore, the ecosystem patterns and functions that sustain the elements for which that site was selected. A portfolio will include the number and distribution of sites needed to protect multiple, viable or restorable occurrences that can best ensure the survival of the target species and community types. The sites will be selected using the best available information across the range of species and community types. The portfolios developed will be the basis for site-conservation actions. The Conservancy will set its action-site priorities based on uniquely important ecological themes that distinguish each ecoregion, and based on the threats and opportunities, the degree of existing protection, and the partner strengths in the region.

The Nature Conservancy of Canada's (NCC) conservation goal is the long term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions. Conservation blueprints, or ecoregional plans, will become a foundation of the long-term conservation work of NCC, directing how we approach our work, set our priorities

for action, build effective partnerships, and act on best implementation strategies.

Definition: *Trans-jurisdictional conservation mapping and data analysis undertaken for individual ecoregions to define the portfolio of sites that, if conserved, would sustain the viable plant and animal species and ecological communities of the ecoregion.*

Conservation Blueprints and Ecoregion Plans – What are they?

Conservation blueprints or ecoregion plans are projects that are based on our natural geography, such as the Northern Tallgrass Prairie ecoregion, and that invite partners from various agencies and jurisdictions to assemble and analyze the available data on our species, sites and landscapes. The goal is to define the portfolio of sites, which, if conserved, would sustain the plant and animal species, and communities of the region. The portfolio empowers participants to develop action plans appropriate to particular sites and situations.

- **Groundwork** . *Establishing the Partnership*
 . *Starting Steering Committee, Work Teams and Expert Workshops*
- **Gathering the Pieces** . *Identifying Biodiversity Targets and Viability Criteria for Targets*
 . *Mapping Sites with Targets Meeting the Criteria*
 . *Assessing Existing Conservation Portfolios and Protected Areas*
- **Designing the Portfolio** . *Assessing Viable Target Occurrences and Identifying Priority Sites*
 . *Identifying Accomplishments, Threats and Opportunities*
- **Compiling the Blueprint** . *Developing Participant Strategies for Action Sites*
 . *Communicating the Project*

Ecoregion planning builds science, consensus and energy into conserving portfolios of sites. Flowing from the analysis and mapping of the portfolio of sites is the ability of different participants to identify action strategies for particular sites or suites of sites. An assessment of threats and opportunities is part of these action strategies, and participants will be invited to consider how direct securement, leverage and innovation can achieve site conservation. For example, on Crown lands, provincial programs may wish to consider protection options. Elsewhere on private

The portfolio of sites in a conservation blueprint is assessed regardless of ownership or history, based on current protection status, features, threats and strategic ecological themes. The portfolio can become a consensus instrument for conservation partners to assess their conservation priorities in a region. For the Conservancy, the portfolio and blueprint will become the basis for deriving the key action sites where securement or other approaches are critical. Conservation blueprints are being developed continent-wide and involve several key steps:

lands, NCC and its partners interested in direct land securement will have an enhanced ability to focus on the most significant real-estate investments. Through its conservation blueprints, the Conservancy will also develop its slate of national action sites for its emerging national capital campaign. Some of the innovations of this approach are as follows.

- Invites and strongly leverages individual and group efforts to identify particular portfolio sites as action sites, and invites

consensus on action strategies based on a commonly conceived portfolio of sites.

- Adds two additional dimensions to site identification work, specifically 1) the emphasis on occurrences of globally vulnerable species and communities, data held and managed by the Conservation Data Centres in each of the prairie provinces and states, and 2) the identification of landscape-scale action sites where coincident conservation values are particularly high.
- Takes advantage of new technology and methods not previously applied in identifying conservation sites.

NCC is moving towards comprehensive, documented portfolios of sites reflecting both the interests of other groups and agencies, and the best bets for investing in viable, long-term biodiversity conservation.

The Northern Tallgrass Prairie ecoregion was the first bi-national conservation blueprint (1998), encompassing parts of five US states and Manitoba. Its standard methods were based on the TNC documents *Conservation by Design* (1996) and *Geography of Hope* (1997). The major, largest portfolio site to be identified through that study straddles the international boundary; to date, about 5000 ha of these Manitoba tallgrass prairie sites have been secured, as has a comparable area stateside.

Ecoregion planning is focused first on ecoregions at greatest risk, and we are working with Environment Canada's EcoMap project to document the ecoregions, all straddling the US border, that have the heaviest ecological footprint and the highest biodiversity values.

Why is the Nature Conservancy of Canada committed to conservation blueprints?

Ecoregion planning is a priority of the Canadian conservation community, and the Conservancy was identified as taking the lead on this for the settled ecoregions of southern Canada at discussions among leaders of Canadian national conservation organisations at Strathmere in August 1999.

Ecoregion planning is the focus of our North American partners in conservation

The (US) Nature Conservancy (TNC) is undertaking ecoregion planning across the US and supporting the development of international, unified visions for conservation across national boundaries. To accomplish this, they are cooperating on bi-national projects in ecoregions shared with Mexico, and are working with the Nature Conservancy of Canada to develop these conservation roadmaps across our international boundaries as well.

The NCC has Made Investments in and Commitments to Ecoregion Planning...

NCC, working with the TNC, took a leadership role in Canada in promoting and supporting the development of natural-heritage programs and Conservation Data Centres (CDCs). The CDCs are now achieving a level of data density that makes them powerful tools for identifying site-conservation priorities.

The Conservancy has supported the development of Canada's network of seven Conservation Data Centres (CDCs) to the amount of \$2.1 million since 1988, with the TNC supporting the start-up of the CDCs to an equivalent level. We currently have agreements for research projects with two CDCs and for site surveys with another. The CDCs represent an investment in data and expertise, which we now want to direct at landscape-scale ecoregion planning and, by doing so, strengthen the CDCs and

conservation. The Conservancy's strategic plan for 1998 to 2002 specifically identifies as targets the initiation of ecoregion planning projects and the support of Canadian CDCs.

The science goal of NCC is:

- To target areas for Conservancy action in a more systematic fashion, a better knowledge of the species, habitat characteristics and stresses in ecoregions and at sites is needed. This will require NCC to invest in upgrading the Conservation Data Centres and build stronger working relations with the data centres and TNC.
- NCC will improve its capacity to develop ecoregional plans and will utilise its Scientific Advisory Network more effectively.
- Seven fully functioning CDCs in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Atlantic Canada providing services and products required by NCC to achieve its goals.
- Five ecoregional plans completed and associated action strategies prepared.

These are coincident interests, supported by CDCs, which are ready for the challenges of developing conservation blueprints.

Ecoregion Planning is Now a Focus of the Prairie Conservation Community...

The concept of ecoregional planning for the prairie ecoregions has been discussed with

the NCC partners in conservation, specifically the directors, managers and staff of TNC, Environment Canada, Parks Canada, World Wildlife Fund, Ducks

Unlimited, the Conservation Data Centres of Alberta, Saskatchewan, Manitoba and Montana, the universities of Calgary, Alberta, Saskatchewan and Regina, Alberta Environment, Alberta Agriculture, Saskatchewan Environment, Manitoba Conservation and others.

Ecoregional planning was initiated at a meeting in Calgary in February of 2000. Four prairie ecoregions were defined at this meeting. These ecoregions, all of which intersect the Canada-US boundary, include Aspen Parkland, Fescue – Mixed Grass Prairie, Northern Great Plains Steppe, and Northern Tallgrass Prairie (see attached map).

Existing data sets and related and/or convergent projects underway, which could form the basis of an ecoregional planning database, were identified by partners. The meeting participants also compiled a list of candidate sites for conservation and identified priority sites.

NCC is currently working with partners to complete the planning process for the four prairie ecoregions.

PARTNERS IN STEWARDSHIP: THE OLD-MAN-ON-HIS-BACK PRAIRIE & HERITAGE CONSERVATION AREA

Sue Michalsky

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Abstract: High on a plateau anchoring the east end of the Cypress Uplands lies 13,100 acres of grassland - the Old Man on His Back Prairie & Heritage Conservation Area (OMB). Thanks to the conservation efforts of Peter and Sharon Butala, the original owners of the ranch, it is one of the best intact expanses of Semi-arid Mixed-grass Prairie left in Saskatchewan and is large enough to conserve the full range of biodiversity. Located between two large blocks of intact native grassland primarily owned and managed by the Crown, the securement of OMB completes a contiguous block of native prairie over 60,000 acres in size. A wide diversity of flora and fauna are present including species at risk such as the Burrowing Owl, Swift Fox, Ferruginous Hawk and Sage Grouse. The Conservancy acquired the ranch in 1996. The primary goal of the project is to showcase the compatibility and sustainability of ranching and conservation. The new owners, Saskatchewan Agriculture and Food (SAF), Saskatchewan Environment and Resource Management (SERM) and The Conservancy, guided by the advice of the local community and other stakeholders, are managing the property to meet this goal. This project is an opportunity for a variety of conservation groups, government agencies, industry, as well as ranching, hunting, tourism, artistic and other local interests to work cooperatively to ensure the protection of an important natural asset for the benefit of the community, the province and all Canadians. The program developed for OMB centers around long term stewardship and includes: the restoration of 1050 acres of cultivated land to native prairie; reintroducing of bison as the natural grazer; preserving cultural history through restoration of the existing buildings; and documentation of a last great place by profiling the landscape and conservation through the writing and nature photography of Sharon Butala and Courtney Milne.

The Nature Conservancy of Canada (NCC) focuses on achieving conservation through partnership. Many of our partnerships focus on the land acquisition component of conservation. We have recently begun to prioritize stewardship as an important component of our conservation work.

Stewardship is best accomplished through partnership – partnerships with landowners, with scientists, with government agencies, and with other conservation groups. The Old-Man-on-His-Back Prairie and Heritage Conservation Area (OMB) is an example of

a project where NCC is applying this philosophy.

BACKGROUND

High on a plateau anchoring the east end of the Cypress Uplands lies 13,100 acres of grassland - the Old Man on His Back Prairie & Heritage Conservation Area. Thanks to the conservation efforts of Peter and Sharon Butala, the original owners of the ranch, it is one of the best intact expanses of mixed-grass prairie left in Saskatchewan. When Peter began to think about retiring he offered NCC ownership – a chance to secure forever a piece of intact prairie large enough to conserve the full range of biodiversity. This chance offered an opportunity for a variety of conservation groups, government agencies, corporations, and ranching, hunting, tourism, artists and other local interests to work cooperatively to ensure the protection of an important natural asset for the benefit of the community, the province and all Canadians.

NCC acquired the ranch in 1996. The property is located in southwestern Saskatchewan near Eastend in semi-arid mixed-grass prairie. Today, only about 30% of the original semi-arid mixed-grass prairie remains in Canada. Large, unbroken tracts only exist near the Cypress Hills and along the Frenchman River Valley.

SIGNIFICANCE

Sweeping vistas of open prairie, incredible sunrises and sunsets, and an abundance of wildflowers and grassland birds are just some of the many natural attractions at OMB. The ranch is a haven for wildlife rarely seen by most Canadians. Small herds of Pronghorn Antelope frequent the property, and Mule and White-tailed Deer are commonly sighted. Because very little

of the property has been cultivated and the native range has been so well managed, plant diversity is high. The property provides habitat for significant species such as the once-extirpated Swift Fox, the nationally endangered Burrowing Owl, the nationally threatened Sprague's Pipit and Loggerhead Shrike, the nationally vulnerable Long-billed Curlew and Ferruginous Hawk, the Sage Grouse, and Northern Leopard Frog.

The Old-Man-on-His-Back Prairie & Heritage Conservation Area is also significant from a historical and cultural perspective. In the distant past, this was home to dinosaurs. The nearby town of Eastend boasts the famous Tyrannosaurus Rex – Scotty, and a museum has been devoted to education and research of the palaeontological resources of the area.

Numerous teepee rings and other archaeological features remain intact. Home, in the early 1800s to the Assiniboine or Stoney people, this was the area to which Sitting Bull led the Dakota Sioux in 1877 to escape persecution from the American government. Currently the Nikaneet Nation of the Plains Cree represent the only Aboriginal people living in the region.

OMB is just over 20 km from the Canada – US border, thus the route of the famed Boundary Commission passed nearby. A portion of the ranch, now called the 'Remount Pasture' was used by the North West Mounted Police after their march west in the 1880s to pasture their horses. A rail line used during the settlement era still traverses the property.

Wallace Stegner's family homesteaded just south of the ranch along the Montana border. Stegner is a Pulitzer Prize winner and author of 'Wolf Willow'. The house where Peter

Butala was raised remains on the property, and this is where Sharon Butala created her nationally acclaimed book entitled 'Perfection of the Morning'.

This last great place will be profiled through the eyes of Sharon Butala and Courtney Milne in a book about the property, its significance and its history.

MANAGEMENT

Using input from all partners, NCC is in the process of designing a stewardship blueprint for OMB that incorporates ecological protection, ranching, restoration of cropland to native prairie, environmental education, monitoring and research.

The primary goal of the project is to showcase the compatibility and sustainability of ranching and conservation. The new owners, Saskatchewan Agriculture and Food (SAF), Saskatchewan Environment and Resource Management (SERM) and NCC, guided by the advice of the local community and other stakeholders, are managing the property to meet this goal.

Management at OMB is guided by four broad principles:

- The conservation values of the property must be maintained or enhanced;
- The land must be grazed, and grazing must be considered at the core of any site plans;
- Activities and planning for the site must provide some form of local benefits or opportunities; and
- The project must provide opportunities for public education by being a showcase for conservation.

The Old-Man-on-His-Back Conservation Area is managed by a Steering Committee,

which is made up of the three new owners of the land – NCC, SERM and SAF – and the Rural Municipality of Frontier. The Steering Committee is advised by a Local Advisory Committee, which is made up of individuals who have local or regional knowledge. Members of this committee include local landowners, Peter Butala, and representatives from The Saskatchewan Stock Growers Association, The Saskatchewan Wildlife Federation, Eastend Tourism, SaskPower and the Nikaneet Nation. Members of the Steering Committee also sit on the Local Advisory Committee.

The management plan will identify and guide future activities on the property. The management goals for the property include:

- restoring cultivated fields to native prairie species;
- constructing a visitor complex to support tourism and education programs;
- reintroducing bison as the natural grazer; and
- ensuring a commitment to long-term stewardship to support monitoring, management and research activities.

Restoring Biodiversity:

The restoration of a functioning mixed-grass prairie realizes the dreams of conservationists and others interested in reclaiming the natural past. Approximately 1000 acres of the property are currently cultivated and used as cropland. This land will be reseeded to native plant species.

The Conservancy is working with Ducks Unlimited Canada's Native Plant Solutions program, the oil and gas industry, agriculture chemicals sector and the Saskatchewan Government on this component of the project. Most of the funding to complete this undertaking has been committed and

will be provided by Wascana Energy Inc., SERM's Fish & Wildlife Development Fund, foundations and individuals.

This project has the potential to change government policy by demonstrating large scale success of restoration of disturbed lands to native plant species.

Sharing a Cultural Heritage:

This project provides The Conservancy with a unique opportunity to share the natural and cultural heritage of the prairie with people from around the world. The property will be used to showcase the beauty of the prairie with its incredible history, and will demonstrate the positive relationship between ranching and the environment.

The ranch will be used to further conservation efforts through education and extension. The opportunity to influence conservation in this way is truly unique and has drawn international attention as a result.

A visitor center will be constructed and programs developed to educate the interested public on grassland ecology, grassland restoration, ranching and conservation, and natural and cultural history. This aspect of the project will allow us to link with other efforts in the region including the T-Rex Centre in Eastend, Grasslands National Park, Fort Walsh Historic Site and Cypress Hills InterProvincial Park.

The unique history of this site will allow The Conservancy to develop programs that link conservation and the arts. The site will be used for artist retreats, and photography, art and writer's workshops.

The public will also be able to come as tourists to use the site for its best known quality – solitude. OMB also has the

potential to draw attention to the plight of the Canadian prairies by educating visitors to the site. With so little native prairie remaining, time is of the essence to accomplish these goals.

Bringing Back the Bison:

NCC intends to graze OMB in an ecologically sustainable manner to help maintain the prairie in its natural condition. Once the dominant grazer on the Canadian prairies, the Plains bison have been gone for more than a century. The grassland ecosystem evolved in response to their influence. While cattle have partially replaced this influence, bison have a number of traits that are friendlier to their environment such as their ability to utilize native grass more efficiently. A large component of the vision for the property is to reintroduce bison to this landscape.

This showcase project has the potential to influence the management of both private and public grasslands by demonstrating sustainable ranching using a natural grazer.

Most of the large parcels of intact Semi-arid Mixed-grass Prairie on private lands are owned by ranchers. These productive lands provide a substantial amount of the remaining biodiversity on Canada's prairies. Therefore, a major goal of the Old-Man-on-His-Back project is to help maintain these ranch landscapes. To meet that goal, The Conservancy will establish the bison herd as an agricultural co-op and trade shares in the herd for conservation easements on surrounding private ranches. This strategy serves a triple purpose. First, it allows NCC to utilize OMB to complete conservation work off the project site. Second, it allows the project partners to invest in the local community. Third, it rewards and encourages good land managers.

Ensuring Long-Term Stewardship:

As part of The Conservancy's commitment to stewardship, an endowment fund will be created to support adaptive management, research and monitoring on the property. The endowment has been seeded with \$100,000 thanks to the generosity of SaskPower. The goal is to have a \$500,000 fund that will provide a minimum of \$25,000 annually to help cover the costs of stewardship.

SUMMARY

NCC would like to thank all our management and funding partners who have cooperated with us and helped make OMB one of our flagship projects. A project of this scope will significantly increase the profile and support of The Conservancy by being a destination property for our membership.

RE-LOCATION OF AN INTENSIVE LIVESTOCK OPERATION FROM A WATERCOURSE IN SOUTHWEST SASKATCHEWAN

Jason and Karmen McNabb

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Abstract: Jason and Karmen McNabb are third generation ranchers and farmers who are responsible for managing 2000 acres of native fescue prairie in the east end of the Cypress Hills, 1000 acres of tame forage, riparian areas along Bone Creek, a major trout bearing stream and a cultivated landbase of 2000 acres. In 1998, the McNabbs began a project to relocate a 500 head (cows and background calves) wintering facility from the Bone Creek Valley to an upland site. Windbreak fences, corrals and feeding areas had to be constructed and a livestock watering system developed to replace the water and protection which was naturally provided by the creek and the valley. Benefits include a positive impact on water quality and the creation for the opportunity for future expansion. Jason and Karmen will discuss the project, the benefits, the costs, the problems and their experiences of working with both conservation and agricultural agencies in their attempt to comply with *Agriculture Operations Act*.

McNabb Ranch is a third generation ranch in the east end of the Cypress Hills. The yard site and winter feeding pens are located along Bone Creek. A combination of economic and environmental concerns was the driving force behind moving the intensive wintering facilities from the valley bottom to higher ground. This project was developed in conjunction with the Sask. Wetland Conservation Corporation.

PREVIOUS SITUATION

Approximately 250 animals were wintered in a 3 acre wire pen, consisting of 2.5 acres of swamp and bush, and .5 acres of firm ground. This pen is located in the valley bottom, approximately 60 yards from Bone Creek.

Benefits of this location included:

- 1) Close to yard site for easy access for winter feeding
- 2) Animals have access to water at yardsite
- 3) Heavy willows provide shelter during winter storms

Drawbacks of this location included:

- 1) A large watershed area drains through this pen causing significant runoff concerns in the spring.
- 2) The willows are slowly being pushed back due to cattle pressure (chewing and rubbing).
- 3) The carrying capacity of this pen is limited due to its size and lack of firm ground in the spring.

PROPOSED PROJECT

The project will reduce the number of animals wintering near the creek under

intensive conditions. This was accomplished by constructing a 500 head facility out of the valley bottom, that complies with the current Agricultural Operation Act of Saskatchewan. SWCC agreed to contribute 50% of the project costs (labor and materials) and will use this facility as a demonstration site.

In order to meet the requirements for soil type and drainage, the new facility needed to be built entirely out of the valley bottom. As a result we were essentially starting from scratch – new power, water, and shelter. The project can be broken down into the following parts.

- a) An **Intensive Livestock Operation (ILO) permit** was necessary as the site is located within 1000 yards of both the main creek channel and two springs feeding into Bone Creek, as well as the number of cattle involved. The actual application took less than 1 hour to fill out. It consisted of identifying the site, the number and type of animals, a nutrient management plan for the manure, and a dead stock management plan. Completing the accompanying drawings for the application, illustrating the proposed site, planned drainage control and corral layouts were much more difficult to complete. The local PFRA office had very little experience with ILO permits, the overall process in developing intensive operation projects, and ended up providing very little help in the ILO permitting process. This caused much frustration and considerable time spent ourselves putting drawings together necessary to accompany the permit application.
- b) A **water source** had to be developed for the feeding pens. The original plan called for a new well to be drilled as close as possible to the new site but a dry

test hole required a revision to this. A new shallow well was drilled in the existing yardsite adjacent to the farm shop. This second attempt had marginal capacity and a small addition to the existing farm shop was required to house a storage tank necessary to accommodate peak periods of water demand. The water then had to be lifted 75 feet out of Bone Creek valley to the new site, requiring a slightly more involved pressure system than originally planned for.

- c) A **power service** had to be established as the site was too far from the existing yardsite to supply from there. Fortunately the Sask. Power transmission lines did run right through the new location making a new service only a matter of hanging a transformer and meter on an existing pole already in place.
- d) **Earthwork** was required in order to comply with the ILO permit requirements. A ravine was blocked off along one side and the entire area sloped to this containment area along the back of all the pens. This involved a buildup of roughly six feet along most of the feeding side of the pens while sourcing dirt from the back side of all the pens and containment pond area. Pit run gravel was hauled and placed along the feeding fence alleyway to provide stability for feeding during wet conditions. The facility is 20% smaller than planned, as the earthwork required to achieve the original design size in accordance with the ILO permit requirements was cost prohibitive.

e) **Five corral pens** were built, composed of 460 feet of feeding fence made from used drill stem along a single side

alleyway, and 1550 feet of 20% porosity windbreak fence to provide shelter from the back and sides of each pen.

PROJECT COSTS

The following costs reflect the purchased materials or services for the project.

Earthwork	Soil test holes and sloping the facility to control drainage, and construction of containment pond	\$4,665
Electrical	Installation of the power service and material such as panels, breakers, underground wire and yard lights.	\$3,356
Water	Water bowls, waterlines, approx. 2700ft water line trenching, cement for pads under each waterer, hydrants, and fittings	\$13,350
Well and Pressure System	340ft of dry test hole, 50ft of completed small bore well, pressure system, submersible pump and controller, plastic storage tank, and fittings	\$10,218
Pump House	12x16ft addition to existing farm shop for storage tank and pressure system (insulated, wired and heated).	\$7,751
Corrals	16ft gates, slabs, rough 2x8's, nails, railroad ties and gate posts, used drill stem and oilfield pipe, cement for steel posts	\$10,975
Materials Total		\$50,315

The labor was nearly 100% supplied by ourselves, including all electrical and plumbing. The labour effort hours relating directly to the construction of the facility were tracked on a daily log from January 17th, 2000 to October 19th, 2000. The rates used were \$15.00/hr for general laborer work, \$35.00/hr for electrical, plumbing or welding work, and \$50.00/hr for our loader tractor for augering post holes and backfilling trenches. To complete this project 733 hours were needed at a cost of \$16,855

This brings the project total to **\$67,170**, of which approximately 50% has been reimbursed by SWCC.

LESSONS LEARNED

1) There was not enough time spent to understand all costs up front. Our original project cost estimate was \$37,300, completed in May of 1999, six months before construction started (revised to approx. \$70,000 in December 1999). In addition, there were hidden costs that we had not anticipated e.g. multiple trips to town for materials, labor hours spent sourcing

materials, etc.. If we had thoroughly understood our all costs upfront, we may have made some different decisions. Even with 50% funding of all project costs from SWCC, the cost has been difficult for our operation to absorb.

2) The ILO permit process has room for improvement. The role of our local PFRA office was not clear to either themselves or producers involved. The average producer will most likely look at both the daunting pile of paperwork required, and the clear lack of support and direction from this agency, and decide it is in their best interests to lay low and hope no one notices them. This is also evident by observing several new and expanding operations in our area with respect to their general disregard for the Agricultural Operations Act requirements. The two site visits from the Sask. Ag. and Food representative were very beneficial in helping us through the process. This method of actually visiting the producer and working through specifically what is needed and not needed for each situation, both improves the understanding of the Agricultural Operations Act for the producer involved and smoothes out the process as well.

3) Meeting the requirements of the ILO permit added not only paperwork and frustration, but also increased the costs, and resulted in a smaller facility than originally planned. In our case, moving out of the valley would have provided the majority of the environmental benefit. We feel that the \$5,000 cost for soil tests and earthwork to meet the requirements of the permit exceeded what was necessary for drainage control in this particular situation. In light of this, even producers who are concerned about their impact on the environment will need encouragement to comply.

CONCLUSIONS

We have significantly reduced the number of animals wintering in the valley bottom. This will improve the health of the riparian area within the old wintering pens, as well as contribute to the improvement of Bone Creek water quality – especially during spring runoff.

Our original situation was very similar to that of many producers. Most cattle ranches have evolved from smaller operations where natural water and shelter were used wherever possible. As margins become tighter, more animals are needed and the natural settings are being stretched to the limit. As we have found however, replacing Mother Nature is expensive! Between our two families, we have spent over 700 labor hours on our project, and the equivalent of a \$33,500 – and we were only paying 50%! We do not believe the average producer will *volunteer* that kind of commitment – on the basis of environmental improvement alone.

Would we have done this over again? This question has caused much debate within our family, as there are other operations in the local area that have expanded *without* complying with the Agricultural Operations Act and they are considerably dollars ahead – at least for now. Our conclusion – had we not had the financial support from SWCC, the project would not have been possible. However, our project was designed to accommodate an immediate expansion of our herd, as well as to allow for further expansion in the future, and our new practices will allow us to feed at a lower cost via the shift to perimeter bunk feeding. These factors will increase our returns on wintering calves, and help offset the capital costs required for the project. This combination of environmental improvement with economic value we believe, is critical to the success of future projects.

MANAGING A SMALL PARCEL OF PRAIRIE

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Abstract: We own a 30-acre remnant of mixed grass prairie in south-central Manitoba. Some years ago we attempted to reduce the distribution of chokecherry on our prairie. Initial control efforts through burning proved counter-productive. Subsequent experiments using burning, mowing, and herbicide techniques have effectively eliminated chokecherry from the prairie. We have now re-focused our management objectives to the restoration of oak savanna, with its components of hazel and aspen, and to the control of smooth brome. Our experiences may be of interest to other owners of small parcels of prairie which could be restored and managed by inexpensive and hands-on techniques. Our presentation may also be of interest to organizations interested in promoting conservation stewardship of prairie remnants by private individuals and families.

We own a piece of land in south-central Manitoba, nine miles north of the village of Treherne. The legal description is NW 19-9-9, though it is in fact less than a quarter section, the entire south border being a bend in the Assiniboine River. Our land rises through river forest, up a series of steps and ridges where lie many spring fed ponds and pools. The river forest gradually changes to bur oak forest, interspersed with grassy openings. The valley rim, south facing, is where we live. Here the oaks are undergrown with hazel and poison ivy.

Our prairie falls away from the valley in a gently rolling profile, and is almost completely surrounded by oak and aspen mixed woods. We estimate that we have about 30 acres of prairie. The soil is Stockton loamy sand, light and free draining, easily eroded by wind and water. There is a variety of prairie plants, including at least 17 grasses and over 80 species of interesting, and in some cases, relatively rare prairie forbs. Many bird species utilize the different habitats offered by our land.

Though we have lived here less than a half dozen years, we purchased our land in 1976. Over the years we perceived a gradual encroachment of woods onto the prairie and, with the best of intentions, we set about to reverse this process. Through the Manitoba Naturalists' Society, we had become aware of prairies, prairie plants and prairie management. We knew that woody plants are the enemy of prairie and that fire, bison, and climatic conditions were the major factors in resisting these woody invaders. With neither wildfires nor bison, the woody plants were free to flourish. Our reading and research seemed to indicate that mowing could substitute for grazing buffalo, and that controlled burns were the post-settlement alternative to prairie fires.

Our first objective was to control the number of chokecherry trees that were scattered across parts of our prairie. What we failed to understand at that time was that our unbroken prairie was probably a relatively stable environment, in a normal state of slow succession. We remember that most of the chokecherry trees were stunted, and that

their thickened, twisted trunks were old and greyed with lichen.

Nevertheless, naively, we proceeded to learn how to do a controlled burn. We purchased books on controlled burns and, to gain some experience, we volunteered to participate in several prairie burns. Though still wary of runaway fire on our woods-encircled prairie, we borrowed a drip torch, a couple of sprayers and a few fire flappers, enlisted the aid of family and friends, and we undertook to burn some patches of our prairie. It was a warm day in early spring, before any greening on the prairie. Though the wind was quite light, the rolling topography of our land caused enough wind swirls and eddies to teach us very quickly that controlled burns have the potential to become dangerous and difficult to control. The billowing smoke brought fearful neighbours rushing to the scene.

That burn eliminated accumulated thatch, but we soon learned it was not the end of the chokecherry problem. After burning, the chokecherry responded vigorously, sprouting three or more shoots from the base of every burned tree. We saw that we had a much worse situation to deal with than the one we had set out to correct. It may be that repeated burning, over several years, in several seasons, may kill woody invaders such as chokecherry, but for our small prairie, as a method of controlling woody plants, it is not worth the trouble and the risk. It remains the best way to eliminate thatch.

Mowing and cutting seemed a much easier approach. In the years following our bug burn, we toiled with lawn mowers, Swede saws and a hand-held, gas powered brush saw. We became part owners of an old tractor and a five-foot brush mower. WE began to mow selected sites, trying to deal with the flourish young forest of vigorous

chokecherry. But, like burning, mowing is indiscriminate. While woody plants are being mowed and burned, the desirable prairie plants suffer the same treatment. We began to study whether there was a more desirable time to mow, setting up test plots and mowing one plot per month through the summer season. WE began to realize that mowing and burning may have unforeseen and perhaps drastic impacts upon prairie plant species. We do not have enough years left in our lives to plan a rotation of burning, mowing, and perhaps grazing at different seasons, nor did we have the resources to implement plans whose outcomes are questionable or unknown.

WE came to use the herbicide, ROUNDUP, with a good deal of reluctance, and might never have begun to use it had we not learned of Vogel's Wick Weeder. The Wick Weeder is a device resembling a hockey stick. The cylindrical handle is hollow, to be filled with an appropriate strength solution of ROUNDUP. The blade of the hockey stick is covered with a sock-like wick into which the ROUNDUP seeps at a controlled, steady rate. Donning rubber boots and rubber gloves, we began to wipe the leaves of the unwanted plants with a sweeping motion, wetting the leaves sufficiently to cause the eventual death of the chokecherry, while avoiding the indigenous grasses and forbs.

Through trial and error, experience, and from information from as many sources as we can locate, we have evolved some methods which we have used for successful poison control of unwanted brush on our prairie. In the main, we work with a narrow window of opportunity whose three indicators are:

1. The area to be poisoned must be carefully checked and be found to be free of nesting birds.

2. The chokecherry must be fully leafed out. At this time the plants are the most vulnerable, their resources are at the top of the plants, the roots are the weakest.
3. The plants to be wiped must be taller than the surrounding prairie plants, reducing the possibility of accidentally poisoning desirable plants.

These three criteria find us working our wick weeders primarily in the two-to-three week period of late May and early June. As an aside, this period seems to coincide closely with the height of the black fly season, another dimension of our work!

When the chokecherry to be removed is young and profuse, but tall enough for safe wiping, we proceed as follows:

1. Using two lengths of cord, we set 5-foot wide corridors, 200 feet long.
2. With the Vogel's Wick Weeders, filled with 25% solution, we begin, one at each end of the corridor, wiping our way towards each other. We wipe each plant twice, once from the right, once from the left. This double wiping ensures good coverage on both sides of a maximum of leaves.
3. When we meet in the middle, we move one cord, to start a new corridor, and begin again. WE have found that the corridors organize the application, practically eliminating the hit-and-miss effect of a wandering wiper.

From our test plot studies we have learned that ROUNDUP at 25% solution is quite adequate to kill chokecherries by wiping. Weaker solutions are not always effective, and no one wants to do that sort of job twice.

Stronger solutions are merely wasteful. Even with care, we do occasionally drip or wipe a few desirable plants, though these are relatively few. We absolutely never apply ROUNDUP when any of the prairie plants have reached the height of the chokecherry. This is why the poison period is limited to two or three weeks.

ROUNDUP is effective, though not instant. Treated leaves may show brown spotting within a few days, yellowing and leaf drop follows within weeks. The remaining stems remains pliant for an agonizing time, but never regrow. Any plants missed during the first wiping, and those too short to be wiped safely must be dealt with the following year, using the same techniques. The chokecherry is eliminated within three years.

As we have said, our prairie is surrounded by mixed woods, and these woods are creeping in upon our prairie. Discovering some old photos from the late 1970's, and re-examining old aerial photos of our land, we were startled to note the extent of the encroachment. We began to plan some action to reverse, or at least control the encroachment. As a first, easy step, annual mowing of the entire prairie perimeter holds back advancing suckers.

Poplar suckers can be found surprisingly far out into the prairie, well away from the parent tree. These suckers are really pliable, and usually have sparse foliage, making them difficult to wipe adequately, though when well wiped, they die quickly. It is more effective, however, to deal with the mature trees that spawn the suckers. Poplar trees are easily killed with ROUNDUP.

When removing full-grown poplars, we proceed as follows:

1. Check for wildlife. Our tree clearing operations have twice been

suspended, once for a newborn fawn, and once for a nesting grouse.

2. Using a chain saw, cut the trees at knee height, then flush with the ground.

If the trees to be cut form a bluff, we cut the perimeter first, gradually working toward the centre in more or less concentric circular patterns. The cut stumps must immediately be wiped with 100% ROUNDUP, using a paint brush of appropriate size. Treated stumps are immediately sprayed with blaze orange paint, to clearly identify them from those yet to be treated. Poplars treated in this way never spout or sucker, and the death of the parent tree often causes the death of the young, surrounding suckers, even those some distance away.

When removing a stand of mature chokecherry, five or more feet in height, we use a combination tactic, as follows:

1. The area to be cleared is mowed with the tractor and bush mower, then left for one, two or even three years to re-grow.
2. The flush or new growth, when sufficiently tall is wiped with the Vogel's Wick Weeder.

Though this procedure spans two or three years, has proven effective, and we find it much easier than attempting to wipe chokecherry trees at shoulder height or greater.

Removing a bluff of trees is, of course, no easy task, and some pre-planning is essential. We immediately top the trees as they are felled, then cut the major trunks and branches into firewood. These we split on the site, then haul them home for future use in our fireplace. Dealing with the slash presents a greater problem, as there is so much of it, and it is heavy with sap and the

flush of new leaves. We have tried hauling it away to pile as wildlife havens. When we tried waiting till fall to haul it away, we found that, though it was much lighter, it was entangled with a heavy growth of new grasses that had sprung up over the summer, responding to the new found light. Every branch had to be tugged and yanked to be moved, and then it still had to be "put somewhere". Slash can be stacked and left to dry, then burned later, when snow cover eliminates the danger of runaway fire, but a big fire scorches the earth, eliminating any growth of any kind for several years, so that slash piles can not be burned on the prairie itself.

Response to brush removal has varied on our prairie. One site responded immediately with a flush of early grasses, and has continued to diversify ever since. One site, north facing, suffered from the non-removal of slash with had hidden too many stumps from the wiping of ROUNDUP. That site will have to be treated again. The third site, by far the more mature stand of poplars, responded with a growth of hazel and chokecherry and will have to be mowed and wiped again. In all three cases, however, removal of the shade cast by the trees resulted in increased vigour among the surrounding prairie.

Our plan to control smooth brome began last fall. To reduce the risk of fire, we first mowed the brome, and then burned the area. The ground was scarified with a diamond harrow pulled by an ATV. Canada Wild Rye grass was hand broadcast, then packed with the ATV.

The brome is expected to sprout much earlier than the Wild Rye, and is expected to reach a suitable height for ROUNDUP application before the Wild Rye appears. The Wild Rye should be the first to re-

colonize the area, providing adequate competition for undesirable weeds.

The spread of leafy spurge continues around us, and we are ever vigilant of its appearance on our prairie. We are hopeful that the health of our prairie will offer some measure of protection, as we are aware of the difficulties we would face having to deal with leafy spurge.

In addition to the rich flora, our prairie is presently the eastern-most range extension of the Northern Prairie Skink, Manitoba's only true lizard. In February 1997, a cougar was encountered within 300 yards of our home by a skier enjoying our cross-country ski trails. Cougar tracks and several deer kills provide further evidence of the occasional use of our prairie by this elusive predator. Recently, earth mounds created by Northern Pocket Gophers have revealed lithic debris, bone fragments, potsherds and a scraper, establishing the presence on our prairie of an extensive archaeological site. Except for the activity of our rodent excavators, the site is undisturbed, though confirming what we have always suspected.

Our prairie is very special. It is truly sacred ground.

What motivated us to undertake this project? As enthusiastic amateur naturalists, we were more than half way there. The growing awareness of the value of our prairie, coupled with a better understanding of its complex nature pushed us into action. Most landowners would not likely come to appreciate their prairie without promotion and education from external sources.

Prairie management is not only labour intensive, it also requires special skills, training, and investment in equipment. We believe that few landowners would be

prepared to make the commitment without a good deal of assistance. Agencies interested in promoting small-prairie conservation could provide enormous help, from on-site inspections, providing landowners with knowledge and appreciation of their prairie remnants, to identification of objectives and the development of management plans. On-site demonstrations and the loan of necessary equipment is almost essential.

Our search for information was never easy. Trial and error marked most of our efforts, and doffed determination has been responsible for much of our success. We understand that our prairie project will never end, but as time passes, the job becomes easier, one of vigilance and fine tuning. Our prairie watch is now a pleasure to be enjoyed in all seasons.

BIODIVERSITY AND HEALTH OF RIPARIAN SYSTEMS IN TWO WATERSHEDS OF SOUTHERN SASKATCHEWAN

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Abstract: The Saskatchewan Wetland Conservation Corporation delivers the Streambank Stewardship and Riparian Enhancement Program in both the Bone Creek watershed of the Cypress Upland and Mixed Grassland Ecoregions, and the Whitesand Creek watershed of the Aspen Parkland Ecoregion. In partnership with private landowners, the Riparian Enhancement Program employs tools such as grazing plans, fencing, remote watering, and buffer strips to improve riparian condition. To evaluate the effectiveness of these enhancement activities, we collected baseline data in 1999 and 2000 on a wide variety of parameters relevant to riparian condition, including soil and hydrology condition, land-use of surrounding uplands, vegetation condition, and abundance of aquatic macro-invertebrates and birds. Water quality information for the Whitesand Creek watershed was obtained from Volunteer Water Quality Monitoring data for the area. Community composition of riparian areas varied significantly both within and between watersheds. Community structure varied from grassed stream margins to wooded draws along the linear riparian areas. Bone Creek was dominated by willow/sedge communities although mature aspen communities were present at some sites, whereas a maple/chokecherry/willow community dominated Whitesand Creek. Neither avian nor macro-invertebrate indices of richness and evenness differed significantly between treatment and control sites for either Bone or Whitesand Creek. Avian species richness was significantly higher at Whitesand than Bone Creek in both years, but species evenness did not differ between watersheds. Macro-invertebrate richness indices did not differ between watersheds. In 1999, we identified three distinct avian species assemblages, two within the Bone Creek watershed, and a single Whitesand Creek community. There was more overlap in avian species assemblages between the two watersheds in 2000. Macro-invertebrate assemblages were more similar between watersheds than

avian assemblages. Aquatic macro-invertebrate group richness did not differ significantly between control and treatment sites for either watershed, or between watersheds. The relationship between avian and macro-invertebrate richness indices was not significant ($P=0.47$). Comparison of biological and physical parameters of riparian condition will provide land managers with 1) an estimate of the magnitude of variation between riparian areas, and 2) a benchmark for long-term evaluation of riparian condition and enhancement activities.

INTRODUCTION

Riparian areas are the transition zones between terrestrial and aquatic ecosystems, which often support diverse biological communities. In western North America, the abundance of water in riparian areas results in vegetation that is more productive than that found in drier upland locations. Vegetative communities of Saskatchewan's riparian areas range from herbaceous meadow to shrub to woodland communities,

reflecting differences in factors such as flow regimes, climate, and soil (Hansen unpubl.). As avian species richness generally increases with the vertical and horizontal structural complexity of vegetation (Stauffer and Best 1980), riparian areas may support a diverse community of both breeding and migrating birds, despite covering only a small percentage of the western landscape (Stevens et al. 1977, Knopf et al. 1988a, Skagen et al. 1998). The aquatic portion of the community also supports a diverse assemblage of macro-invertebrates.

In the Prairie Ecozone of southern Saskatchewan, riparian areas provide valuable resources for agricultural producers. Riparian areas provide a water supply for livestock grazing, and floodplains have created fertile ground for cultivation.

However, riparian condition can be seriously damaged by poorly planned grazing and cultivation (Knopf et al. 1988b, Johnson and Jehl 1994, Dobkin et al. 1998). Ohmart

(1994) estimated 95% of riparian habitats in the western United States have been altered, degraded or destroyed in the last 100 years. Poorly managed grazing decreases plant vigour, alters the vegetative community, erodes streambanks, and may enable invasion by exotic weeds. Cultivation too close to riparian areas eliminates perennial vegetation altogether increasing the probability of erosion, salinization and leaching of chemical residues. Avian communities are affected indirectly by alteration or elimination of the structure of the vegetative community and possibly changes in predation rates (Ammon and Stacey 1997). Aquatic organisms are affected by degraded water quality, sedimentation, and changes in water temperature.

The Saskatchewan Wetland Conservation Corporation (hereafter SWCC) delivers the Streambank Stewardship and Riparian Enhancement Program in the Bone Creek watershed of the Cypress Upland and Mixed Grassland Ecoregions, and the

Whitesand River watershed of the Aspen Parkland Ecoregion. In partnership with private landowners, the Riparian Enhancement Program employs tools such as grazing plans, fencing, remote watering, and seeding buffer strips to improve riparian condition. To evaluate the effectiveness of these enhancement activities, we collected baseline data in 1999 and 2000 on a wide variety of parameters relevant to riparian health, including soil and hydrology condition, vegetative condition, and presence and absence of aquatic macro-invertebrates (hereafter invertebrates) and birds. Our objective was to gather information at both control and enhancement sites that would enable future comparative evaluations of program effectiveness. Here we use the baseline data to 1) describe the bird and invertebrate communities inhabiting riparian areas, 2) examine whether changes in the animal community between sites are consistent with changes in indices of riparian health, and 3) evaluate the suitability of control sites for the enhancement sites.

METHODS

Study area.--A total of 24 riparian sites were surveyed in two watersheds of Saskatchewan's Prairie Ecozone in 1999 and 2000 (Figure 1). Although long-term evaluation of riparian enhancement activities is possible by repeatedly sampling enhancement sites over time, we strengthened this design by also sampling control sites upstream and downstream of the enhancement site. The Bone Creek study area consisted of 5 main enhancement sites each with control sites upstream and downstream for a total of 15 study sites. The Whitesand River study area consisted of

7 control sites selected for 2 project sites for a total of 9 sites. The vegetative community varied from grassed stream margins to woodland along the linear riparian areas. Bone Creek was dominated by willow/sedge communities although aspen communities were present at some sites, whereas a maple/chokecherry/willow community dominated Whitesand River (Godfrey et al. unpubl.).

Riparian health index.--Field assessments were conducted from June to August in 1999 and followed the lotic health assessment protocol (Hansen unpubl.). Surveyors examined one complete stream meander at each site and scored site condition in various categories of vegetation cover and integrity, and the condition of soil and hydrological parameters (Hansen unpubl.). Each site received a total score out of a maximum score of 100. Lower scores indicated poorer riparian condition.

Bird surveys.-- The variation in topography and vegetative communities among sites necessitated use of both transects and point counts to survey birds (see Bibby et al. 1992, Ralph et al. 1993, Dobkin and Rich 1998). Sites with riparian zones greater than 100 m wide or dominated by woodland were surveyed using point counts, while sites with narrow or variable width riparian zones were surveyed using transects (see Anderson and Ohmart 1981, Franzreb 1981). Point counts consisted of 50 m radius circles with 5 minute recording duration. The number of points per site ranged from 5 to 11. Transects were 800 m in length and followed the main channel of the water body, with the surveyor attempting to remain in the riparian zone. The surveyor walked slowly along the

route, pausing occasionally to look and listen but avoiding long stops to prevent double counting of birds. All transects were completed within approximately 30 minutes. Birds observed ahead on the route were not tallied until within approximately 35 m. Once an individual bird had been seen or heard, it was not counted again. Birds flying over or foraging above the riparian area were noted but not included in the analysis. Edge-to-observer distance varied with the width of the riparian zone (following Emlen's 1977 protocol for narrow habitat strips, see also Mills et al. 1991). Surveys began 20 minutes before sunrise and were completed by 0830 h (CST). Surveys were not conducted in rain or when winds exceeded 20 km/h. Each site was surveyed twice between May 27 and July 13, 1999, and June 11 and July 7, 2000. The order of the point counts and transects were reversed between surveys such that a location surveyed at the end of the morning on the first visit was surveyed at the beginning of the morning on the second visit, and vice-versa.

We calculated species richness as the total number of species detected per site over the two surveys. For many species few individuals were detected, so we did not consider abundance of individuals in these analyses. To determine bird-habitat associations we calculated the proportions of species at each site by breeding habitat guild as defined by Sauer et al. (2000). To calculate the conservation importance of each species we used trend estimates based on the survey-wide Breeding Bird Survey data from 1966 to 1996 (Sauer et al. 2000). We used the survey-wide data to increase the reliability of the trends over estimates obtained for smaller geographic regions.

Aquatic macro-invertebrate sampling and tolerance rating.--Three samples were collected from 3 locations within each site during three visits between May 26 and August 11, 1999 (i.e. there were a total of 9 samples taken at each of the 24 sites). Each site was sampled only once between June 27 and July 7, 2000. In both years effort was made to sample riffle, run, and pool habitats if available at each site. A d-net was used to sample 2 m long swaths parallel to flow and in an upstream direction. For finer sediments (mud to coarse sand) a sweep method was used in which the topmost 1-2 cm of sediment were scooped up and gently sieved using the net. Larger pieces of debris and weeds caught in the net were checked for invertebrates prior to removal. The resulting samples did not exceed 250 ml. Sites with gravel to cobble sized substrate were sampled using a 2 m "kick" in which debris and organisms were loosened and subsequently flowed into the net. Larger cobbles and logs were then "cleaned" by hand so remaining organisms flowed into the net. Samples were either processed on site or placed in jars containing ethanol solution and processed at a later date. Processing involved placing the sample in a sorting tray and tallying the number of individuals of each order or family. Only organisms visible to the naked eye were tallied. A summary sheet prepared by David et al. (1998) was used to record counts and calculate tolerance scores for each site. This rapid bioassessment technique assigns values to each group of invertebrates detected at a site based on their sensitivity to changes in stream condition (David et al. 1998). Sites with more taxa present that are sensitive to disturbance or degradation receive higher

scores and are assumed to be in better condition.

Analysis.—We used *t*-tests for both equal and unequal variances (as required) to compare species richness between control and enhancement sites within watersheds (when sample sizes permitted), and between watersheds with control and enhancement sites pooled. When *t*-tests indicated a significant difference we calculated 95% confidence intervals (95% CI) for the difference between the means. We examined the relationships between bird and invertebrate richness indices between years, and each other, using the Pearson correlation coefficient. We used linear regression to compare both 1999 and 2000 bird and invertebrate richness indices with the 1999 index of riparian health. Invertebrate tolerance scores were compared with the 1999 riparian health index using the Pearson correlation coefficient. Sites were divided into groups using the hierarchical polythetic divisive classification technique Two Way Indicator Species Analysis (TWINSpan) for presence/absence data, with options set at maximum 5 indicator species per division, maximum 6 levels of divisions, minimum group size of 5 to be divided, and equal weighting (Gauch 1982). We used the TWINSpan tabular output and dendrogram to determine both the proportion of sites from each watershed, and control and enhancement sites, that were classified into distinct groups. Although we constructed dendrograms for all analyses, we illustrate only two here for use as examples. Varying the minimum group size to be divided altered the results only slightly. Indicator species are those influential in determining the

identity of sites in each group when a division is made (Gauch 1982).

RESULTS

In both years slightly more bird species were detected at Bone Creek than Whitesand River (1999: 46 vs 44, 2000: 48 vs 46, respectively). Song Sparrow (*Melospiza melodia*), Brown-headed Cowbird (*Molothrus ater*) and Clay-colored Sparrow (*Spizella pallida*) occurred at 75% or more of all sites in 1999 and 2000 at both watersheds. Yellow Warbler (*Dendroica petechia*), Gray Catbird (*Dumetella carolinensis*) and Alder Flycatcher (*Empidonax alnorum*) occurred at 75% or more of all sites in both years in the Whitesand watershed. The proportions of species by habitat guild were consistent between watersheds, and were dominated overall by wetland species (11% grassland, 30% wetland, 19% shrub, 16% woodland, 5% urban, and 19% generalist). In both years mean bird species richness did not differ significantly between enhancement and control sites for Bone Creek (Table 1). Avian species richness was significantly higher at Whitesand than Bone Creek in both years (Table 1; 95% CI, 1999: -8.9 to -1.5, 2000: -7.1 to 0.001). However, the number of species showing significant population declines was slightly higher at Bone Creek than Whitesand River (21 vs. 19 species respectively), and totals of 8 significantly declining species occurred at more than 50% of sites at both creeks. A greater proportion of species experiencing significant population declines was associated with shrubs than other habitat types (17% grassland, 13% wetland, 30% shrub, 13% woodland, 4% urban, 22% generalist).

Individuals of Amphipoda, Odonata and Chironomidae occurred at all sites of both watersheds in 1999 and 2000. Individuals of Decapoda and Hemiptera occurred at all sites in the Whitesand watershed in both years. Invertebrate taxonomic richness indices did not differ between control and enhancement sites or watersheds (Table 1). Sites had similar patterns of bird and invertebrate richness indices between years (birds: $r = 0.78$, $P < 0.001$; invertebrates: $r = 0.65$, $P = 0.002$). The correlation between bird and invertebrate richness indices for both watersheds combined was not significant in 1999 ($r = 0.16$, $P = 0.47$), but was in 2000 ($r = 0.47$, $P = 0.01$). Although bird species richness tended to increase with the 1999 riparian condition index, the relationship was not significant in either year (1999: $F = 1.60$, $df = 1,20$, $P = 0.22$; 2000: $F = 2.42$, $df = 1,20$, $P = 0.13$). Invertebrate richness did not vary significantly with the 1999 riparian condition index in either year (1999: $F = 0.38$, $df = 1,21$, $P = 0.55$; 2000: $F = 0.17$, $df = 1,18$, $P = 0.69$). The invertebrate tolerance index was not significantly correlated with the riparian condition index ($r = 0.08$, $P = 0.71$).

Bird and invertebrate communities were relative distinct between watershed. In both years the first or second TWINSPAN division separated a large proportion of sites into distinct watershed groups (Table 2). For example, in 1999 the watersheds were neatly divided into 2 groups based on the bird data (Figure 2). In contrast, within watersheds enhancement and control sites were not clustered in any discernible fashion, indicating considerable variation between control and treatment sites. However, classification of sites varied between years.

For example, sites in 2000 were classified based on bird data into groups that sometimes included both watersheds (Figure 3). While most Bone Creek sites in Figure 3 are clustered at the bottom of the dendrogram, sites such as Bone 31 and 42 are at the top of the dendrogram indicating significant similarity in community composition to Whitesand River sites. The differences between Figures 2 and 3 also illustrate the extent of variation in community composition between years. The percentage of sites separated successfully to watershed groups for both years ranged from 73 to 100% for Bone Creek, and 64 to 100% for Whitesand River.

DISCUSSION

Bird and invertebrate communities varied between watersheds, and between years within watersheds. Bird communities were composed of species from a broad range of habitat associations, reflecting both the variability and edge habitat commonly associated with riparian habitat. The fact that Bone Creek provided habitat for as many declining species as Whitesand River, despite supporting fewer species, supports the contention that habitat with poor species richness may still harbour regionally unique or important species (Knopf et al. 1988a). Thus species richness alone should not be used to prioritize riparian communities as values may be inflated by cosmopolitan species. The tendency for more declining species to be associated with shrubs supports recommendations for maintenance or restoration of shrub vegetation (Sanders and Edge 1998). The presence of cowbirds at all riparian sites in both watersheds suggests parasitism rates could be high in

these habitats. However, in other riparian systems nests are more likely to fail due to predation than cowbird parasitism (Best and Stauffer 1980, Powell and Steidl 2000).

Given the differences in community composition between enhancement sites and downstream and upstream control sites, a paired design appears unsuitable for future evaluation. Indeed the effectiveness of pooling control and enhancement sites for comparison may vary among years. For example, control and enhancement sites were more similar within watersheds in 1999 than 2000. Bird and invertebrate richness indices showed similar patterns between years, but were correlated with each other in only 1 of 2 years. Bird and terrestrial invertebrate diversity have been found to be correlated in some studies, but at larger landscape scales rather than the scale of the site (Murphy and Wilcox 1986, Blair 1999). Neither index of species richness or the invertebrate tolerance index were significantly correlated with riparian health assessment scores. This result is not unexpected given the different parameters these indices measure, and suggests a multi-faceted approach measuring a variety of parameters is necessary to effectively monitor the state of riparian areas over time.

Numerous aspects pertaining to the quality of riparian habitat for birds require further research. The importance of riparian areas in Saskatchewan for migrating birds is poorly known. Determination of differences in nest success among species associated with tree, shrub or herbaceous cover (Stauffer and Best 1986) could further focus management of vegetation in riparian areas. The role of landscape features in predicting species

richness, species occurrence and nest success in riparian areas have been shown to be important in other studies (Saab 1999, but see Skagen et al. 1998).

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Table 1. Mean bird and aquatic macro-invertebrate species richness ($\pm$ SE, n) compared between control and enhancement sites within watersheds, and watersheds (control and enhancement sites combined) for both years.

		Species richness				
Year	Watershed	Control	Enhancement	<i>t</i> (<i>P</i>)	Control and enhancement combined	<i>t</i> (<i>P</i>)
Bird						
1999	Bone	13.0 ± 1.3 (9)	13.3 ± 0.7 (6)	-0.12 (0.9)	13.1 ± 1.3 (15)	-2.92 (0.008)
	Whitesand	18.7 ± 1.0 (7)	17.0 ± 2.0 (2)	--	18.3 ± 0.9 (9)	
2000	Bone	12.5 ± 1.7 (8)	11.8 ± 1.3 (6)	0.30 (0.77)	12.2 ± 1.1 (15)	-2.1 (0.05)
	Whitesand	15.9 ± 1.6 (7)	15.5 ± 3.5 (2)	--	15.8 ± 1.4 (9)	
Aquatic macro-invertebrate						
1999	Bone	14.8 ± 0.6 (9)	14.5 ± 0.6 (6)	0.3 (0.77)	14.7 ± 0.4 (15)	-0.58 (0.58)
	Whitesand	14.7 ± 1.5 (7)	18.0 ± 1.0 (2)	--	15.4 ± 1.3 (9)	
2000	Bone	8 ± 0.7 (8)	9.3 ± 0.6 (6)	-1.4 (0.18)	8.6 ± 0.47 (14)	-1.5 (0.16)
	Whitesand	10.0 ± 1.6 (6)	12.5 ± 0.5 (2)	--	10.6 ± 1.3 (8)	

Table 2. Percent of watershed sites with membership in groups as divided by TWINSpan analysis on bird and aquatic macro-invertebrate community data in each year. Indicator species are those most influential in determining group membership, and are listed with the group toward which they are biased.

Division	Group	%Bone sites	%Whitesand sites	Indicator species (habitat guild)
Birds 1999				
1	1	80	100	
	2	20	0	Western Meadowlark (grassland)
2	1	0	100	Alder Flycatcher (shrub)
	2	80	0	
Birds 2000				
1	1	25	64	House Wren (shrub) Black-capped Chickadee (woodland) Least Flycatcher (woodland)
	2	75	36	
Aquatic macro-invertebrates 1999				
1	1	80	12.5	Gastropoda Chironomidae
	2	20	87.5	Elmidae Decapoda
Aquatic macro-invertebrates 2000				
1	1	27	100	Hirudinea Elmidae
	2	73	0	

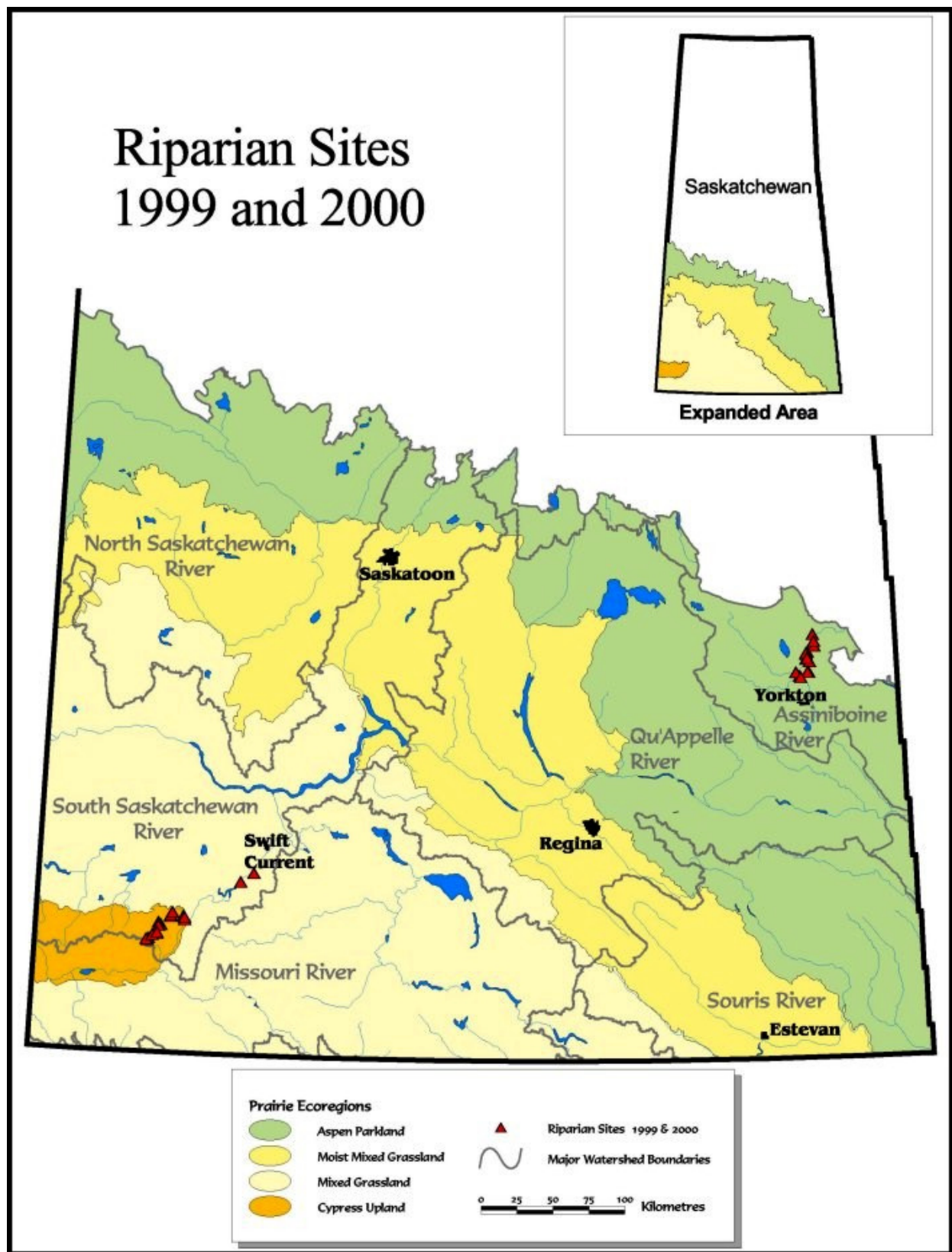


Figure 1. Location of riparian study sites in 1999 and 2000.

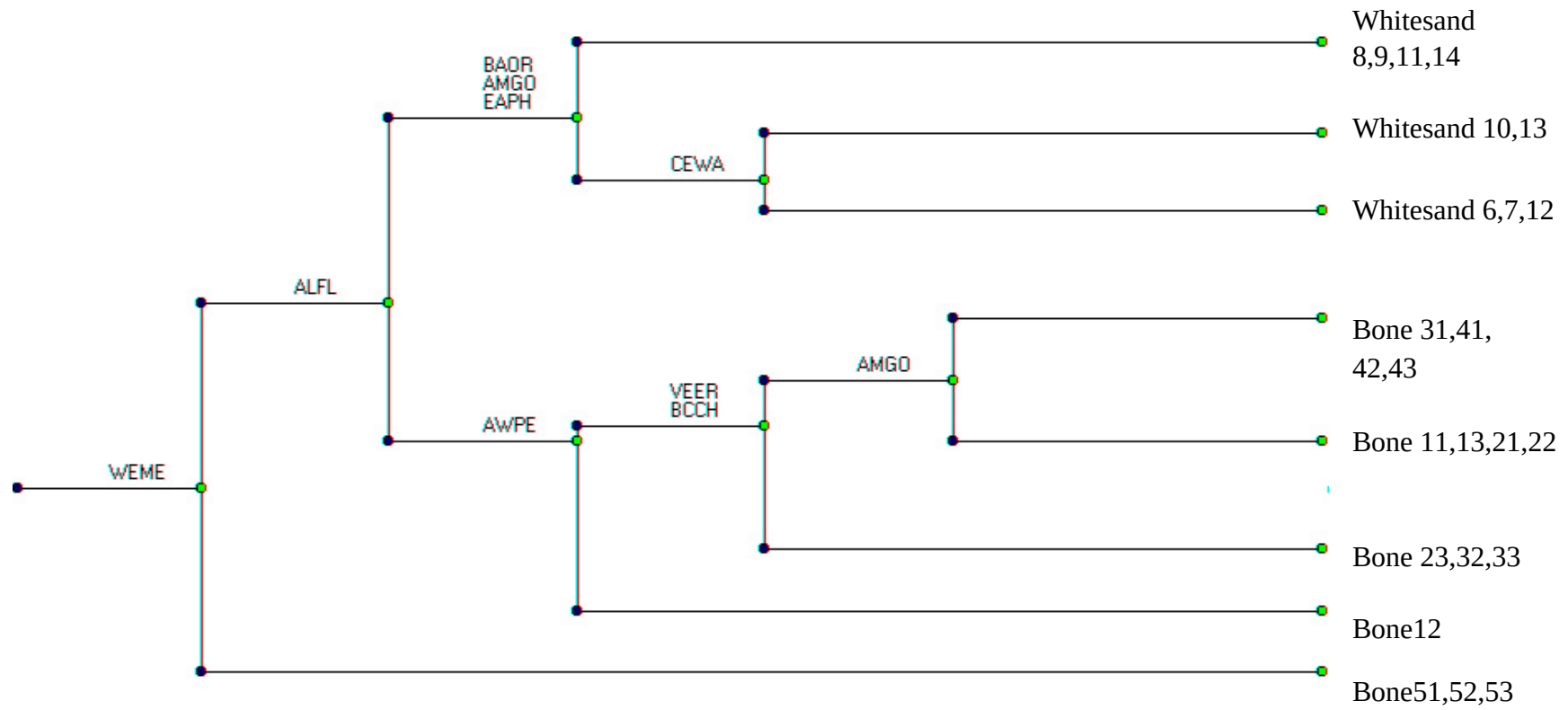


Figure 2. Bird community structure differed between the Whitesand and Bone watersheds in 1999. The dendrogram shows results of TWINSpan analysis of bird species presence and absence by watershed site. Watershed name and site location number are indicated on the righthand side. Site groups are ordered in the dendrogram so those next to each other share more species than groups further away. Indicator species are noted at each branch division using four letter alpha codes; WEME = Western Meadowlark, ALFL = Alder Flycatcher, BAOR = Baltimore Oriole, AMGO = American Goldfinch, EAPH = Eastern Phoebe, AWPE = American White Pelican, CEWA = Cedar Waxwing, VEER = Veery, BCCH = Black-capped Chickadee. Division 1 occurs at WEME, which is biased toward Group 2 (lower branch). ALFL marks Division 2, and is biased toward Group 1 (upper branch).

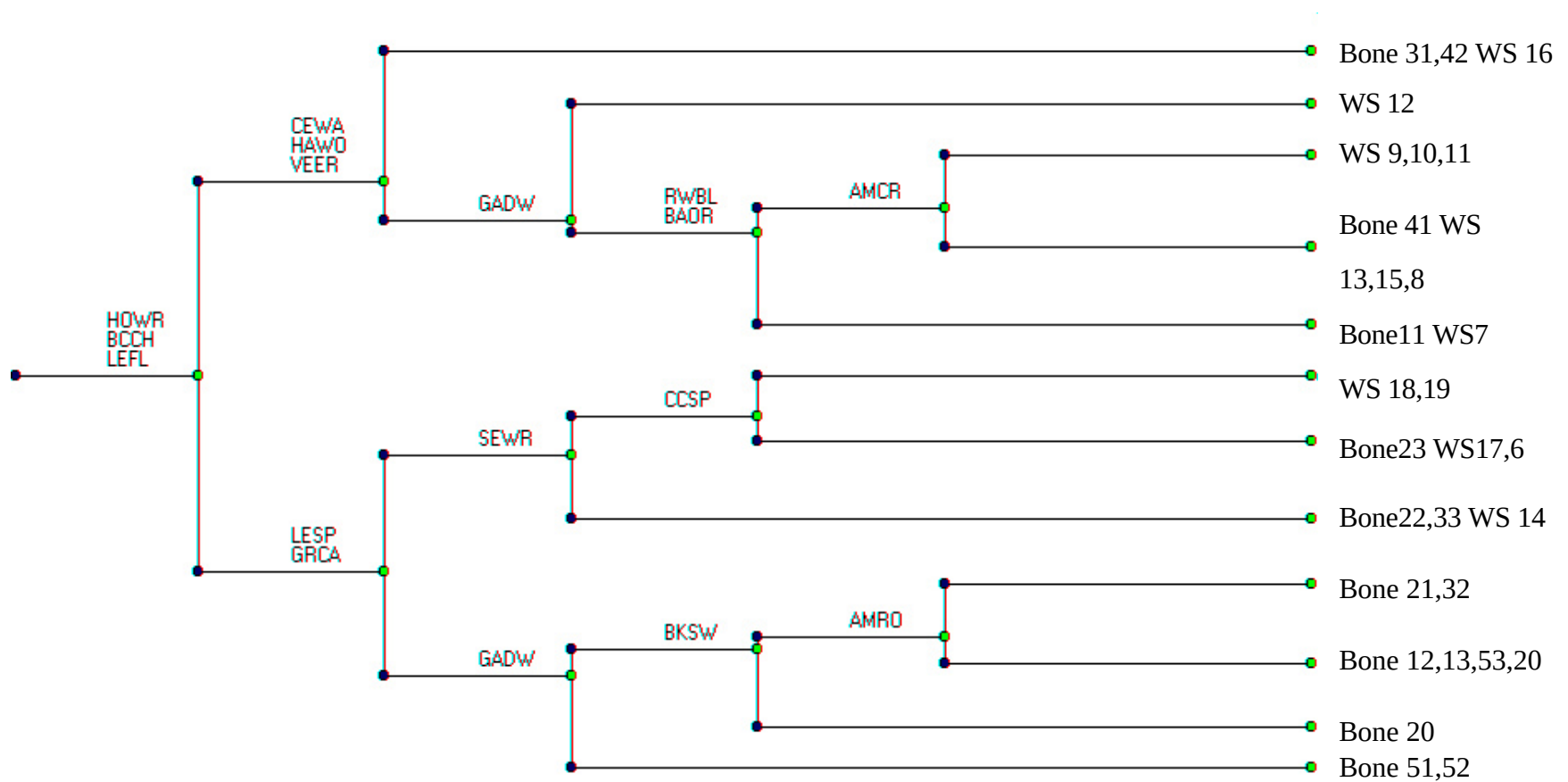


Figure 3. Significant overlap in bird community structure occurred between the Whitesand (WS) and Bone watersheds in 2000. The dendrogram shows results of TWINSpan analysis of bird species presence and absence by watershed site. Watershed name and site location number are indicated on the righthand side. Site groups are ordered in the dendrogram so those next to each other share more species than groups further away. Indicator species are noted at each branch division using four letter alpha codes; HOWR = House Wren, BCCH = Black-capped Chickadee, LEFL = Least Flycatcher. Division 1 occurs at HOWR, BCCH, LEFL, and all three species are biased toward Group 1 (upper branch).

STATUS OF MIXED-GRASS PRAIRIE IN MANITOBA FOR CRITICAL WILDLIFE HABITAT PROGRAM

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Abstract: Since 1996, Critical Wildlife Habitat Program has conducted a Mixed-grass Prairie Inventory in southwest Manitoba. The objective of the Mixed-grass prairie inventory was to identify the extent and quality of the remaining parcels of prairie in Manitoba. Grades were based on relative abundance of native and nonnative species, and the impacts of humans on the community. The major threats to prairie in the inventory target range are cultivation, aspen encroachment, non-native species, and inappropriate grazing management. From 1991-1999, 44,242 ha have been inventoried. There were 18,191 ha of good quality prairie (C or greater). The best prairies were found in the southwest corner of Manitoba, Spyhill/Ellice and Ellice/Archie PFRA Community Pastures, the Oak Lake region, and around Brandon/Sprucewoods.

Mixed-grass Prairie once covered 24 million hectares in Canada. This habitat occurs where rainfall is between 25-50cm on sandy or well drained soil. Mixed-grass prairie habitat has decreased dramatically in the last 200 years. The remaining prairie is generally unsuitable for cultivation. Today less than 25% remains (WWF, 1989).

There are over 150 grasses and wildflowers that occur on mixed-grass prairie. Both cool season and warm season grasses are found on the prairie. Only native pastures have warm season grasses, which are adapted to hot, dry summers. They retain more forage value than cool season grasses in the heat of summer and provide high quality nutrients later in the season when cool season grasses have lost most of their nutrients. Grasses found on mixed-grass prairie include the warm season big bluestem, little bluestem, and blue grama and the cool season June grass, bluegrasses and spear grasses. A wide variety of wildflowers bloom on the prairie from early spring until fall, including

some such as Echinacea that are used as herbal medicines.

In Manitoba, mixed-grass prairie occurs within the aspen parkland and mixed-grass prairie ecotones in the southwest of the province. The largest areas occur around CFB Shilo and Carberry, Melita and the Poverty Plains, Oaklake, Miniota and the Archie-Ellice and Spyhill-Ellice PFRA Community Pastures.

The objective of the mixed-grass prairie inventory conducted by Critical Wildlife Habitat Program was to identify the extent and quality of the remaining parcels prairie in Manitoba.

To determine the study area, landsat, forest inventory, soil surveys, orthophotos, and previous inventories were used. Once sites were selected, private landowners were contacted for permission to inventory their property. Each site was divided into communities using the Conservation Data Centre natural community descriptors. All

species observed in random 1x1 m quadrats and from walking the site were recorded; dominant species of grasses, forbs, shrubs and trees were noted. Each site was then graded using Conservation Data Centre grading guidelines.

Grades were based on relative abundance of native and nonnative species, and the impacts of humans on the community (cultivation, herbicide application, unsound grazing, long term fire suppression). An A-grade prairie has no evidence of human impact. A B-grade prairie has some human impact, but there is little overall effect in species composition; there may be increased shrubs and less native species. A C-grade prairie has moderate human impact, but has the potential to improve over time with management. A D-grade prairie has had heavy human impact which has greatly affected the overall community structure and species composition and would require significant time and management to improve rank and is dominated by nonnative species. A grade of C or higher indicates good quality prairie. A grade of D indicates poor quality prairie.

From 1991-1999, 44,242 ha of good quality prairie (C or greater) were inventoried. The best prairies were found in southwest corner of Manitoba, PFRA Community Pastures, Oak Lake region, and the Brandon-Sprucewoods area. CFB Shilo estimates (from landsat) that there are 22,500 ha of prairie remaining on the base. There are still large blocks yet to be inventoried.

The major threats to prairie in the inventory target range are cultivation, aspen encroachment, non-native species, and inappropriate grazing management. Since

European settlement, prairie has been cultivated. Most of the remaining prairie is unsuitable for cultivation because of poor moisture conditions or unfertile or stony soil. Irrigation has recently increased the loss of native grasslands in south-west Manitoba, especially in the Shilo/Carberry area.

Trembling aspen and other woody invaders are increasing in southwest Manitoba, partly because natural wild fires have been suppressed since European settlement. Prairies are adapted to fire and are not affected by occasional burning.

Non-native species such as leafy spurge, sweet clover, smooth brome invade native prairie sites and once become established out-compete native species and result in a reduction of species richness and quality of prairie.

Overgrazing, late and early season grazing results in a modified species composition on native pasture. Desirable forage plants, such as ground-plum and switch grass decrease after excessive grazing leaving less desirable forage species, such as wolf willow and gum weed, with a competitive advantage. The long-term result is decreased species richness and poorer available forage for livestock. Prairie plants have co-evolved with grazing animals and have developed adaptive mechanisms to grazing. With sound grazing practices both the prairie and livestock owners benefit.

The information gathered from the inventory is shared with private landowners. A list of all species found on the property as well as general comments is mailed to each landowner. A interim report has been

compiled listing all sites surveyed in the inventory from 1992-1998 and will be updated to include 1999 and 2000 data. Inventory information is also forwarded to the Mixed-grass Prairie Stewardship Program. The inventory will continue in 2001.

CONSERVING PRAIRIE HABITATS THROUGH THE MANITOBA IBA PROGRAM

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Abstract: An Important Bird Area (IBA) is a site providing essential habitat for one or more species of breeding or non-breeding birds. The IBA program will also serve to protect the flora and fauna associated with an IBA site. The goals of the Manitoba IBA program are to (1) identify a network of sites that conserve the natural diversity of Canadian bird species and are critical for the long-term viability of naturally occurring bird populations; (2) conservation of sites through partnerships of local community stakeholders who develop and implement appropriate on-the-ground conservation plans; and (3) Establish ongoing local involvement in site protection and monitoring. Criteria for an IBA site include sites containing threatened species, endemic species, species representative of a biome, or sites with large concentrations of birds. In Manitoba, the IBA program is being delivered through the Manitoba Naturalists Society and over 100 sites have been nominated by Manitoba birders and conservationists. Of these nominated sites, a number of sites in prairie Manitoba have met IBA site criteria and have moved forward into the community conservation planning (CCP) phase. The IBA program, and how it is being delivered in southwestern Manitoba will be introduced. Examples CCP's from Douglas Marsh, Whitewater Lake, Poverty Plains, Souris River and Lyleton will be presented, where community partnerships are championing conservation efforts. These sites all provide critical habitat for endangered and threatened bird species.

MANITOBA'S LEOPARD FROG EXPLOITATION AND RECOVERY HISTORY

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Abstract: Manitoba has been a commercial supplier of leopard frogs for half a century or more. Manitoba frogs are valued for their large size and hearty nature, suitable for keeping alive until the spring school term. Leopard frog populations have traditionally concentrated in Manitoba's Interlake region where large marshes with nearby lakes or artesian wells provide both winter and summer habitat. A leopard frog "die-off" in 1975-'76 reduced densities greatly throughout the province. Only recently have leopard frog densities returned to near pre-1975 levels.

Manitoba has a long and colorful history of leopard frog exploitation that dates back to at least the 1950's. The highest densities of large leopard frogs have traditionally been in Manitoba's Interlake where the southeastern shores of Lake Manitoba and the artesian wells near Chatfield were important collection areas. A large portion of Manitoba's leopard frogs have traditionally been used in universities for use in biology labs. Manitoba's frogs were sought after because of their size (9-12 to the pound) and heartiness. Heartiness made them particularly valuable for the spring school term.

In the 1950's and 1960's, frogs were dip-netted from artesian wells in the dead of winter. There are some two dozen artesian wells in the area that remain open all winter. Some of these wells are as much as 15 meters across and over 6 meters deep. Men used long-handled dip nets to haul out the nearly torpid animals from the near freezing water. The frogs were then dumped into barrels and transported by horse and sleigh to a site from which they could be shipped to biological supply houses or universities. Collectors were only able to sell the largest frogs captured. These artesian wells are less

than three kilometers from the major snake dens at Narcisse.

By the late 1960's, frog picking became a fall activity particularly in some of the marshes along the East Side of Lake Manitoba. Again, it was only the largest frogs that were valuable. These frogs were also used primarily for the second school term due to their heartiness. Leopard frogs mass along the Lake Manitoba shoreline and winter under the lake ice. They spend the summer in the marshes behind the beach ridge. Pickers use flashlights and cloth bags to collect thousands of frogs as they cross between Lake Manitoba and the marshes behind. Captured animals are typically transported to old granaries or sheds and kept on straw until shipping. Some 110,000 pounds of frogs (over one million animals) were shipped from Manitoba in 1972.

The Department was pressured in the late 1960's to regulate the exploitation of amphibians and Branch staff were assigned to develop regulations and a licensing procedure. Boreal Labs was interested in establishing a facility in Manitoba to "pith" frogs thus creating jobs and spin-off monies. A licensing program was established through

which picker licenses are now sold (family licenses are double the cost of single licenses). Local dealer licenses are also sold. Local dealers are required to fill out forms as to how many pounds of frogs they receive from each picker and to report the number of pounds they sell to buyers from out of the province. This information is then passed on to the Wildlife Branch. The Wildlife Branch has records for the numbers of pounds of frogs shipped and collected from Manitoba for over 30 years.

In 1975-'76 there was a "die-off" of leopard frogs in Manitoba and elsewhere in North America. No Manitoba frogs were sold for 5 years as the populations were at rock bottom. The "Frog Holes" were frog-less and have yet to recover. The laws were not changed because with no frogs present there was no concern for over-exploitation.

By 1982 the leopard frog populations had recovered somewhat along the Lake Manitoba shorelines. Reports indicated that Manitoba frogs were not as hearty as they had been in the past because kidney parasites were weakening the animals. Kidney failure often results in blood pooling under the opaque skin of the back legs resulting in what people refer to as "red leg". There is also a disease called "red leg" and confusion continues as to the real cause of the frog "die-off". Some 3,000 pounds of frogs were

shipped from Manitoba in 1982. Animal care concerns, computers and the raising of exotic frog species in captivity have reduced the market for Manitoba's leopard frogs for dissections in University Biology labs. The low standard of living for the few people who partake in frog picking makes closing the season difficult. Policy was drafted in 2000 to reduce the frog picking season length to prevent the establishment of a live bait industry using native frogs. This policy has yet to be enacted.

For a few years in the early 1970's, Wildlife Branch staff captured and measured frogs for several evenings in the fall along Lake Manitoba's beaches. This project never developed into a long-term monitoring program. The anuran surveys that have taken place in Manitoba since 1993 have underestimated the leopard frog population. The breeding window for leopard frog singing is very narrow and the species is often missed.

The Wildlife Branch continues to receive reports of leopard frog "die-off" in scattered pockets of Manitoba habitat but no large-scale "die-off" have been reported in recent years. Leopard frogs are encountered across the province to as far north as the Churchill River and beyond. What I have noticed is that a much larger portion of the population is now brown spotted as opposed to green spotted as had been the case prior to the 1975-'76 "die-off".

Table 1. Manitoba's Amphibian Harvest; from Dealer Records.

<u>Year</u>	<u>Frogs in Pounds</u>	<u>Estimated Frog Numbers</u>
1971	68,348	700,000
1972	109,796	1,200,000
1973	26,796	270,000
1974	43,868	450,000
1975	12,980	135,000
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	0	0
1982	0	0
1983	2,911	30,000
1984	13,058	135,000
1985	30,058	320,000
1986	35,981	375,000
1987	9,079	100,000
1988	2,516	28,000
1989	3,546	40,000
1990	5,891	65,000
1991	5,558	65,000
1992	2,408	25,000
1993	0*	0
1994	0	0
1995	12,757	135,000
1996	8,955	100,000
1997	15,388	165,000
1998	3,155	35,000
1999	1,842	20,000
2000	3,444	40,000

*There was one major buyer for Manitoba frogs (Bill Lemburger from Oshkosh Wisconsin) from the 1950's until Bill's death around 1993. After Bill's death it took Manitoba Frog Dealers some time to find new buyers.

MANITOBA'S ANURAN SURVEY HISTORY

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Abstract: Anuran monitoring in Manitoba is a volunteer program that began as a joint effort between the Manitoba Museum of Man and Nature and the Wildlife Branch in 1993. Annual participation produces over 3000 data entries from roughly 50 individuals or groups. The province was broken into four regions for data analysis. Data from each region includes calling periods and density information for each species over the entire summer season. It is stored in the Wildlife Branch database. Information updates are provided annually to volunteers through "The Frog Monitor" newsletter. This information will likely be included in a revised Biodiversity Conservation Section newsletter describing the combined results of several of Manitoba's volunteer data producing programs.

Manitoba's volunteer frog monitoring program began in 1993 long after the leopard frog die-off of 1975-'76. Public interest had been kindled by the many media productions identifying major worldwide amphibian die-offs and the value of amphibians as indicators for the status of the environment. Dr. Bill Preston at the Manitoba Museum of Man and Nature, was the major motivator; Bill Koonz from the Wildlife Branch played a lesser role. Data entry was with the Manitoba Museum of Man and Nature for the first several years but switched to Ron Larche with the Wildlife Branch before Bill Preston's retirement. Data from each year is stored on electronic and paper files in the Wildlife Branch.

Anuran data comes in annually from at least 50 contributors from across the province. Volunteer data reports average approximately 60 observation days each in a given year producing some 3000 data entries for each species detected. Data is compiled annually and information can be compared by region, by year or by the time of year for each species recorded. Contributors have been kept informed through an annual

newsletter that is distributed in the winter. Staff from the ONSITE program have entered data and produced the newsletter in recent years. Volunteers who contributed information in one of the past two survey years are mailed the current year's information package prior to the spring calling period. This information package includes an updated field form and instructions on how to carry out the survey.

The database is so huge that it has become difficult to store and manipulate. There is a need for someone with statistical knowledge to extract trend data by species, region and over time (within years and between years). The database is complicated by the fact that there is little consistency over time within and between years for the numbers of volunteers and the dates when sampling was done in each region.

There is a contact database that goes back to the beginning of the initiative. It includes the names and addresses of each contributor for each year of the survey. This source is used to determine whom to send the information packages to each spring and who is to receive a newsletter each winter.

The Biodiversity Conservation Section of the Wildlife Branch currently administers the program but there is pressure to abandon the program or to find another party to administer it.

Manitoba's Wildlife Branch has come to appreciate the value of the public's participation in data collection and analysis. The Branch currently sponsors at least four volunteer programs that provide information on a variety of Manitoba's wildlife diversity (owl survey, dragonfly survey, anuran survey and breeding bird survey). In recognition of this public commitment, the Biodiversity Conservation Section is changing the format and emphasis of its newsletter (BioNet) to emphasize the Branch's appreciation for volunteerism.

Even though vacant Branch positions continue to be lost, there is continued commitment and expectation that programs will continue. It is through the efforts of volunteers that much of our field data will be collected in the future. It will be up to those who remain with government to design statistically valid, meaningful data collection forms so that people of many skill levels can quickly and easily collect useful data. We

must design analysis programs that can quickly and easily extract data that can be used in species monitoring and management. It is also essential that the volunteers have easy access to information and can be provided with positive feedback for their volunteering. These volunteer programs will provide up-to-date information on the range, status and population trends for many of Manitoba's wildlife species.

The future of many programs will be dependent upon Branch staff being able to identify and capture the core stakeholder groups for research and monitoring initiatives. The days of broad based extension programs are being replaced by programs that seek out vested interest groups that can be focused to do most of the data collection and analysis. It will be up to Branch staff to identify the resource information needs, then find and motivate volunteers to collect and analyze the data necessary to make appropriate management decisions.

In Conclusion: The biggest challenge for Branch staff will be to find and motivate interested client groups; develop quick and easy systems for volunteer data collection and analysis, and then illustrate to the volunteers that their databases are being used for the wellbeing of whatever they are monitoring.

NORTHERN LEOPARD FROG INVENTORY (2000)

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Abstract: The Northern Leopard Frog (*Rana pipiens*) is designated as a Threatened Species under the Alberta Wildlife Act. Once a common and widespread species throughout much of Canada, the leopard frog has declined or vanished from much of the western portion of its range. In Alberta, the decline resulted in a significant range contraction and reduction in population numbers. Current data suggests that leopard frogs are largely extirpated from the central parkland and completely absent from the upper Red Deer River drainage. Remnant breeding populations of leopard frogs primarily occur in the southern portions of Alberta.

In the spring of 2000, Alberta Environment initiated a leopard frog inventory to better understand the current status and distribution of the leopard frog in the province. A detailed inventory protocol was drafted to ensure standard survey methods. Information relating to leopard frog phenology, natural history and habitat requirements was also included in the protocol to increase survey productivity and efficiency. Specific survey sites and localities were identified from leopard frog observation records stored in Alberta Environment's Biodiversity/Species Observation Database (BSOD).

The primary objective of the inventory was to determine the presence/absence of leopard frogs at historic and current sites in Alberta. Relative abundance and breeding success was also noted at sites where frogs were observed. This presentation will highlight the methods and significant results obtained during the Northern Leopard Frog Inventory (2000).

PRAIRIE CONSERVATION: DEVELOPING A LAND STEWARDSHIP PROGRAM FOR THE GRASSLAND NATURAL REGION OF SOUTHERN ALBERTA

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Abstract: Of the 24 million acres that comprises Alberta's grassland natural region, only 43% remains as native prairie. Of these native areas, 56% are under Crown ownership. Although under Crown ownership, the majority receives some level of grazing management (lease or grazing reserve) and is therefore functionally private land managed by the lessee or grazing association. The key to native prairie conservation in Alberta therefore lies within the hands of the ranching community, and a collaborative approach in the form of a land stewardship program is well suited for the protection and enhancement of native prairie habitat. The Alberta Conservation Association (ACA) has developed a land stewardship program for the grassland natural region of southern Alberta. The program relies on the rancher and their participation as land stewards in managing the range for both cattle and wildlife. The goals of the program are to conserve and enhance the native prairie ecosystem and the biodiversity of prairie wildlife. The main direction of the program is to develop, implement and evaluate range/wildlife management plans designed to improve residual cover (litter) and productivity in both native and tame rangelands which will enhance wildlife habitat and range condition. Development of the land stewardship program was built upon the successes of the ACA's Sharp-tailed Grouse Habitat Program.

INTRODUCTION

Native prairie habitat has always been recognized as an important commodity. Native Americans realized the value of the prairie as a food source for the large herds of migratory bison that they relied upon. European settlers saw them as a source of forage for their livestock. The agricultural community saw them as a source of fertile soil, easily converted into forage and annual crops. The oil and gas industry has realized the advantages of extracting resources in

areas where little development is required. In addition, the native prairies are of significant international importance, acting as breeding grounds and nesting habitat for migratory waterfowl and birds (Gibbs and Brown Landscape Architects Ltd. 2000). In Alberta, they are a high use area for recreational activities with approximately 45% of the big game harvested coming from the Prairie and Aspen Parkland region (Boyce 2000). Under the cumulative effects of urbanization, cultivation, livestock grazing, roads and oil and gas development, the face of the native

prairie in Alberta has been altered dramatically (AEP 1997).

In Alberta the term native prairie encompasses the Grassland and Aspen Parkland Natural Regions and encompasses some 24 million acres. Seventy-eight percent of the species in Alberta declared at risk are dependent on prairie habitat while four plants are currently endangered or threatened (Gibbs and Brown Landscape Architects Ltd. 2000). Changes in agricultural practices have resulted in a decline in grassland bird populations, with those remaining being concentrated on the native range (Dale and Prescott 2000). The plight of prairie wildlife is a reflection of habitat loss and degradation. Of the 24 million acres comprising the Grassland Natural Region only 43% remains as true native prairie. Of this 43% only 56% is under Crown ownership (Alberta Environment 2000 unpublished data). Although under Crown ownership, the majority receives some level of grazing management (lease or grazing reserve) and is therefore functionally "private land" managed on a day-to-day bases by the lessee or grazing association.

In managing the prairie landscape for cattle production, the ranching community has changed the prairies from a natural ecosystem (open system) to a closed system. Intensive management, property ownership, fences and different grazing practices based on individual preference and knowledge now govern grazing patterns that were originally controlled by climatic conditions (Adams et al. 1993, Bradley 1996). The principles of sustainable rangeland management strive to align livestock grazing with the natural processes were they are occurring, by imitating natural processes through the use of range management practices (Adams et al. 1993).

Protection and enhancement of native prairie habitat has to start at the landowner / rancher / lessee level. Many landowners take pride in the fact of having wildlife present on their ranches. (Pearman 1991, Scott 1991, Clark and Wallace 1998). That being said, landowners will act in a manner that they perceive is in their best interest (Clark and Wallace 1998). Therefore conservation of prairie habitat and wildlife must take into account the social and economic forces. To ignore them may prove catastrophic (Kellert 1985, Clark and Wallace 1998). A conservation strategy for the prairie landscape must have the ranching community as its cornerstone if it is to be effective.

In developing a native prairie stewardship program, the Alberta Conservation Association's (ACA) goal is to act as a bridge between the science of range management and the ranching community. The program is based on educating the ranching community on the principles of sustainable range management, while accounting for the economic and social realities faced by the ranching community. In building a partnership with the ranching community, as natural land stewards, conservation of native prairie habitat can be made.

SHARP-TAILED GROUSE HABITAT PROGRAM

By the mid 1990's populations of sharp-tailed grouse declined in Alberta by 50 to 70 percent (Goddard 1995). As such the sharp-tailed grouse is yellow listed as a sensitive species that may require special management (ABFW 1991, AEP 1996). Loss of habitat and increased agricultural practices, within the grasslands and aspen parkland, has contributed to these declines. As a result, a Sharp-tailed Grouse Habitat Program was

initiated in 1995 under the “Buck for Wildlife” program to address the loss of habitat. In 1997 the “Buck for Wildlife” program came under the administration of the Alberta Conservation Association. The Sharp-tailed Grouse Habitat Program continued under the management of the ACA.

The goal of the program was to work in cooperation with landowners and other conservation agencies to maintain and enhance habitat for sharp-tailed grouse and many other prairie wildlife species. The concept of land stewardship as a tool to manage and conserve habitat is deeply rooted in this program. The main direction is to develop, implement and evaluate ecologically based range/wildlife management plans designed to improve residual cover (litter) and productivity in both native and tame rangelands which will enhance wildlife habitat and range condition.

NATIVE PRAIRIE STEWARDSHIP PROGRAM

A review of the Sharp-tailed Grouse Habitat Program concluded that it was larger in scope than just sharptail habitat. In fact the program was a prairie conservation strategy with a species-specific focus (sharptail). It was concluded that the program could be expanded into a Native Prairie Stewardship Program (NPS) that uses a course filter approach across the landscape. Where it deemed necessary, a species (i.e. sage grouse) specific approach would be utilized when developing the management plan. This approach would allow the program to work with ranchers within the Grassland Natural Region without the restraint of having sharp-tailed grouse present. Work will continue within the 3 project areas (Milk River Ridge and Writing-On-Stone, Special Area #4 and Pakowki Lake) initiated under the sharptail habitat program.

Cooperating landowners under the sharptail program will form the foundation of the NPS Program.

The mission statement of the NPS Program is to educate ranchers / landowners on the practices of sustainable rangeland and wildlife habitat management, through the development of a cooperative range and wildlife management plan for their ranch. The goals of the NPS project are (1) to educate ranchers and landowners on the principles of sound ecologically based range management (2) to conserve and enhance the native prairie ecosystem and (3) to conserve and enhance the biodiversity of prairie wildlife. The key message to be delivered through the program is the benefit of leaving adequate residual cover in terms of moisture retention, a source of forage during dry conditions and its value as nesting and hiding cover for prairie wildlife.

PROGRAM PHASES

The NPS Program will adopt and expand upon the 4 phases that were utilized in the Sharp-tailed Grouse Habitat Program. It will separate the initial phase into 2 (wildlife survey and partnership building) while also fully developing the evaluation phase that was not designed in the original sharptail program. Each phase is not static but continues for the life of the program, with each being linked to the individual rancher. Each phase is described below in detail, with examples and accomplishments achieved by the Sharp-tailed Grouse Habitat Program provided (Miller 1999, Jones and Lee 2000).

PHASE I Wildlife Survey

Beginning in 1995, sharp-tailed grouse dancing grounds (leks) were surveyed each spring. Initially each project area was aerial surveyed to locate sharptails and lek

locations. All sightings were then ground truthed to confirm the presence of a dancing ground. These initial surveys allowed the Sharp-tailed Grouse Program to focus its efforts on the ranches of landowners that were known to have sharptails present. As the program expanded to incorporate more cooperating landowners, only those leks located on their property were surveyed due to time restraints. Since 1995, 180 new or previously unconfirmed leks have been located as a result of the program's efforts.

In expanding into a NPS program we are in the process of developing a survey method to assess the grassland bird community. These surveys will establish baseline information on community assemblages and act as a measure of biodiversity (Bock and Webb 1984, Wershler 1993.). The surveys will be conducted on the ranches of new cooperating landowners prior to the development and implementation of the range/wildlife management plan. The information gathered from these initial surveys will form the bases for the wildlife assessment component of the evaluation phase.

PHASE II Partnership Building

Landowner workshops and interviews have been conducted to assist the program in meeting potential landowners. Before working with individual landowners, interviews and workshops are conducted to assess the general feeling of the ranching community and individuals. The program has interviewed 64 people and 15 have attended workshops in the 3 project areas (Table 1). Prior to doing the range inventory and designing a management plan, we have met with the landowner two to three times to get a solid understanding of his or her desires and to allow the landowner to become comfortable with our program

objectives. Landowners must see the potential for real gains by working with us (i.e., what's in it for me?) which must be recognized in order for the program to meet with success.

PHASE III Range / Wildlife Inventory and Management Plan

It is our goal to have the landowner buy into the program and take "ownership" of the management plan and utilize it to its full potential. Development of the management plan is done under the direction and continual involvement of the landowner. Since there are many different grazing systems and practices, a range and wildlife management plan is developed for each cooperating landowner that accounts for the unique circumstances, goals, economic restraints and resources of the individual (Adams et al. 1993). Thus each plan is truly an "individual" plan that accounts for the economical realities faced by the rancher. In most cases the cost of the inventory and management plan are covered by the NPS Program.

The inventory and management plan are conducted and developed for the entire ranch and not specific pastures or fields that are known to contain sharptail leks or other wildlife species of concern. It is important to note that without a thorough inventory and understanding of existing range condition for the entire ranch, land use changes implemented through the program may do more harm than good. The range inventory is conducted during the summer and the range/wildlife management plan is designed throughout the winter via phone conversations and in-person meetings. The work is completed for implementation the next spring. We are currently working with 12 landowners and 1 community grazing association in the various project areas

running ranches ranging from 1,280 to 76,800 acres.

PHASE IV Implementation

The key to a successful ecologically based management plan is the distribution of cattle and the management of individual paddocks or fields. With most ranching operations individual fields tend to be over utilized in areas (i.e. around watering areas) and under utilized in others. Recommended range improvements are provided in the management plans to address these issues. Range improvements such as fencing, water developments and salt/mineral block placements are implemented to return gains for the entire ranch. It is understood that it will take time to implement all of the range improvements and that costs can be expensive. We work with each individual landowner to implement these improvements by offering incentive payments or cost sharing in projects. To assist with the costs, additional conservation organizations, such as the Prairie Farm Rehabilitation Administration (PFRA), Ducks Unlimited Canada (North American Waterfowl Management Plan) and Pheasants Forever (PF) have provided funds to assist with the implementation of range improvements.

PHASE V Evaluation

With any program a critical evaluation should be a key component to assess its value and accomplishments. It should serve to address whether the goals and objectives of the program have been met. Keeping these factors in mind we are currently developing an evaluation program that will consist of 3 components. Each will evaluate a key goal of the program: (1) whether the program is serving its role as an educational tool and of value to the rancher, (2) is the program resulting in changes in habitat

condition and (3) is the program resulting in changes to the wildlife community.

The value of the program to the rancher will be evaluated through the use of a questionnaire and assessment of financial contributions by each landowner to implement the management plan. The questionnaire is currently being developed and will serve 2 purposes. It will determine if we are getting our message across of the importance of residual cover and allow for participating landowners to provide feedback on our program. If the management plan is of importance to the landowner, then they should be willing to spend their own funds to implement the recommendations. Based on the percentages of dollars contributed to the program by the different partners, in particular the landowners, it appears there has been a “buy-in” to the program (Table 2). Landowners have seen the value of the management plan and begun to contribute their time and funds to implement the recommendations.

The last 2 components of the evaluation will require time. They will consist of a quick range assessment and the continued survey of the grassland bird community and were applicable spring sharptail lek counts. We are currently working with Alberta Agriculture, Food and Rural Development; Public Lands to assess the feasibility of utilizing the Short Form Range Assessment protocol that they are currently developing (Adams et al. 2000). This assessment will serve as an indicator of changes to range health as the management plan is implemented. The bird and sharptail lek surveys will follow the protocol established under phase I.

PROGRAM ADVANTAGES

The NPS Program, though it is a large endeavor, does have a number of advantages:

1. By combining workshops and individual contact the program serves as an education tool working on a community and individual level.
2. By educating and assisting individual landowners with the development and implementation of the wildlife / range management plan we see landowner buy-in as they take ownership of the plan. This approach is proving successful in achieving the programs goals and objectives.
3. The program allows for a community approach by allowing different partners (such as the landowner and conservation organizations) to participate to achieve common goals. It then becomes cost effective for all partners involved.
4. By using a coarse filter landscape approach we are able to target large areas. There is also the flexibility to take a species-specific approach, when needed, during the development of the management plan.

PROGRAM DISADVANTAGES

With every stewardship program there are a number of disadvantages:

1. Because of the time constraints of conducting individual range inventories, developing the management plan and implementing the range improvements there is a restriction on the number of participants.

2. In covering the expenses to conduct the inventory and develop the management plan, the majority of the ACA's financial contributions associated with the program are up front costs.
3. With any program that relies on the volunteer participation by the cooperating landowners, there is no guarantee that the management plan / recommendations will be implemented

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Table 1. Number of landowner interviews conducted and workshops held from 1995 – 2000 under the Sharp-tailed Grouse Habitat Program.

Project Area	Workshop (Attendance)	Interviews (Number)
Milk River Ridge and Writing-On-Stone	11	18
Special Area #4	4	45
Pakowki Lake	-----	1
Total:	15	64

Table 2. Funds spent on the inventory, management plan and recommended improvements by the ACA, landowners and other partners within the 3 project areas between 1997 – 2000.

Project Area	ACA (\$)	Landowners (\$)	Partners (\$)	Total
Milk River Ridge and Writing-On-Stone	80,252	68,763	13,500	162,515
Special Area #4	90,037	78,020	21,552	189,609
Pakowki Lake	19,875	0	8,000	27,875
Total:*	190,164 (50%)	146,783 (39%)	43,052 (11%)	379,999 (100%)

* percentage of total funds spent under the Sharp-tailed Grouse Habitat Program

GRAZING, GRASSHOPPERS, BIRDS AND ECOSYSTEM ORGANIZATION

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Abstract: Grasshoppers are important components of grassland ecosystems. Because of their high rates of chewing and feeding during warm conditions, they participate in a significant portion of nutrient cycling and energy flow, and represent an important food source for other invertebrates (such as recent high populations of grassland spiders) and grassland vertebrates (notably ground-nesting birds). Grasshopper species diversity is great enough that activities such as grazing result in modified communities, and consequent changes in the food resources available to birds, which may effect changes in the resulting avifaunas of grazed ecosystems. Long-term ecological monitoring of the impact of grazing intensity on grasshopper species composition in Alberta Foothills Fescue grassland indicated that the relationship between grazing pressure and grasshopper density is nonlinear, in some cases parabolic, because of differential impacts of removal of vegetation on different species of grasshoppers. Habitat selection by common species (mainly Dawson's grasshopper, Marsh Meadow grasshopper, Migratory grasshopper and Clear-winged grasshopper) in response to available cover explains the effect.

MANAGEMENT OF RIPARIAN AREAS AND NATIVE PRAIRIE IN SOUTHWEST SASKATCHEWAN

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Abstract: Joan and Jason Jackson operate the 3J ranch which includes a 150 purebred and commercial Angus cow herd, 960 acres of native prairie, approximately 500 acres of tame pasture and two mile stretch of Miry Creek, a spring fed tributary of the South Saskatchewan River. In 1994 an assessment of their property was performed by an independent contractor. There was heavy use of the areas adjacent to Miry Creek due to cattle distribution problems and the lack of water in remote areas of the pasture. The solution was to implement a rotational grazing plan that saw the creation of two riparian fields, three native fields and one tame pasture and development of a livestock watering system. Follow-up assessments in 1997 and 1998 revealed that there were significant improvements in range and riparian condition particularly in the areas of reduced browse and improved plant cover. By converting cropland to perennial forages, they have increased their grazing resources, wildlife habitat and at the same time their cattle herd. In 1999, they developed two additional livestock watering sites to further improve distribution. Since 1997, the Jackson's have hosted four field days for producers, two technical training workshops for professionals, made presentations at interprovincial conferences and have been awarded the 2000 Environmental Stewardship Award (TESA) for Saskatchewan. In their presentation they will discuss their management plan, their benefits, values and experiences of working with both conservation and agricultural agencies.

“Cabri ranchers win environmental stewardship award”

A couple from Cabri, SK, were chosen as winners of the Environmental Stewardship Award (TESAward).

Jason and Joan Jackson, owners of the Three J Angus Ranch have won the prestigious award which is presented annually by the Saskatchewan Stock Growers Association (SSGA), Ducks Unlimited and the Royal Bank. They were awarded the TESAward at the SSGA annual meeting in June, and will receive a customized gate sign at the Royal Bank

Supreme Challenge on November 26 at Agribition in Regina. The award recognizes exemplary environmental stewardship in the ranching industry. Winners and nominees have taken innovative and successful approaches to environmentally and economically sustainable cattle production.

The Jacksons started ranching in 1988 on eight quarters of land northwest of Cabri. They started with about 300 acres of cultivated land; the remaining acres were left as native pasture for their 21 head of cattle. A creek on the land was the main water source for the herd.

“After a few years we could see a distribution problem with the cow herd”, says Joan, “We could not control where or what the herd grazed. The cows were overgrazing the wetland area and the pasture areas closest to the only water source. The cows also spent hot summer days along the creek banks, damaging and exposing them to erosion. Our neighbours down stream were using this water too and we did not think it was right to send them dirty water with animal waste in it.”

In 1993, the Jacksons realized they needed to make major changes. “We could see farm income dropping and if we didn’t have a plan for the future there was not going to be a future on this place.” says Joan.

They rented more land, decide to intensify their cattle operation and stop cultivating altogether. “We know it was going to be a rough, hard road but survival dictated that we change direction and we were not going to give up easily. Actually it was a blessing in disguise!”

In 1994, the Jacksons had 70 head of cattle, but were still faced with the same grazing problems. That year, Bill Bristol, a wildlife biologist with the PFRA Green Plan, approached the Jacksons with some ideas. He was looking at aerial photographs to find wetland areas to set up riparian zones for environmental improvement. “What Bill suggested fit into our plans like a missing puzzle piece,” says Joan.

A rangeland assessment was made by Tom Harrison, a rangeland specialist with Sask. Wetland Conservation Corporation. Harrison then drew up a plan to centralize a water source and to control animal distribution with a series of cross fences.

With the new plan in place, the Jacksons now controlled where and when the animals graze the pastures. A central water system allows the ranchers to move animals from one pasture to another simply by opening one gate and closing another. Native pastures are left ungrazed for one year to allow time to regeneration.

During the fall the cows are put on hayed fields. The wetland riparian zone is used at this time for a weaning pasture. “We have seen that calves on clean ungrazed pasture with lots of water are much healthier,” Jason comments.

The second riparian zone is used when the cows come home in January of February just before calving. Since the more delicate plant species are dormant, the cows cause no damage during their stay.

Jason and Joan know this type of cow and pasture management takes time and effort but both feel it is worth it.

“We have a limited land base with which to make a living so we must make maximum use of our available land resources but at the same time we have to look after the environment and plant species to achieve that maximum. You can’t abuse the land and expect it to provide for you year after year. Nature does not work that way.”

Over the years, the Jacksons built up their herd to its present 140 head. “We have been told we can’t sustain that many cows on 2000 acres in the Brown Soil Zone,” says Joan. “The last few relatively wet years have allowed us to successfully graze 140 cow/calf pairs, put up enough hay for the winter with half a year extra and sell some to the local neighbours besides.” Grazing alfalfa also helps accomplish this, but it takes special management and monitoring to

be successful without loss. Seventy-two acres of irrigation provide a guaranteed source of hay in dry years ,but it is very time consuming and labour intensive.

Each year a re-assessment is done on the riparian zones to monitor improvement. In just a few years, these zones have gone from a low-good to a high-good condition score. Desirable plant species have flourished while undesirable plants diminished. Creek banks once bare and eroding are now covered with vegetation, leaving the creek water much clearer than before. “We hope that some day the creek will sustain fish like it used to years ago.”

Wildlife populations have also increased in the riparian zone. Ducks, geese, and pheasants now raise their young during

critical nesting periods without being disturbed by cattle. About 1,000 ducks winter over on the spring-fed creek, providing a food source for owls, hawks, golden eagles, bald eagles, foxes and coyotes.

The Jacksons’ are beginning to realize their long term goals with their new management plan. “We have added two more watering sites, and we plan to increase the breeding herd to 150 cows by 2002, and seed the last 150 acres of cultivated land to grass and alfalfa. Land base expansion is also on the horizon,” says Jason.

“Our children will inherit this ranch we have built and we intend on giving them a place of earth that is much healthier than when we started.”

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BURROWING OWLS --- GOING, GOING.....?

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Abstract: The steep decline of the burrowing owl population in Canada continues. This endangered owl is effectively extirpated in Manitoba and rare north of Regina in Saskatchewan, and the Red Deer River in Alberta. Releases of captive bred burrowing owls in BC are limited in size and returning birds have been exceedingly rare. Research of the Burrowing Owl Recovery Team in recent years has focused on limitations to productivity, male foraging habitat, post-fledging habitat use and survival, migration timing, and winter distribution. Conservation efforts have centered on landowner programs such as Operation Burrowing Owl and Operation Grassland Community, on environmental assessment guidelines, and on educational programs including the Saskatchewan Burrowing Owl Interpretive Center and school programs. Population monitoring data are contributed by both researchers and landowners. The Second International Burrowing Owl Symposium in Ogden, Utah in Sept 1998, and a current review of the status of the burrowing owl in the US has brought greater attention to the status and conservation needs of the burrowing owl in the USA. The current and future activities of the Burrowing Owl Recovery Team will be presented.

SWIFT FOXES AND BURROWING OWLS FUR AND FEATHERS -- CAN THEY FLOCK TOGETHER?

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Abstract: Swift Foxes and Burrowing Owls are high-profile species that have been extirpated (now re - introduced) or are in decline, respectively, on the Canadian prairies. As "flagship" endangered species they have received a lot of public attention and have been the subject of various management programs. We suggest that flagship species should be used to promote biodiversity and should be extended to benefit conservation of a range of prairie wildlife. We propose that these efforts be extended to include research on the key shared and non - shared elements necessary for the long survival of both "flagship species" within ecosystems that are located in the northern edges of their distribution. Factors important to both species are either stochastic or non - stochastic in nature. Human induced changes further influences biodiversity, prey species availability and survival. Both species have common needs, many of which are likely to be influenced by climate change. Most climate change scenarios suggest that in semi - arid regions of the world, an increase in frequency and length of droughts will be a consequence of the "green house effect". Not much is known if management, such as cattle grazing regulation, could be manipulated to offset, or reduce negative impacts anticipated from climate change. We compare and contrast those factors which are likely to affect survival of these two species should environmental conditions remain static (i.e. no climate change) but anthropogenic do not -and vice versa. The cumulative effects of both climate change and anthropogenic are also discussed. In addition, Swift Foxes, Burrowing Owls and other high profile flagship species, should continue to be used to benefit conservation of all prairie wildlife. Many species of prairie wildlife occurs on native grasslands that are privately owned. Flagship species are usually obvious and appreciated by prairie landowners. These and other flagship species can be used to promote conservation programs such as land management techniques, stewardship and easements. Recovery programs to conserve endangered species are rarely single species efforts, rather they are programs that benefit all prairie wildlife that share the same habitats.

WILDLIFE HABITAT CONSERVATION AND THE WTO: POTENTIAL FOR CONFLICT?

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Abstract: In recent years, the World Trade Organization (WTO) has been the focus for many complaints involving environmentally-based trade disputes between countries. Indeed, there has been increasing pressure for the WTO to explicitly address environmental issues in its governance of barriers to international trade. In this paper, we examine the main areas of conflict between WTO provisions and environmental management. We place this debate in the context of environmental sustainability and wildlife habitat conservation in the agricultural landscape of the Canadian prairie provinces. In particular we highlight potential positive and negative impacts of trade liberalization and WTO principles on this system. Finally, we discuss measures for resolving the trade-environment controversy, with the aim of determining whether there is potential for conflict between habitat protection measures and the WTO rules.

INTRODUCTION

In recent years environmental issues have become increasingly common as a focus of international trade disputes. The World Trade Organization (WTO), formed in 1995 as an organization designed to liberalize world trade, has been at the centre of these disputes. The decisions made by the WTO in many of these disputes have led many environmental non-governmental organizations (NGOs) and other sectors of society to believe that the WTO systematically works against the interests of the environment. The level of dissatisfaction

with the WTO held by these groups was highlighted through demonstrations and protests during the WTO Ministerial Conference in Seattle in November 1999. There is now broad expectation amongst many members of the public that the WTO should address social and environmental issues in their relationship to trade. However, the stated objective of the WTO has always been to govern the rules of trade in order to provide a stable environment for businesses to conduct international transactions, and as such the WTO has been reluctant to become involved in social and environmental issues.

The economic viability of Canadian agriculture, and in particular western Canadian agriculture, is very dependent on international trade. Therefore, trade liberalization and the WTO trade rules play an important role in determining land use within the agricultural landscape. In turn, the quantity and quality of the environmental amenities in this landscape, including wildlife habitat, biodiversity and environmental function, is determined by the pattern of production and land use. As a result, the development of policy initiatives aimed at preserving and conserving aspects of the western Canadian environment will need to recognize, and be consistent with, the pressures and opportunities that come with trade liberalization and the WTO trade rules.

The following section of this paper will discuss the economic context of trade and environment focusing on some of the basic economic models used to describe the relationship between economic development and environmental quality. The focus of the next sections will be the potential areas of conflict between environmental quality and trade in general, and the WTO and its predecessor the GATT more specifically. The role of Multilateral Environmental Agreements (MEAs) in trade and environment conflicts is then briefly discussed. Finally, the paper presents a discussion on some specific consequences of trade on habitat conservation in the Canadian prairies.

ECONOMIC CONTEXT FOR TRADE AND ENVIRONMENT

The impact of economic activity on the environment has received much attention, particularly in the last quarter of the 20th century. The development of the resource and environmental economics disciplines

has been driven by concern over the ability of traditional economic models to incorporate the environmental costs associated with the allocation of scarce resources. While the majority of the resource/environmental economics literature has not explicitly evaluated the impact of liberalized trade policies on environmental systems, the insight into the causes of environmental degradation provided by this work is important.

Market failures are situations where the market forces of supply and demand do not allocate resources in a way that is socially optimal. A simple economic model can be used to depict a market failure associated with allocating land to wildlife habitat or intensive agriculture (Figure 1). For demonstration purposes it is assumed that only these two land uses are possible. The optimal allocation of land is given by the point where the marginal benefit (demand) just covers the marginal cost of production (including the cost of conversion). In this model, the private optimum will also be optimal for society if all costs are captured, including the costs of decreased wildlife habitat, biodiversity and environmental services. However, the public good characteristics of these environmental goods and services result in these costs not being captured by the farmer, as represented by the divergence between private and social marginal costs (Figure 1). The failure of the market to capture the environmental costs of land conversion results in more land allocated to intensive agriculture and, therefore, less land allocated to habitat than is socially optimal.

Market failures are an important cause of environmental damage associated with economic activity. As an export opportunity, for example, that arises from liberalizing foreign markets can be seen as an increase in

demand in the market depicted in Figure 1, it will amplify the scale of the environmental damage. However, the reason for the increased environmental damage is not trade as such but the failure of the market to effectively capture the social costs of the activity. As such, members of the trade community may well argue that environmental degradation associated with trade liberalization is not bad trade policy, but bad environmental management. If

market prices do not reflect the cost to society of damage to the environment, then these costs should have been internalized through effective environmental management” (Sampson, 2000). The development of effective environmental policies aimed at “internalizing” the environmental costs would be an important step to ensuring trade, or economic activities in general, are less damaging.

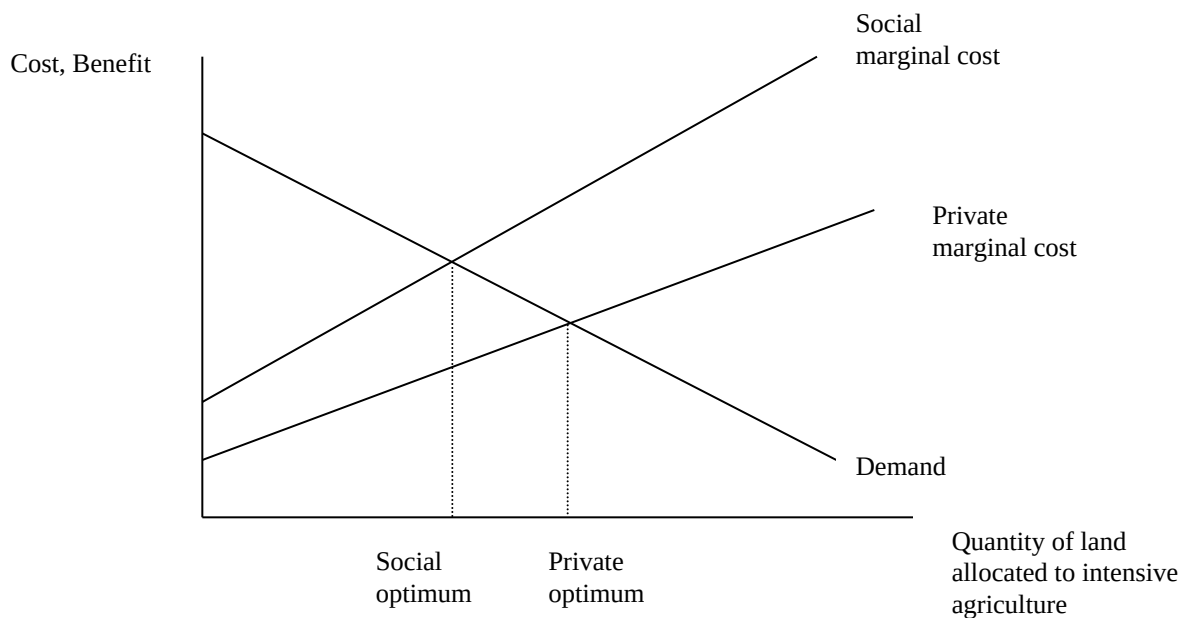


Figure 1. Market failure expressed as the divergence between the social and private marginal cost and the social and private optimum quantity of land allocated to intensive agriculture and wildlife habitat.

An important component in the argument for freer trade is the potential relationship between per capita income and environmental degradation. In general, it is argued that if poverty is the core of the problem, economic growth will be part of the solution in that as income increases, social preferences will change with greater demands by society for higher environmental quality. This relationship is called the environmental Kuznets curve

(EKC) (Figure 2). The EKC has been used to justify an increase in trade involving developing countries, which lie on the upward sloping portion of the curve, based on the potentially positive environmental impacts.

While there is some evidence to support the EKC, there is also evidence and arguments to suggest that this relationship is not valid. In general, for the relationship to hold, the

changes in preferences that are facilitated by increased income must be reflected in changes in environmental policy. It has been shown that growth itself often increases environmental impacts, thereby requiring additional environmental protection policy to simply maintain environmental quality, let alone improve it (Ekins et al., 1994).

Another important consideration is that the EKC depends on the capability of the system to repair the environmental damage, and thereby provide the downward sloping

segment of the relationship. In situations where there is irreversible damage to the environment (i.e. species extinction, changes in ecological function), subsequent environmental improvement is no longer possible (Ekins et al., 1994). Further, it has been shown that countries are more prone to respond to environmental issues that have local impacts (i.e. local pollutants, consumptive use of wildlife) than those with global effects (i.e. greenhouse gas emissions, biodiversity loss) (Barbier, 1997).

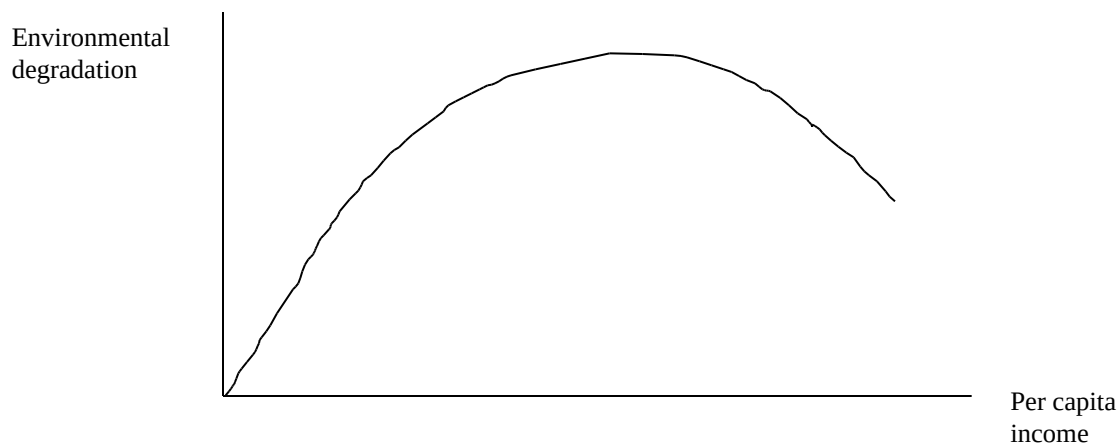


Figure 2. The environmental Kuznets curve.

The institutional and system requirements for the EKC to be valid suggests that faith in the paradigm that follows a progression such as - *trade liberalization leads to economic growth; economic growth leads to higher incomes; higher incomes lead to greater value being placed on the environment; a society that values the environment more highly will put policies in place to better protect the environment* - is not justified. In a similar fashion, however, to suggest that preventing trade, and thus slowing economic growth, somehow provides a solution to problems associated with environmental degradation is also a *non sequitur*. Slower

economic growth combined with expanding population may lead to ever increasing pressure on the environment without the favourable change in attitude toward stronger environmental policies. The root of the problem is not trade, but rather that the income available to people in developing countries at a particular point in time is not sufficient for them to give due consideration to the future state of their environment (i.e. they may be making rational choices given their constraints). This is a problem that transcends any debate regarding the desirability of trade.

The presence of market failures and the uncertainty concerning the validity of the related EKC, reveals that more liberalized trade may often not accompany increasing, or non-decreasing, environmental quality. In this context, economic development and trade must explicitly consider the environmental consequences in order to be environmentally sustainable. Corden (1974) states, "Theory does not say that "free trade is best". It says that, given certain assumptions, it is "best". A critical component of such assumptions is that there is a smooth functioning price mechanism ensuring that all costs and benefits are adequately represented in the market. The following section of the paper will focus on how components of the WTO and GATT may address or incorporate these issues.

THE WORLD TRADE ORGANIZATION

The WTO was formed in January 1995. The objectives of the WTO, as stated in the preamble of the agreement, are to facilitate trade with a view to raising standards of living, ensuring full employment and expanding the production of, and trade in goods and services, while embracing the principles of sustainable development as defined by the Brundtland commission (World Commission on Environment and Development, 1987). However, the WTO incorporates much of the structure of its predecessor, the General Agreement on Tariffs and Trades (GATT), which was developed in 1947 when the environmental consequences of economic integration were not a primary concern. Only indirect references to the environment were included in the exception clause in Article XX, which will be discussed later. Therefore, the underlying structure of the WTO was built to meet the fundamental role of providing a set of rules for firms wishing to enter into international transactions. As a result, the

WTO is not designed to adjudicate issues relating to international development, labour and environment (Kerr, 2000) and has avoided involvement in such issues. However, with the human population increasing from 2.5 to over 6 billion in the last 50 years, and an even larger increase in the scale of the global economy, environmental issues are becoming increasingly tied to economic development, including trade.

GENERAL AREAS OF CONFLICT BETWEEN TRADE AND ENVIRONMENT

In general, the impact of trade on the environment has been decomposed into three interacting elements: (1) composition effect – increased specialization of the economy in response to trade opportunities will be environmentally improving (degrading) if the target industry is less (more) environmentally damaging; (2) scale effect – increased scale of production in response to trade results in greater usage of resources and increased waste emissions; and (3) technique effect – as dictated by the EKC, income growth that results from the scale effect drives an increase in demand for environmental improvement which, if responded to in policy, results in an improved environment (Nordstrom and Vaughan, 1999). The net environmental impacts of these effects are largely ambiguous. However, the prevalence of market failures, as caused by the public good characteristics of environmental goods and services within the Canadian agricultural landscape, suggests that without an appropriate policy response to facilitate the technique effect, there may be net negative impacts of trade associated with the composition and scale effects in the agricultural industry.

SPECIFIC AREAS OF CONFLICT WITHIN THE STRUCTURE OF THE WTO

The GATT

As discussed earlier, the underlying structure of the WTO is primarily the GATT, which was developed when environmental issues were not viewed as important considerations in a trade agreement. The WTO rests upon the three principles of free trade: (1) GATT members must treat like products from all members in the same way, not favouring one above another (Most-Favoured-Nation (MFN) rules, GATT Article I); (2) GATT members must treat “like” products of all members as favourably as it treats its own domestic products (National Treatment, GATT Article III); (3) GATT members are prohibited from using quantitative import or export restrictions (quotas or bans). Only duties, tariffs or other charges may be used to restrict the movement of goods across their borders (Elimination of Quantitative Restrictions, GATT Article XI). However, the WTO continues to work to eliminate all barriers (tariff and non-tariff) from international trade.

The GATT allows member countries to adopt measures that are inconsistent with the above Articles under Article XX, which provides a list of exceptions. Article XX may be applied to justify environmentally inspired rules that conflict with free trade (Schoenbaum, 1997). Several clauses are of particular interest in examining potential trade-environment conflicts; Article XX (b) allows countries to pursue measures deemed “necessary to protect human, animal or plant life or health” and Article XX (g) permits measures which are “relating to conservation of exhaustible natural resources”. The *Chapeau* to this article specifies limits on the extent to which such measures can be

applied, stating that measures must not result in unjustified or arbitrary discrimination, or be a disguised restriction on international trade. It is through this article that most countries facing a GATT/WTO dispute on environmental issues have attempted to defend their trade-restricting measures.

Despite the potential role of Article XX in environmental disputes, there is significant confusion concerning the interpretation and uncertainty in the application of its specific terms. Several commentators have evaluated the range of interpretations of the phrases “necessary” and “relating to” in the context of particular environmental disputes. In the case of XX (b), it is the job of WTO dispute settlement panel to determine whether a) the substance of the measure is the protection of human, animal or plant life or health; b) the measures is *necessary* to protect human, animal or plant life or health; and c) the measure is applied consistently with the chapeau (Schoenbaum, 1997). With respect to XX (g), the panel must decide whether a) the measure falls in the range of policies relating to conservation of exhaustible natural resources; b) the measure itself is related to the conservation of exhaustible natural resources; c) the measures is made effective by conjunction with restrictions on domestic production or consumption; and d) the measures is applied in conformity with the chapeau.

It may be the case that although the terms of clauses XX (b) and XX (g) are easy to meet, countries are constrained in their use of trade measures by the strict terms of the chapeau (Charnovitz, 1998). Indeed, “no country in the GATT fifty-year history has been able to successfully invoke Article XX for the protection of a trade measure” (Simmons, 1999). In fact, the decisions on two recent trade disputes involving Article XX, U.S. versus Mexico, E.U. and Netherlands in the

dolphin/tuna cases in 1991 and 1994, and U.S. versus India, Pakistan and Thailand in the sea turtle/shrimp case in 1998, were not granted to the U.S. From the perspective of the WTO dispute settlement body, it is often difficult to determine whether trade measures are environmentally justified or whether they are a disguised restriction to international trade. As the WTO's primary purpose is to protect those wishing to engage in international transactions from government's capricious use of trade barriers for protectionist purposes, it is probably not surprising that its deliberations focus on this aspect of the argument rather than wider environmental issues.

WTO Provisions

As concerns over the protection of public health and the environment have increased, so has the development and implementation of mandatory regulations and voluntary standards for processes or products that could affect either health or the environment. When these standards differ between countries, they have the potential to impede trade. Concern over the implications of standards for international trade has stimulated the development of a range of WTO agreements. Of particular relevance to environmental considerations are the Sanitary and Phytosanitary (SPS) and the Technical Barriers to Trade (TBT) agreements.

The SPS Agreement applies to measures to protect humans, animals and plants from additives, contaminants, toxins or disease-causing organisms in food substances as well as from the spread of disease by pests animals or plants. While the agreement recognizes the members' rights to take measures that may restrict trade, these steps must be equivalently applied to local and foreign products (in accordance with Article

I) for the sole purpose of ensuring food safety and animal and plant health, and the measures must be scientifically justified. The primary source of controversy in this agreement centres around the difficulty of developing significant scientific proof when evaluating the impacts on complex environmental systems. The concern is that the agreement will facilitate the exploitation of any scientific uncertainty surrounding a protective law as a reason to limit preventative environmental action (French, 2000).

It has been argued that the SPS Agreement requirements for scientific proof are in direct conflict with the spirit of the precautionary principle. The Rio Declaration on Environment and Development, agreed to at the Earth Summit in 1992, declares that: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". In essence, the SPS Agreement imposes the burden of proof such that the additives, contaminants and toxins must be proved harmful, whereas the precautionary principle requires that the element must be proved benign. These issues proved to be central in the WTO decision on Europe's ban on hormone treated meat. The WTO rejected the EU's argument due to a lack of scientific evidence of a health and safety risk. In addition, it was stated that the specific wording of the SPS Agreement prevailed over the precautionary principle. However, the panel concluded that "the precautionary principle awaits confirmation as a customary principle of international law" (Sampson, 2000).

It is worthwhile to note that the SPS agreement can be considered precautionary in spirit since it allows countries to put trade

barriers in place when scientific information is insufficient to reach a scientific judgement. It is expected that these restrictions, however, will be temporary until sufficient information becomes available. There is an obligation on the country imposing the trade barrier to make every effort to acquire sufficient information to reach a scientific conclusion. It seems clear that this SPS clause was written to deal with relatively simply scientific questions such as short-run food safety and not long term or scientifically intractable questions relating to the environment. The WTO claims that such questions are beyond its competence and require separate international agreements to deal with them. Furthermore, it is important to point out that the WTO is only allowed to implement those measures that its Member States have agreed to; it has no ability to initiate trade legislation or measures of its own. Thus it is not fair to condemn the WTO for not applying the precautionary principle when the member states have not sanctioned it. There is nothing to prevent the inclusion of the precautionary principle in the WTO through future negotiations.

The TBT Agreement establishes obligations to ensure that voluntary standards, mandatory regulations and conformity assessment procedures are not prepared, adopted or applied with the view or effect of creating unnecessary obstacles to international trade. As with the SPS Agreement, technical regulations pertaining to mechanisms such as labelling, testing and certification procedures must adhere to the restrictions imposed under Article I of the GATT. At present there has been no disputes brought forward concerning the obligations of the TBT Agreement. However, it has been ruled that the GATT does not allow trade bans based on production methods in the two high profile cases involving the incidental catching and killing of dolphins during tuna

harvests and sea turtles during shrimp harvests. Given this precedent, there is little doubt that the TBT agreement will become increasingly important in future disputes between WTO members as disagreement over the legitimacy of certain technical regulations and standards widen (Sampson, 2000).

It is anticipated that the primary source of conflict surrounding the TBT Agreement is the lack of consensus as to its coverage of standards and regulations relating to the processes and methods that produced the product, unless the method of production is evident in the product itself (Sampson, 2000). In terms of the environmental impact of trade, the processes and methods that produced the traded products are of critical importance. Von Moltke (1999) states that trade can contribute to sustainability only if it is possible to distinguish between products produced using sustainable and unsustainable production practices. Eco-labelling schemes provide consumers information about how goods have been produced to help them discern between products that incorporate environmentally destructive and environmentally benign production practices.

Even if it is decided that labelling of products for environmental purposes are covered by the disciplines within the TBT Agreement, there is uncertainty about whether process-based eco-labelling schemes are legal in the WTO. In general, both the GATT and TBT Agreement prohibit discrimination between “like” products. The question of interpretation is whether likeness extends to the production and process methods (Sampson, 2000). In the Canadian agriculture context, the competitiveness of agricultural commodities that are produced using environmentally friendly practices may depend on the

interpretation concerning these labelling schemes. The first hints of this controversy have shown up in the conflict between the EU and the United States and Canada over the labelling of genetically modified food products which has recently been brought forward as a concern to the TBT Committee.

It is worthwhile to note that developing countries have been particularly concerned about and critical of proposals to allow trade restrictions on the basis of the process(es) used in production. They fear that allowing the imposition of trade barriers based on differing environmental standards underlying production processes is simply a new means by which developed countries can extend disguised protection to their industries. Developing countries are suspicious because they find their access to developed countries markets blocked despite WTO agreements to liberalize. If trade barriers are allowed on the basis of the environmental friendliness of the processes used in production, those trade measures still provide domestic industries with protection from foreign competition. Developing countries fear that playing the environmental card will become a far too convenient method for developed countries to respond to traditional protectionist pressures. Future negotiations over this issue are likely to be particularly acrimonious and developed countries attempts to have the issue (along with labour standards) put on the negotiating agenda was one of the major reasons for the failure of the Seattle meeting.

The WTO and Subsidies

Subsidies have been an extremely important component of domestic and international agricultural, resource and environmental policies. The WTO rules pertaining to subsidies are largely contained in the Subsidies and Countervailing Measures

Agreement, signed in 1994 at the Uruguay Round of trade talks. This agreement allows subsidies that are non-recurring and limited to 20% of the cost of adaptation of existing facilities to new environmental requirements imposed by law (World Trade Organization, 2001^a). Subsidies that do not meet the criteria set out in this agreement are determined to be either actionable or prohibited. Therefore, the extent to which a member can subsidize domestic production is limited under these rules, especially since other members can challenge the use of a subsidy if it feels it undermines their access to that market (Swinbank, 2000).

The Agreement on Agriculture, also signed at the Uruguay Round, designated 'Green Box' measures which allowed some specified subsidies to be paid to domestic producers. Under this exception the subsidies should have no, or minimal, trade-distorting effects and be designated under an environmental program (World Trade Organization, 2001^b). Specifically, the agreement states the payments should be made under a specified government environmental or conservation program, and are limited to covering the extra costs or loss of income associated with program compliance. As an example, the U.S. government has argued that the Conservation Reserve Program (CRP) payments are permitted under the criteria for a 'Green Box' measure. According to the Due Restraint Clause of the Agreement, other members of the WTO cannot challenge subsidies made within the Green Box category. However, subsidies targeting such environmental issues as species conservation could be challenged under the WTO if the disputing country can provide evidence that the subsidy is an arbitrary and unjustified barrier to trade. Further, future challenges to domestic subsidies may be forthcoming with the Agreement on Agriculture currently

being re-negotiated by WTO members, and the Due Restraint clause expiring in the year 2003. Recently, some members (EU, Korea, Japan, Norway) have suggested broadening the scope of the Green Box, while the major agricultural exporters continue to stress that environmental and social objectives should be met through means other than subsidies (World Trade Organization, 2000).

MULTILATERAL ENVIRONMENTAL AGREEMENTS

In addition to working together to establish rules for the conduct of international trade, countries have also been actively seeking co-operative means of dealing with global environmental problems. Multilateral Environmental Agreements (MEA) have been established in a number of areas including biodiversity (The Convention on Biological Diversity), endangered species (Convention on International Trade in Endangered Species (CITES)) and climate change (Kyoto Protocol). Approximately twenty of these MEAs contain clauses directly affecting trade, and many of these provisions are inconsistent with the rules of the WTO. An important question in this context is, if an environmental measure implemented by a country in accordance with its MEA obligation violates provisions of the WTO, which agreement would take precedent?

The potential for conflict between MEAs and WTO rules is most acute when there is dissimilar membership in the two agreements. For example, a country which is not a member of a specific MEA may object to the trade limiting provisions of the MEA, under the auspices of the WTO, since they have not voluntarily agreed to such trade measures. In such cases the WTO would provide the only possible mechanism for settling the dispute. In general, present

MEAs have no dispute settlement system and no coercive ability beyond moral suasion, while the dispute resolution capacity of the WTO is very strong. It seems evident that under the current relationship conflicts that emerge between MEAs and the WTO rules will likely be decided on the basis of the WTO's rules on trade. In fact, as discussed earlier, the WTO decision on the E.U. barriers to hormone beef has been perceived as being in conflict with the precautionary principle as specified by the Rio Declaration on Environment and Development.

It should be remembered that both MEAs and the WTO simply reflect what countries have agreed that they can do. For example, there is nothing to prevent those negotiating an MEA from agreeing that it should take precedent over the WTO when there is a conflict. Countries have simply failed to agree to do so. In some cases, such as the recent Biosafety Protocol, the final agreement leaves the question of precedent hopelessly muddled. However, the WTO is not an environmental policymaking institution; it does not have the expertise, nor does it want to be involved in making policy aimed at environmental problems. The WTO's Committee of Trade and Environment (CTE), established in 1994, believes that trade measures used for environmental management are not an optimal solution, and has stated that MEAs are the best way to co-ordinate policy action to tackle global and trans-boundary environmental problems co-operatively. The WTO has stated that: "We agree that environmental considerations should be taken fully into account in the upcoming round of WTO negotiations. This should include a clarification of the relationship between both multilateral and environmental agreements and key environmental principles, and WTO rules" (World Trade

Organization, 1999). Until member countries of the MEAs or the WTO are willing to contribute to this clarification, the potential for conflict remains.

HABITAT CONSERVATION AND AGRICULTURE

Agriculture is a very important industry to the prairie provinces of Canada. An important characteristic of Canadian agriculture is its heavy dependence on international trade, with approximately 75% of the value of production sold on the world market (Saskatchewan Agriculture and Food, 2000). Consistent with this economic profile, land use on the Canadian prairies is dominated by agricultural production with almost 93% of the prairie ecozone dedicated to agriculture. Agriculture has extensively altered this landscape, with only 1% of the original tall-grass prairie, 19% of the mixed-grass prairie, 16% of the aspen parkland and 30% of the prairie wetlands remaining (Neave and Neave, 1998). Further, a number of Canada's endangered species use Canadian prairie habitat for part of their life cycle. In response to these changes there has been increasing interest in the development of policy aimed at conserving and preserving prairie habitat. Due to the nature of the agricultural industry, any conservation policies or activities will be subject to the forces of trade liberalization in general, and the WTO rules specifically. The potential impact of trade liberalization on conservation and environmental sustainability will now be discussed.

Changes in the structure and scale of the agricultural production system, as influenced by trade liberalization, are important contributors to the impact of trade on conservation and environmental sustainability. The composition, scale and technique effects discussed earlier comprise

the indirect effects of trade. Shifts in the types and scale of farming systems and production enterprises may have negative or positive impacts on the prairie habitat and wildlife populations. A potential example of these effects is the proliferation of intensive livestock operations in western Canada reflecting a change in the composition of the agricultural system, and an increase in the scale at the enterprise and industry level. It remains to be seen, however, whether environmentally benign intensive livestock operations will be stimulated under the technique effect.

In general, the effects of the market failures that are exacerbated by trade liberalization are often not accompanied by policies and practices that attempt to adequately reflect the value of the natural system (Conway, 1998). In other words, in the absence of appropriate domestic policy to adequately value environmental goods and services (i.e. wildlife habitat, biodiversity, environmental function) the extant market failure is simply amplified by the scale and composition effects of trade liberalization. However, in order to address the market failure the type of domestic policy is important; Conway (1998) states, "a government's environmental policies are an important but entirely insufficient response to the needs of biodiversity conservation. Social and economic development policies often have a much greater influence on biodiversity stresses". Therefore, within the agricultural landscape, land use policies will undoubtedly be required to address these environmental conservation and preservation concerns.

The development of domestic policy to address the inherent market failures that occur when dealing with non-market and public goods, such as wildlife habitat, seems to be a well accepted response to the indirect

effects of trade liberalization. However it is likely that there will be some resistance to such policies within the industry if it is perceived that these policies will compromise their competitiveness in the global market. As a result, there may be an unwillingness to develop environmental or development policies aimed at addressing the market failure. In fact, there is often pressure to create domestic policies that encourage trade-intensive sectors and to not develop policies that may affect the competitiveness of an industry (Conway, 1998). It should be noted that a body of research indicates that stiffer environmental regulations do not necessarily undermine competitiveness (Porter, 1991).

Although it is important to consider the technique effect, in reality the Environmental Kuznets Curve may have limited application within the Canadian agricultural landscape, since it is likely that Canadian society, with its relatively high per capita income, is on the downward sloping segment of the EKC. However, a number of the bird species which use breeding habitat in the Canadian prairies are neotropical migrants that over winter in Central and South American countries. Conservation plans for these species necessarily include consideration of over winter habitat quality and quantity. More liberalized trade could be beneficial to these species since many of these countries are likely on the upward sloping portion of the EKC. However, as discussed earlier in this paper, a significant concern about the EKC and biodiversity issues is the irreversible nature of species loss. If irreplaceable habitat is destroyed and/or some of these species are made extinct during the economic development that accompanies an increase in incomes, these species will be lost no matter how the preferences of these societies change with increased income. However, there is also no

guarantee that limiting trade will lead to more environmentally friendly policies in any of the countries that provide habitat for these species.

While the indirect impact of trade liberalization on the environment is an important effect, it is also worthwhile to examine the direct influence of trade rules on policy development. The trade literature indicates that trade rules provide for environmental improvements in agriculture by removing trade distorting policies. These policies, by distorting the marginal cost of specific production practices, are another form of market failure. Agriculture subsidies have led to intensified land use, increased applications of agrochemicals, adoption of intensive animal production practices and overgrazing, degradation of natural resources, loss of natural wildlife habitats and biodiversity, reduced agricultural diversity, and expansion of agricultural production into marginal and ecologically sensitive areas (World Trade Organization, 1996).

In western Canada, the presence of the various trade agreements has contributed to the removal of the Crow rail transportation subsidy in recent years. The phasing out of the Crow subsidy began in the late 1980s with the final termination and pay-out occurring in 1994. The effect of this subsidy was to decrease grain transportation costs to farmers that had encouraged an inefficient allocation of land to annual crop production. The result of the removal of this subsidy showed up in the 1996 Agriculture Census which reported a decrease in annual crop land in Saskatchewan, the first decrease in this category since the census began, and an increase in tame forage since 1991. The increase in perennial vegetative cover, and decreased incentive to convert native cover

to annual crop, is a positive effect for prairie wildlife species.

It is also important to consider the effect that trade rules may have on future policies aimed at conserving wildlife habitat within the agricultural landscape. As discussed earlier, it is difficult to predict how such measures as Article XX, the SPS Agreement and the TBT Agreement will be interpreted by the WTO in the case of a domestic environmental, economic development or land use policy aimed at conserving wildlife habitat. As an example of a potentially acceptable policy, the CRP program in the U.S., which has significant wildlife habitat benefits, is argued to be a 'Green Box' subsidy. Therefore, a similar program designed for Canada would also likely not be actionable. However, if such a program permitted some agricultural use of the set-aside lands there may be conflicts. While the most recent endangered species legislation (Bill C-33) died on the order paper due to the federal election in the fall of 2000, it is probable that any new legislation will include some form of compensation to landowners for costs and losses associated with conservation. The means by which this compensation is paid will need to be carefully considered in order to ensure such payments do not conflict with WTO rules.

There has been increasing discussion lately about how to remedy some of the conflicts between the WTO rules and environmental sustainability. It has been suggested that amendments be made to the WTO including changes to Article XX to either expand the Article or amend existing provisions to include specific exemptions for environmental trade measures (Choo, 1997). However, such amendments and/or changes will involve tortuous negotiations between members with divergent ideas and differing agendas, making this an unpopular option.

Another option, as discussed earlier, is to clarify the relationship between the WTO and MEAs. A proposal put forward by Switzerland states that the relationship between WTO and MEAs should be characterized by mutual supportiveness, with each agreement focusing on its primary area of competence. This suggests that while the WTO should not be allowed to determine the legitimacy or necessity of trade-related environmental measures, it should be able to assess whether specific measures are a means of arbitrary or unjustified discrimination between countries, or a disguised restriction on international trade (World Trade Organization, 2000^b). The proposal draws attention to the fact that the problem is too fundamental to be resolved on a case-by-case basis by WTO judiciary bodies. Another proposal is to enhance the power of the United Nations Environmental Program (UNEP) in order to match the status of the WTO (Choo, 1997; Peterson, 2001). While UNEP is the only global institution responsible for coordinating and monitoring the various MEAs, it lacks enforcement capabilities. With an enhancement of its powers, UNEP could work with the WTO to resolve trade-environment problems more effectively.

In order to make MEAs more effective tools, when these agreements are negotiated to include trade provisions, the policymakers designing the MEAs trade provisions should be required to consult with the WTO to limit conflicts with WTO principles. In recent years the WTO has taken a pro-active role in briefing those responsible for administering MEAs on WTO principles and conventions in an attempt to reduce potential problems. Often those charged with devising domestic environmental policy are poorly informed regarding their countries WTO obligations. In many cases one suspects that conflicts arising from the design of domestic

environmental policies could be reduced if environmental officials were better informed regarding the WTO, and if those responsible for trade policy and environmental policy were encouraged to cooperate to a greater degree.

CONCLUSION

The strong linkage between the economic development of western Canadian agriculture and international trade dictates that the environmental sustainability of the Canadian prairies will be strongly influenced by trade liberalization and the trade rules of the WTO. The impact of these factors on such environmental components as wildlife and biodiversity conservation and environmental function may be positive or negative and will occur indirectly through changes in the socioeconomic systems and directly through specific trade rules and disputes administered by the WTO. It is important to recognize the role of domestic policy in either ameliorating or exacerbating these trade impacts. Further, it is difficult to predict how the WTO will interpret such areas of uncertainty as Article XX, the SPS Agreement, the TBT Agreement and the future of Green Box subsidies. As a result, predicting areas of conflict and recommending future direction in agro-environmental policy initiatives is problematic. However, in order to ensure the environmental and economic sustainability of the western Canadian agricultural system, these areas of conflict will need to be resolved in order to develop essential policy initiatives.

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CHANGING FARM DEMOGRAPHICS AND LAND USE PRACTICES IN THE NORTHERN GREAT PLAINS: GREATER RISKS TO SUITABLE WILDLIFE HABITATS

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Abstract: Bigger and faster farm equipment, fewer farmers, larger farms, less diversity in cropping systems, and larger-sized livestock are among the factors contributing to the destruction or conversion of remaining natural wetlands and prairie sod remnants in the northern Great Plains. Although conservationists have been aware of the negative effects of intensified farming practices in the northern Great Plains on wildlife and their habitats for several decades, most are not aware of some fairly recent changes in farming and crop processing practices that perpetuate even great risk to natural resources. Using socio-economic, agricultural statistics and human resource data sources, we will demonstrate how recent changes in traditional land use practices and farm demographics in South Dakota and nearby states are resulting in greater acreages of unsuitable habitats for prairie wildlife. We will also demonstrate how well natural resource agencies and institutions have been doing at preserving wetland and native prairie upland habitats in this region in the past. Our summary will emphasize the need for accelerated preservation efforts relative to wetland and remnant native prairie grasslands in the northern Great Plains during this decade and beyond.

WATER IN THE PRAIRIES

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Abstract: Biotic communities are generally in balance with the environment they live in. Most of the environmental factors affecting these communities are slow to change e.g. soil composition, predator species, and constitution of the air. However, other factors such as land cover and climatic conditions can change over relatively short time periods. This presentation will focus specifically on the variability of the water component of the climate system within the prairies and how new patterns might be established under future climate scenarios. Some specific questions will be posed: What are the general circulation models predicting for the Prairies? What might be the potential impacts on biotic communities and some of our economic sectors? Will the future conditions be beyond the adaptive capability of some biotic communities? What impact might climate change have on the number of “duck rearing” Prairie potholes?

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Prior to joining Environment Canada, Ross taught engineering courses in the Water Sciences Technology program at Kelsey Institute of Applied Arts and Sciences in Saskatoon. He began his association with the Water Resources Branch of Environment Canada in 1980 as a hydrologist in the Regina office and for several years was the manager of the Saskatchewan office of Water Survey of Canada. From 1990 to 1993, Ross was the Head of the Planning Division of the Water Planning and Management Branch for Environment Canada’s Prairie and Northern Region. One of his priorities was contributing to the South Saskatchewan River Basin Study. In 1993, he joined the Atmospheric Environment Branch of Environment Canada as Head of the Adaptation and Impacts Section. He is continuing his involvement in studies of prairie climate variability and change within his present position.

Ross holds bachelor’s and master’s degrees in Physical Geography from the University of Manitoba and an M.Sc. degree in Civil Engineering from the University of Saskatchewan. He is registered as a professional engineer in Saskatchewan.

MANITOBA'S RARE, THREATENED, OR ENDANGERED SPECIES: TO WHAT EXTENT IS THEIR HABITAT PROTECTED?

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Abstract: Since 1990, Manitoba has undertaken several initiatives to protect endangered species and their habitat. The *Endangered Species Act* was passed in 1990, and to date a total of 15 species have been designated as endangered or threatened. In 1990, Manitoba also embarked on a Protected Areas Initiative to help complete the network of protected areas throughout Manitoba's natural regions. In 1994, the Manitoba Conservation Data Centre was created to establish an integrated biodiversity data bank and comprehensive inventory of plant and animal species of special concern and of representative plant communities.

This paper combines data from the latter two initiatives by examining the extent to which habitat of rare, threatened or endangered species is found within the current network of protected areas. Digital maps of the known recorded occurrences of each rare, threatened, or endangered species were superimposed on digital maps of the current network of protected areas to assess the extent of habitat currently protected for each species. The results will help assess where gaps exist in the protection of habitat of these species, and where to focus efforts to establish new protected areas.

INTRODUCTION

This paper examines the extent to which the habitat of species considered to be rare, threatened, or endangered in Manitoba is protected. Although the whole province has been considered, the focus of this paper is on species and protected areas in the Prairie Ecozone.

The landscapes and biodiversity now present in Manitoba, and more

specifically in the Prairie Ecozone of southern Manitoba, reflect Manitoba's glacial past and the history of human occupation. About 23,000 years ago, the last Wisconsin glaciation invaded southern Manitoba, eroding most of the pre-existing loose rock and soil from the surface, and grinding away underlying solid rock (Teller 1984). Glaciers began to retreat about 16,000 years ago. Subsequently, plants (Shay 1984), animals (Lammers and Wrigley 1984) and people (Pettipas 1984; Shilliday 1993) returned to colonize the

exposed landscape. Human colonization began to accelerate about 300 years ago (Shilliday 1993), with the most intense transformation occurring since 1870 (Shilliday 1994).

The Prairie Ecozone (adapted from Smith *et al.* 1998)

The Prairie Ecozone extends in an arc across the southern portions of Alberta, Saskatchewan and Manitoba along the Canada-United States border. It consists of the northern extension of the former open grasslands of the Great Plains of North America. Relief is generally subdued. Large river valleys and large expanses of undulating hummocky terrain are the most striking landscape features.

The climate of the Prairie Ecozone is determined by its mid-continental location, especially in Manitoba, and by the Rocky Mountains which impede moisture bearing winds from the Pacific. The result is a continental climate, subhumid to semiarid, with short, warm summers and long, cold winters, low precipitation and high evaporation. Winds are frequent and often strong. Precipitation in Manitoba ranges from 400 to 550 mm, with about one-quarter falling as snow. Two major rivers cross the area. The Assiniboine River flows southeast and east across most of the Ecozone. The Red River flows north along the eastern edge of the Ecozone.

Cretaceous shales underlie most of the Ecozone in Manitoba, except for the most easterly portions which are underlain by Paleozoic limestone. Surficial deposits are largely level-to-rolling plains of hummocky glacial moraine and level-to-undulating, sandy-to-clayey lacustrine deposits. Chernozems are the dominant soils. Grassland and parkland plant communities

once made up the native vegetation of the area but they have extensively been modified by agriculture. Tall-grass prairie once dominated the Red River Valley along the eastern edge of the Ecozone, but it has virtually been extirpated. Parkland communities in eastern portions of the Ecozone include bur oak as a common dominant along with aspen (Bird 1961). Mixed-grass prairie once covered the bulk of the grassland areas of the Ecozone, but now only about 25% of their original area remains.

This paper examines in more detail the extent to which the modifications arising from human settlement have affected protection and conservation of natural areas, particularly on species considered to be rare, threatened, or endangered. The paper consists of two parts. Part one presents the foundation on which the current approach to protected areas and endangered species rests. It provides background information on Manitoba's protected areas and the history of land and resource administration and conservation efforts in Manitoba. Much of this information has been condensed and updated from Hernandez (1999). Part two provides an analysis of the extent to which our current network of protected areas and other conservation efforts protect the habitats of the current list of rare, threatened, or endangered species, and identifies where gaps exist to focus future effort.

Manitoba's Framework For Establishing Protected Areas

Manitoba's framework for protected areas is described in "*An Action Plan for Manitoba's Network of Protected Areas*" (Manitoba Conservation 2000).

Natural Regions

Manitoba's natural regions framework closely parallels Canada's ecoregions approach (Smith *et al* 1998), but does not duplicate it for several reasons. In the mid 1970s, Manitoba Parks Branch began a system planning effort that called for the preparation of a natural regions map (Wilson 1977). The principal criterion applied was that the regions delineated by the process would have to be observable to the lay

person. Maps of climate, physiography, major vegetation zones, soils, and geology were overlain by hand. The resulting map had 12 natural regions. Since this approach is quite similar to that undertaken for ecoregions mapping, it is not surprising that there are many similarities at a gross scale. With the advent of computer mapping, Manitoba refined the original natural regions map in 1996. The current map follows ecoregion boundaries in northern Manitoba, but not in the south (Fig. 1).

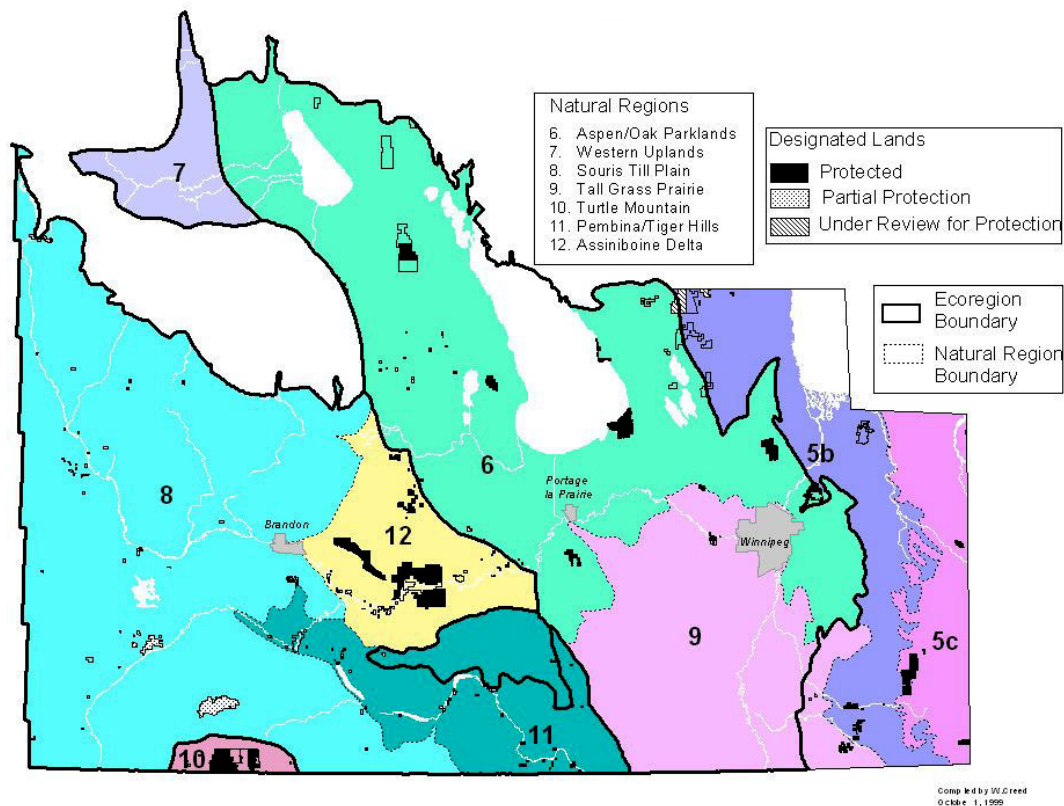


Figure 1. Comparison between Natural Regions of Manitoba and ecoregion boundaries in southern Manitoba.

In the Prairie Ecozone, Manitoba has subdivided ecoregions more finely than the Canadian framework. In the north, Manitoba natural regions are made up of more than one ecoregion, but each ecoregion is recognized as a sub-region of a given

natural region. In all cases, ecoregion polygon data have been followed so that aggregation and adjustment of data can be accommodated easily.

Enduring Features Analysis

In 1991, the Canadian Council on Ecological Areas (Peterson and Peterson 1991) identified a need to use enduring features of the landscape to meet conservation goals. Manitoba adopted this approach as a means of meeting two linked government commitments: (a) representing natural regions in a network of protected lands and (b) preserving biodiversity (Watkins and Hernandez 1996). Enduring features consist of landforms, topographical features, and soils that reflect geology and regional climate, since they are relatively permanent fixtures of the landscape. Biological features are much more ephemeral, but, in large part, they depend on enduring features for "habitat". Since a comprehensive biological inventory is not available for the entire province, Manitoba adopted the protection of representative enduring features as a first approximation and a surrogate for preserving biodiversity.

The Manitoba approach consists of two steps (Watkins and Hernandez 1996). First, the characteristic enduring features that make up a natural region are defined, and, second, gaps in representation are assessed. In 1994, Manitoba adopted a scale of 1:1,000,000 for regional analysis, in part, because this scale provides a coarse filter for identifying gaps in existing systems of protected areas, and in part, because digital data at that scale were available for analysis. The enduring feature unit is called a landscape unit. Landscape units consist of unique combinations of relatively uniform climate and physiography (called an ecoregion (Smith *et al* 1998)), soil landscape and surficial geology.

The enduring features approach has had many successes, and has greatly advanced the evaluation of protected areas and environmental impact assessments in

Manitoba. It has been incorporated in two major forest company environmental hearings to date, and is now routinely used for screening and reviews of development proposals throughout the province. In particular, the use of such a systematic and scientific approach has quickly gained the acceptance of many in industry. Examination of landscape unit maps and vegetation maps has resulted in the identification of many correlations and overlaps. In addition, unique landscape units often have vegetation that is distinct from adjacent sites (e.g. Douglas Marsh Protected Area). Some existing designated areas were found to occupy unique landscape units (e.g. Cowan Bog Ecological Reserve, Portage Sandhills Wildlife Management Area).

Manitoba's Definition of Protected Areas

Protected areas consist of land, freshwater, or marine areas that are protected by legislation or regulation from logging, mining, hydroelectric development, oil and gas exploration and development, and any other activity that significantly and adversely affects habitat (Manitoba Conservation 2000). Only areas considered "protected" are considered in evaluating the extent and adequacy of representation of landscape units in natural regions.

The approach and guidelines used in determining adequacy of representation depend on the size and distribution of landscape units within a natural region and their occurrence in existing protected areas is detailed in the Action Plan (Appendix A *in* Manitoba Conservation 2000). In general, a given landscape unit in a natural region is considered adequately represented where a sufficient portion of it is included in existing protected areas, so that landscape-scale ecological processes and integrity are

considered likely to be maintained. Moderately captured landscape units are those where a significant portion of the landscape unit is included within one or more protected areas, so that disturbance-recovery cycles are judged likely to be maintained across a wide range of scales except for landscape-scale disturbance events. Landscape units where only minor parts are found in existing protected areas or where there is no representation within protected areas are rated as partial/not captured.

The Douglas Marsh protected area demonstrates some of the difficulties with determining what is meant by "adequate" representation in a protected area. The protected area sits on a single occurrence landscape unit present nowhere else in the Assiniboine Delta natural region. Although the protected area captures virtually all of the landscape unit, it is considered only "moderately" represented for several reasons. It is not contained within a larger protected area, and occupies a depression into which agricultural and other runoff drains from at least two sides. A railway and hydro line bisect it, and roads and trails enter parts of the area. Changes in management and protection of additional lands would be needed to bring its rating to "adequate"

History Of Land And Resource Administration In Manitoba

Early Wildlife Administration - Establishment of the First Preserves

Unlike the British colonies that joined Canada with full control of land and natural resources, when Manitoba was created in 1870, it was only given the right to control wildlife. Ottawa retained control over all other natural resources including Crown

land. Until 1876, when the *Act for the Protection of Game* was passed, there was no restriction on anyone killing wildlife in any number at any time of the year. The provincial Department of Agriculture administered the Act and its successors until 1930 (Bossenmaier 1978, Goatcher 1975). Over the years, the principal focus of the Act was on regulating the killing of wildlife.

In 1911, Manitoba asked Canada to set aside the first areas designated to conserve and protect natural resources. Four Game Preserves were established in areas first designated as Dominion Forest Reserves in 1895. Two of these Forests, Spruce Woods and Turtle Mountain, are in the Prairie Ecozone. New Game Preserves were added to the system over the years along with waterfowl refuges, and bird sanctuaries. By 1938, a total of 32 Game Preserves covered some 20,000 km² throughout the province. Many were in the Prairie Ecozone (Bossenmaier 1978).

Transfer of Natural Resources Administration

On December 14, 1929, Manitoba and Canada signed an agreement for the transfer of the other natural resources and the administration of Crown land in Manitoba from the Dominion to the Province (Manitoba Department of Natural Resources 1990). The *Manitoba Natural Resources Transfer Act* came into force July 15, 1930. At that time, a provincial department of Mines and Natural Resources was established, and wildlife administration was transferred to it from the provincial Department of Agriculture through the enactment of a new *Game and Fisheries Act*. One of the purposes of this Act was to establish and patrol game preserves and bird sanctuaries. The newly created position of Director of Game and Fisheries was

responsible for supervision and administration of the Act which remained in force until 1963. By the 1940s, aerial surveys and other biological investigations in support of management programs had become one of the major tasks of provincial wildlife staff. In the late 1950s, pressure for multiple uses of Crown lands was being urged (Bossenmaier 1978).

In 1963, a new *Wildlife Act* was passed and the Game Preserve system that began in 1911 was completely revised (Bossenmaier 1978). Wildlife Management Areas (WMA) were designated to manage specified lands for wildlife. Some Game Preserves became Wildlife Refuges, areas where hunting of specified species was prohibited. This Act and system of designated lands continues in force today, but is now under review. In spring 1999, a public consultation process on the future management and administration of wildlife in Manitoba began under the aegis of the Manitoba Round Table for Sustainable Development (1999). The results of the process are expected to lead to new legislation.

Manitoba's Provincial Park System

Manitoba's current provincial park system had its beginnings under forest administration (Parks and Natural Areas Branch 1998, Schroeder 1997). As mineral exploration and new forestry roads opened up Dominion Forest Reserves to greater public access after the early 1900s, interest in outdoor recreation began to grow. Campgrounds and cottages were built in the Turtle Mountain Forest Reserve in the Prairie Ecozone. With the transfer of natural resources to Manitoba in 1930, Dominion Forest Reserves became Provincial Forest Reserves except for Riding Mountain (outside the Prairie Ecozone) which became Manitoba's first National Park. Over the

next 30 years, the recreational use of Manitoba's forests accelerated, mostly under the administration of the Forest Service. Roads were built, areas surveyed and sites developed, mostly in forested areas outside the Prairie Ecozone. After 1945, Lands Branch began developing cottage subdivisions, campgrounds, and picnic areas outside forest reserves, and the Department of Public Works developed parks and waysides along highways.

In 1960, Manitoba's first *Provincial Parks Act* was passed. It allowed for the formal establishment of provincial parks and recreational areas. The focus of the Act was to preserve areas for recreational purposes. Mining, forestry and agricultural operations, however, could continue provided that they respected recreational purposes.

As environmental awareness grew through the 1960s, parks came to be seen as fulfilling purposes other than recreation. In 1972, The *Provincial Park Lands Act* replaced the 1960 legislation. In addition to recreation, provincial parks were to conserve and manage plants and animals and to preserve areas and features of geological, cultural, ecological or other scientific interest. As in 1960, resource use, harvest and extraction activities could continue.

By the late 1980s, there was recognition of the need to formally protect natural lands from development. In 1990, a survey confirmed that Manitoba had the most permissive resource extraction policies and practices of all of Canada's park systems (Watkins 1990). Later that year, Manitoba was the first jurisdiction in Canada to commit to the World Wildlife Fund Endangered Spaces Campaign. The Manitoba Round Table on Environment and Economy embarked on a public consultation process on natural lands and special places.

The meetings revealed widespread public support for a network of protected areas in Manitoba, and led to the passage of a new *Provincial Parks Act* in 1993. For the first time, this Act allows the designation of parks or portions of parks where intensive recreational development, forestry, mining, and hydroelectric development are prohibited. Further, the Act now requires that advance public notice and consultation occur before any changes can be made to a park's designated external or internal boundaries. Due to this public consultation requirement, implementation of the new Act took four years. The new provincial parks system was designated in March 1997. In general, existing resource extraction areas and intensive recreational areas were accommodated, but many areas are now protected where there was little active extraction, existing development or low potential for future development.

Other Conservation Initiatives

Wildlife Management Areas

Since 1997, Manitoba's Wildlife Management Areas have systematically been screened to see which portions could be moved to a legally protected status. Many WMAs have extensive agricultural use, principally grazing, but as discussed below, grazing is not necessarily incompatible with recognition as a protected area. In addition, oil and gas and gravel extraction are major activities in southwestern Manitoba. Some WMAs have been closed to all extraction activities except oil and gas, so that they are only considered "partially protected" and do not contribute to the network of protected areas.

Douglas Marsh Protected Area

The Douglas Marsh protected area was established on November 7, 1998 in Spruce Woods Provincial Forest. This was the first use of the *Forest Act* alone to protect a portion of a provincial forest. Previous portions of provincial forests were protected using legislation for provincial parks, ecological reserves and wildlife. Protecting this area also involved negotiations with, and agreement of, the Canadian Armed Forces, since Canadian Forces Base (CFB) Shilo occupies part of the area.

Municipalities and Conservation Districts

To date, municipalities have not been extensively involved in the protected areas program because it has concentrated on northern Manitoba, but that is now beginning to change. Wildlife agencies have been much more involved with municipalities. In addition municipal officials are involved in the process of implementing Conservation Agreements.

Conservation Districts are established under the *Conservation Districts Act* and date back almost 30 years. To date, 13 Conservation Districts have been established to provide for conservation, control and prudent use of resources. The Act allows Cabinet to designate protected areas within a District. Districts carry out habitat conservation and protection activities, and one Conservation District has created its own "ecological reserve".

Conservation Agreements

The *Conservation Agreements Act* was passed in 1997, and proclaimed in force July 1, 1998. The Act allows landowners to put a legally binding easement or caveat on the land, to prevent future owners from destroying the natural features for which it was set aside. The then Minister of Natural

Resources signed the first Agreement protecting 35 acres of his farm in perpetuity on May 7, 1999. Manitoba Natural Resources (1999) published a brochure describing the program. To date, 29 Agreements have been signed covering about 900 ha and several others are being evaluated. Most are in the Prairie Ecozone.

Critical Wildlife Habitat Program

The Critical Wildlife Habitat Program agreement was signed July 20, 1989 by Manitoba Habitat Heritage Corporation, Manitoba Natural Resources, Manitoba Naturalists Society, Wildlife Habitat Canada, and World Wildlife Fund Canada. The Nature Conservancy of Canada joined later. The Program's goal was to preserve and manage the remaining critical habitats in Manitoba, with special emphasis on native grasslands and the habitats of unique, rare and endangered species.

Preserving Tall-grass Prairie: The first task of the Program was to survey the tall-grass prairie natural region in the Red River Valley and surrounding areas. Manitoba and southwestern Ontario are the only two areas of Canada where tall-grass prairie occurred prior to settlement. Today, less than 1% of the original tall-grass prairie in Manitoba remains in its natural state since it occupied some of the most fertile soil in Canada (Joyce 1989, Joyce and Morgan 1989). This makes it one of Canada's most endangered ecosystems, comparable to the Carolinian forest of southern Ontario.

Most tall-grass prairie remnants occupy marginal sites. These include sandy and rocky soils on former Lake Agassiz beach ridges (Manitoba Tall Grass Prairie Preserve) or eskers (Birds Hill Provincial Park), surface limestone pavement and related outcrops (City of Winnipeg Living

Prairie Museum), or wet, as-yet-undrained, sites around major lakes and prairie wetland complexes (Lake Francis and Oak Hammock Marsh Wildlife Management Areas). The largest expanse of remnants was found to occupy a beach ridge complex in southeast Manitoba. Most land was privately owned, a result of settlement by the first wave of Ukrainian immigrants in the late 1890s. Since 1989, 2170 ha have been acquired through the Program. The Program partners have raised funds and bought land as it became available. Local residents have participated directly, through a Local Advisory Committee that also has a representative on the Preserve Management Board. Yet to be decided is the final designation for the area, but the Crown mineral rights have been withdrawn and the Preserve is virtually considered a fully protected area, contributing to the province's network of protected areas, and it is counted as such in this paper.

Extensive research has been conducted on how to manage the Preserve. One major research project involves using twice-over rotational grazing (Manitoba Habitat Heritage Corporation 2000) to complement fire. Twice-over rotational grazing involves the use of 3 paddocks each being grazed intensively twice a summer, typically for 15 days each between June 1 and July 15 after the 3 leaf stage for grasses, followed by 25-30 days each from July 15 to October 15. This system also requires other pastures of domestic grasses for early and late season use when native prairie cannot be grazed. Research of Dr. Llewelyn L. Manske and his colleagues (Biondini and Manske 1996, Manske 1998) since the late 1980s demonstrated that a twice-over rotational grazing system stimulated growth, especially of grasses, and resulted in cattle growth equivalent to that on other grazing systems. This approach begins to mimic the effect of

bison grazing as they roamed the prairie: intense bursts of grazing with severe effects, followed by long periods of recuperation. That, combined with fire, helped maintain the health and diversity of the prairie.

The grazing project began in 1995 as a joint cooperative effort of the Critical Wildlife Habitat Program, The Stuartburn-Piney Agriculture District, Manitoba Agriculture, and local cattle growers. Research on the biodiversity effects of this grazing regime has been conducted since. The test pasture contained one designated endangered species, the small white lady's-slipper. The principal conclusion was that twice-over rotational grazing favoured small white lady's slipper which increased on grazed plots, likely due to decreased litter and shading. Cattle had good weight gains, comparable to those of cattle on other grazing systems.

Many long-term challenges remain for managing the Preserve, and research is ongoing (Moore and Fortney 1994, Moore 1996). One significant challenge is noxious weed control, particularly leafy spurge and St. Johns Wort. Biological controls have been released and provided limited success. Hand weeding is also of some success, but it is very labour intensive, and requires a major volunteer effort that cannot always be relied upon. Of greatest concern, however, is a proposal to encourage growing St. Johns Wort as a specialty crop for the pharmaceutical and nutritional supplement market.

Preserving Mixed-Grass Prairie: In 1996, work began on a similar effort to inventory and preserve mixed-grass prairie in southwestern Manitoba (Mansell and Moore 1999). Today, about 25% of the mixed-grass prairie remains. Soils there were not as productive for conversion to annual cereal

crops, due to a drier climate and sandy soils. A small Preserve is being established but is not as far advanced as the Manitoba Tall Grass Prairie Preserve. A grazing demonstration project began in 1997, and results are comparable to that in the Manitoba Tall Grass Prairie Preserve. Many other efforts are now under way to preserve mixed-grass prairie. The Nature Conservancy of Canada completed acquisition of lands for the Yellow Quill Mixed-Grass Prairie Project, almost 2100 ha of privately owned and leased Crown land, in October 1999.

Four major threats remain to preserving the mixed-grass prairie. Inappropriate grazing, exotic species invasion, and woody encroachment are reversible and manageable to some extent. Some of these are being studied in Spruce Woods Provincial Park prairie sites (Schykulski and Moore 2000). The greatest threat to mixed-grass prairie communities, however, is largely irreversible. In recent years many landowners have accelerated the breaking of native prairie, particularly to grow irrigated potatoes for newly expanded processing plants.

Use of biological agents for control of leafy spurge has been ongoing in Spruce Woods Provincial Park for at least 15 years, with some success. In the early 1980s, flea beetles were released at one heavily infested site. Within 2-3 years, the spurge infestation was noticeably reduced. After a few years, native prairie species were once again prominent and spurge was just another element of the flora. Over the years, the beetles and other insects have continued to be transplanted and released throughout the park and elsewhere, with varying degrees of success, but spurge infestation is still a major problem. The initial release site has been visited by numerous people and is well

known. In the early 1990s, reports of "bugnappers" from North Dakota abounded in the area, and beetles were reportedly being sold for \$1.00 each in North Dakota. Today, biological control programs and productions of biological agents are much more active in North Dakota.

The effects of woody encroachment are most easily seen in the Spruce Woods Provincial Forest. For many decades, fire has largely been excluded from the portion of the Forest designated as Spruce Woods Provincial

Park. In the portion of the Forest leased to CFB Shilo for military activities, especially tank training, accidental fires have been frequent. The contrast in vegetation is startling. Land cover classification of the Landsat Thematic Mapping imagery (Manitoba Remote Sensing Centre 1994) shows the Shilo area as grassland/rangeland, and most of Spruce Woods Provincial Park as forest (Fig. 2).

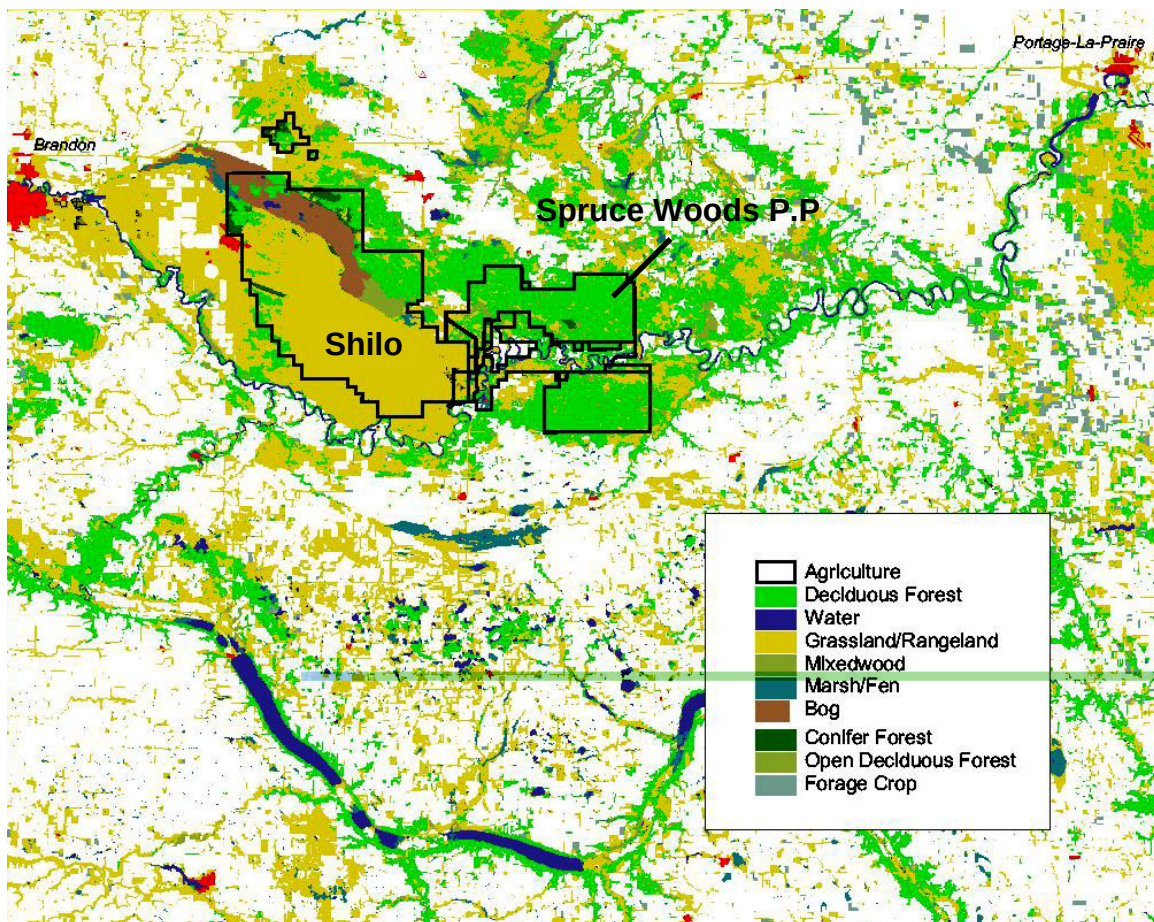


Figure 2. Effect of differing fire and other management regimes on the vegetation of the Spruce Woods Provincial Forest.

Early Naturalists And Conservation Efforts

In the late 1850s, the first major expeditions were mounted to explore and document the natural features and resources of the west including southern Manitoba. Dawson and Hind visited Manitoba in 1857-1858 and Palliser in 1859. The two most significant early naturalists, however, were Ernest Thompson Seton and the Criddle family. Many know about Seton, but the Criddles are less well known.

Ernest Thompson Seton

In 1882, at age 22, Ernest Thompson Seton moved to Carberry. He roamed the surrounding area including parts of what is now Spruce Woods Provincial Park, making notes and sketches in his journals that he later used to write his famous books. In August 1992, Manitoba hosted the 31st Annual Conference of the Federal Provincial

Parks Council and Meeting of Ministers in the centenary of Seton's appointment as Manitoba's first provincial naturalist. At that meeting, an actor recreated a speech that Seton gave on November 15, 1924 to the Canadian Club at the Ottawa Chateau Laurier Hotel (Seton 1924). In the speech, Seton recounted how he became the first provincial naturalist, but, more importantly, he made numerous observations on wildlife and special places that, except for changes in language and style, apply today. An excerpt follows regarding the decimation of wildlife populations. After recounting how he used to see wildlife daily when he first arrived in Manitoba in the 1880s, but had seen no single wild living thing on a 50 mile trip in the fall of 1924, Seton told his audience:

"Why have they all gone? Was it necessary to agriculture to extirpate

all these wonderful beautiful things? Certainly not.

The buffalo? Yes, the buffalo had to go, because he was not compatible with agriculture. But the badger was a harmless thing. The worst I ever heard imputed to a badger was that he dug postholes where they were not wanted. But that happens so rarely, so very, very seldom.

The coyote? Gone, gone, gone! Why? Well, they say he stole sheep. But you can be sure of this: that nine sheep out of ten that are killed are killed by dogs, not by coyotes. Nevertheless, if the coyote killed sheep at all, I bow my head and say: "I am sorry, but he has to go." But what about the prairie chickens? What about wild geese? What about the cranes? What about the swans? What about the ducks? Were they inimical to agriculture? Absolutely not. On the contrary they were helpful.

All over the west, all over Manitoba, I found the same story: gone, gone, gone, gone. And for this simple reason, that we brought in weapons of such destructive force, such virulence that no wildlife had any chance against them. The only reason we did not use poison gas is, we could not get and apply it.

We have desolated our heritage, absolutely devastated these wonderful wilds. We have robbed our children. We have robbed our country. I have no language strong enough to picture this thing as it appears to me, and as I think it will

*appear to you when you are
confronted by cold facts and figures."*

Later in his talk, Seton expanded on the need for sanctuaries, and touched upon the economic value of wildlife and wildlife viewing.

The Criddle Family

Also in 1882, Percy and Alice Criddle and their first four of eight children came to Canada and established their homestead, Aweme, 18 miles southeast of Brandon at the western edge of the sand hills (Scott 1971; England *et al.*, no date; Kusch 1989). In 1906, they built their house, and called it St. Albans. Percy was an English gentleman who had attended university at Heidelberg and brought an extensive knowledge of law, medicine, music and several languages. Alice was one of the first female scholars at Cambridge. Their children were well educated by Alice despite any formal schooling.

Seton visited the Criddles in 1883, and was most impressed with Percy's interest in and knowledge of natural history. Seton told Percy of several learned societies and other naturalists with whom he might correspond, including C. Hart Merriam. For 34 years, Percy carefully recorded his observations of life in the area in daily diaries, corresponded with others, and wrote scientific papers and notes. Three of the children continued their father's careful recording of life, but Norman the eldest son had the most diverse interests. His artistic ability preserved the earliest known record of the Northern Prairie skink in an 1898 watercolour. Entomology became his life's work. He was appointed Entomological Field Officer for Manitoba in 1913, and in 1919 he became Dominion Entomologist for Manitoba. Many type specimens for Canada and North America,

such as dung beetles, come from the Aweme area. Since 1996, entomologists from Brandon University have been conducting entomological studies of Aweme for comparison with the Criddle family records. As a result of the efforts of Percy and three of his children, Norman, Stuart and Maida the youngest daughter, a continuous weather log exists from 1884 to 1960. Today, Aweme and St. Albans are abandoned. Manitoba owns the land, and the Criddles are buried there. Recently, local people have revived efforts to preserve the site and better recognize the contributions of these pioneer naturalists.

Saving the Plains Bison from Extinction

The fate of the Plains Bison can serve as a symbol for current endangered species. By 3000 years ago, the current distribution of parkland and prairie vegetation was roughly present in Manitoba's Prairie Ecozone. Animals, notably bison, had followed the retreat of the glaciers, along with their aboriginal hunters. With exploration and exploitation of the fur trade, intermingling of people resulted in the Métis people. The annual buffalo hunt was the major event of the Métis calendar. As settlement expanded in southern Manitoba, bison populations declined noticeably by the 1860s. In 1883, the Plains Bison was reported extirpated in the prairies. None were seen in an intensive survey between Winnipeg and Fort Edmonton, and the last Manitoba report of free ranging bison was near Souris in the fall of 1883 (Shilliday 1993, 1994).

Manitobans played a role in saving the Plains Bison from extinction in the 1870s (Gorman 1982-1983). Much of the credit for preservation of the Plains Bison has been given to several Americans. Names like Samuel Walking Coyote, Buffalo Jones, Charles Allard, and Michael Pablo are

legendary in the western U. S. Charles Alloway and the Hon. James McKay, Minister for Agriculture, began a captive herd of bison at Deer Lodge in present day Winnipeg with five orphaned bison calves they brought back from hunts in Saskatchewan. With the death of

McKay in 1878, Alloway put up the herd for sale as meat or livestock. Colonel Samuel Lawrence Bedson, warden of Stony Mountain Penitentiary, bought the herd in 1880 and moved it to Stony Mountain north of Winnipeg. In 1888, when he sold his herd, it numbered 110 head. He sold 83 to Buffalo Jones in Kansas and gave 27 to Donald A. Smith (Lord Strathcona), the builder of the CPR, to repay the loan Smith provided to buy the original animals. Buffalo Jones merged the bison he acquired from Bedson with the bison herd he had acquired from Texas, and later sold the resulting herd to Pablo and Allard in Montana. They, too, added some animals, reportedly from Alberta origins. In 1906, the Canadian government purchased the bulk of the Pablo/Allard herd - over 700 animals - to stock ranges at Elk Island, Wainwright and Banff. The portion of Bedson's herd that stayed in Canada with Donald Smith also ended up in Banff, except for five animals. Descendants from these five can still be seen in the City of Winnipeg's Assiniboine Park Zoo (Gorman 1982-1983).

Today, no free ranging herd of Plains Bison exists in Canada. All public herds are fenced and highly managed: fed hay, tested for disease, inoculated, etc. Although the Plains Bison is the symbol of Manitoba, it is not listed as a wildlife species here. Rather, it is considered an agricultural animal, and many ranches raise bison for market and for international trade.

Manitoba's Approach To Endangered Species

Endangered Species Legislation

Manitoba's *Endangered Species Act* was passed March 15, 1990. Initially, designation focussed on mixed-grass prairie birds and other birds known to be declining over the years - Loggerhead Shrike, Burrowing Owl, Ferruginous Hawk, and Baird's Sparrow - and on charismatic plants, notably orchids of the tall-grass prairie - Small White Lady's-slipper, Western Prairie Fringed Orchid, and Great Plains Ladies'-tresses. Recently, however, less showy plants - Western Silvery Aster, Western Spiderwort - and animals such as butterflies have been recognized. Tiger beetles and other non-charismatic "wild life" are under active consideration.

The purposes of the Act are to:

- ensure the protection and enhance the survival of threatened and endangered species in Manitoba;
- enable reintroduction of extirpated species into the province; and
- designate species as threatened, endangered, extirpated or extinct.

This legislation may be applied to any mammal, bird, reptile, amphibian, fish, or plant. The Act is binding on the Crown and on Crown agencies, and it applies to all lands in Manitoba. A species is not protected until such time as it has been declared by regulation under the Act to be threatened, endangered, extirpated or extinct.

Provision is made in the Act for appointment of an Endangered Species Advisory Committee. Among other matters, the role of the committee is to advise the minister in respect to species that are threatened, endangered, extirpated or extinct or whose habitats are endangered, and species that

should be declared threatened, endangered, extirpated or extinct. The Act is administered by Wildlife Branch of Manitoba Conservation.

Once a species has been declared by regulation as threatened, endangered or extirpated, it is unlawful to:

- kill, injure, possess, disturb or interfere with the species;
- destroy, disturb or interfere with its habitat; or
- damage, destroy, obstruct or remove a natural resource on which the

species depends for its life and propagation.

Under the Act, 23 species are currently designated as threatened, endangered or extirpated by Regulation (Table 1). Permits are required in order to conduct studies on designated species according to the Act. The Act also allows for creating regulations to govern other matters, such as preservation and survival of habitat and entry into a designated area that is occupied by a declared species, but no regulations have yet been developed.

Table 1. Species designated under the Manitoba *Endangered Species Act*.

SCIENTIFIC NAME	COMMON NAME
ENDANGERED SPECIES	
Animals	
<i>Ammodramus bairdii</i>	Baird's Sparrow
<i>Athene cunicularia</i>	Burrowing Owl
<i>Charadrius melodus</i>	Piping Plover
<i>Falco peregrinus</i>	Peregrine Falcon
<i>Grus americana</i>	Whooping Crane
<i>Hesperia uncas</i>	Uncas Skipper
<i>Lanius ludovicianus</i>	Loggerhead Shrike
<i>Numenius borealis</i>	Eskimo Curlew
Plants	
<i>Cypripedium candidum</i>	Small White Lady's-Slipper
<i>Platanthera praeclara</i>	Western Prairie Fringed Orchid
<i>Spiranthes magnicamporum</i>	Great Plains Ladies'-Tresses
THREATENED SPECIES	
Animals	
<i>Buteo regalis</i>	Ferruginous Hawk
<i>Hesperia dacotae</i>	Dakota Skipper
Plants	
<i>Aster sericeus</i>	Western Silvery Aster
<i>Tradescantia occidentalis</i>	Western Spiderwort
EXTIRPATED SPECIES	
Animals	

<i>Antilocapra americana</i>	Pronghorn
<i>Cygnus buccinator</i>	Trumpeter Swan
<i>Neominois ridingsii</i>	Riding's Satyr
<i>Numenius americanus</i>	Long-billed Curlew
<i>Ovibos moschatus</i>	Muskox
<i>Tympanuchus cupido</i>	Greater Prairie Chicken
<i>Ursus arctos horribilis</i>	Grizzly Bear
<i>Vulpes velox</i>	Swift Fox

Manitoba Conservation Data Centre

The Manitoba Conservation Data Centre (MBCDC) was established July 4, 1994 through a partnership between the Manitoba Museum of Man and Nature, the Nature Conservancy of Canada (NCC), The Nature Conservancy (United States) and Manitoba Natural Resources (now known as Manitoba Conservation). Manitoba integrated the MBCDC into the Wildlife Branch in 1996 as a major commitment towards maintaining biodiversity.

The MBCDC is part of the Natural Heritage Network, with comparable programs throughout much of the Western Hemisphere. The network functions under the umbrella of the Association for Biodiversity Information (ABI).

The principal role of the MBCDC is to develop and maintain a computerized inventory of Manitoba's biodiversity. A database management system and a geographic information system (GIS) are used to organize the information, following a scientifically and empirically defined methodology and rigorous standards common throughout the network. Biodiversity can be defined at many levels, from molecules to ecosystems. Conservation Data Centres, through ABI and

the Natural Heritage Network, track biodiversity at two intermediate levels: species and ecological communities. These are referred to as **Elements** of biological

diversity. The MBCDC database includes information on these elements and those that are of biological significance such as waterbird colonies, snake or bat hibernacula, etc. It integrates data on species taxonomy, biology, habitat, conservation status, the location of those "elements of biodiversity" that are of concern in the province, as well as the sources of information that document the data. Information is compiled from various sources, such as museums, herbaria, private collections, field inventories, scientific literature, and knowledgeable individuals.

Two of the most useful and better known types of data produced by the MBCDC are the element occurrence data and the conservation status rank. An element occurrence is defined as a specific example of a species or other element of biodiversity at a specific location that represents a habitat capable of sustaining or contributing to the survival of that element. What constitutes an occurrence can vary between species (i.e. breeding ponds where adults, egg masses, and/or larvae have been identified, hibernacula, separate population

of plants, etc.). Some species can have more than one type of occurrence.

The standardized ranking system, used by all data centres and natural heritage programs, has evolved over 25 years as a result of carefully screened suggestions from hundreds of scientists. Species are evaluated and ranked by the MBCDC on the basis of their range-wide (global - G) status, and their province-wide (subnational - S) status according to this system. These ranks are used to determine protection and data collection priorities. They are revised as new information becomes available.

For each level of distribution—global and provincial—species are assigned a numeric rank ranging from 1 (very rare) to 5 (demonstrably secure). This reflects the species' relative endangerment and is based primarily on the number of occurrences of that species globally or within the province. Additional information, such as date of collection, degree of habitat threat, geographic distribution patterns and population size and trends, is considered when assigning a rank. [Appendix 1](#) lists and defines the possible element and conservation status ranks. Global ranks are preceded by a "G" and provincial (or sub-national) ranks are preceded by an "S". For example, the Green Frog (*Rana clamitans*) is ranked G5, S2. That is, globally the species is abundant and secure, while in Manitoba it is rare and may be vulnerable to extirpation. The known numbers of occurrences are not absolute criteria. Rather, they are used to guide decisions.

Methods And Approach

Digital data of known occurrences of all species considered to be "rare", "threatened", or "endangered" in Manitoba in the MBCDC biodiversity database were overlain on a

digital map of the province's current network of protected areas to determine which of the species had occurrences within a protected area. In this study, a "protected" species is defined as occurring within a protected area. These areas may or may not integrate all the ecological factors necessary to sustain each occurrence. Included were all taxa (species, variety or subspecies) (a) listed as **endangered** or **threatened** under Manitoba's *Endangered Species Act*, (b) listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and (c) all others ranked as S1 or S2 by the Manitoba Conservation Data Centre.

Although the focus of this study is the Prairie Ecozone as defined by Smith *et al* (1998), the general analysis included the entire province, and summary data for areas outside the Prairie Ecozone are included in the results. In addition, the area of the Ecozone was modified in two ways for detailed analysis of the level of protection. First, the Ecozone was expanded to the east to include Manitoba's Tall-Grass Prairie Natural Region, Manitoba Tall Grass Prairie Preserve and adjacent areas (Fig. 3). Second, three other sites having some protected areas (Asessippi and Birds Hill provincial parks and Narcisse Wildlife Management Area) straddle Ecozone boundaries. Data on rare, threatened, or endangered species found within the entire protected area of each site were included as within the Ecozone for the results reported below.

Finally, for the purposes of this study, the 2170 ha Manitoba Tall Grass Prairie Preserve is considered protected in its entirety. The Preserve consists of the 329 ha Stuartburn Wildlife Management Area, which is protected under the *Wildlife Act*, and additional private lands that do not yet

have an official legal designation to protect them formally. Since all of the other lands making up the Preserve are owned by Conservation agencies which prohibit

commercial logging on it, and since the Crown mineral rights have been formally withdrawn, we judge this to be sufficient to count the Preserve as protected.

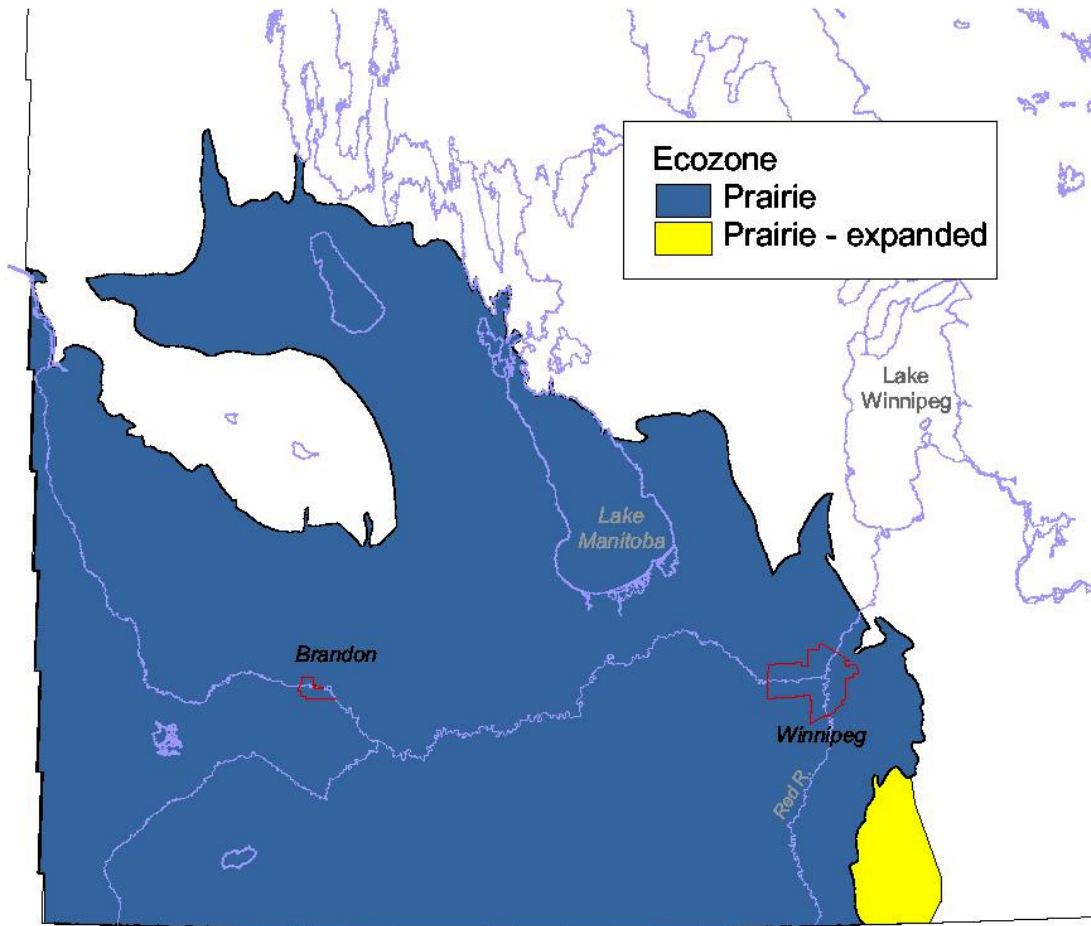


Figure 3. Prairie Ecozone and expanded area including the tall-grass prairie region.

RESULTS

A total of 379 different species are recognized as being rare, threatened, or endangered in Manitoba ([Appendix 2](#)). Of these, 44 are animals (butterflies, gastropods, amphibians, reptiles, birds, and mammals), and 335 are vascular plants. Of the 379 rare, threatened, or endangered plants and animals in Manitoba, 227 have at least one known

occurrence entered in the MBCDC Biodiversity Conservation Database, yielding a total of 2176 occurrences in the province. The Prairie Ecozone (expanded) contains 79% (1720) of these occurrences. The Boreal Plain Ecozone contains 8% (175), the Boreal Shield Ecozone 11% (242), the Hudson Plain Ecozone 1.4% (31), the Taiga Shield Ecozone, 0.2% (5), and the Southern Arctic Ecozone 0.1% (3) (Fig. 4).

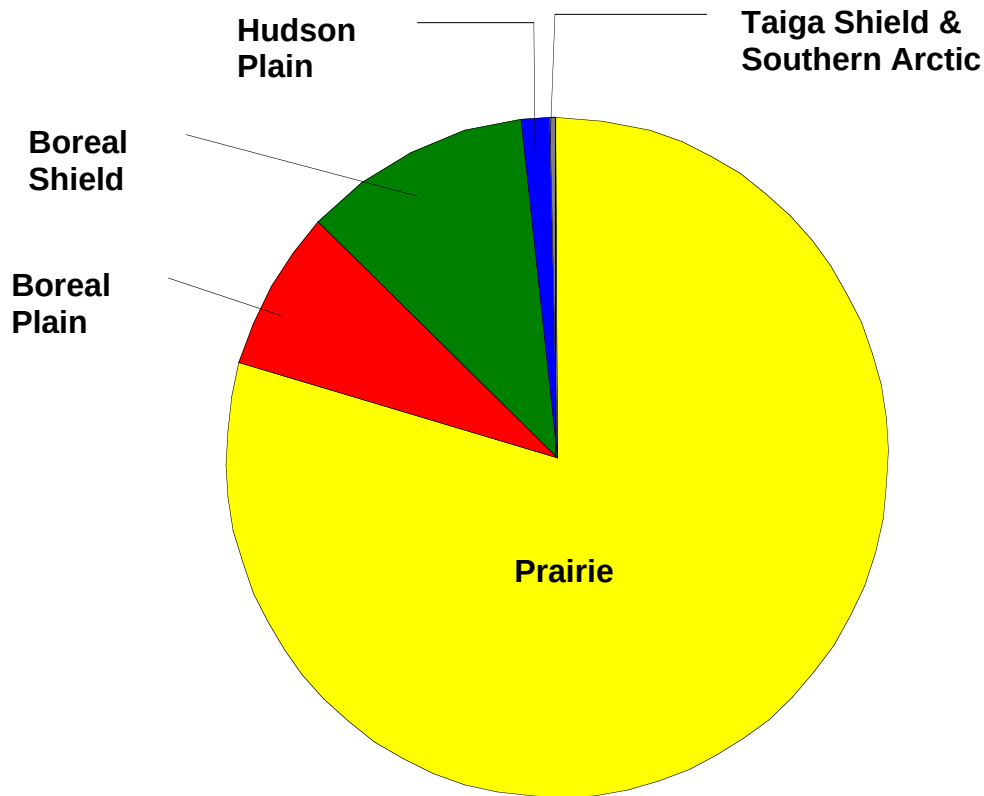


Figure 4. Distribution of the known rare, threatened, or endangered species occurrences in the ecozones of Manitoba.

Counting the Stuartburn WMA and the rest of the Manitoba Tall Grass Prairie Preserve separately, there are 79 protected areas in Manitoba (Fig. 5).

They cover about 5.4 million ha, or about 8.3% of the province. Some areas have dual designation, but for the purposes of this paper they are recorded by the principal legislation used to designate them and are only counted once. They consist of:

- 2 national parks protected under the *National Parks Act*,
- 16 ecological reserves protected under the *Ecological Reserves Act*,
- all or parts of 35 wildlife management areas protected under the *Wildlife Act*, (including Stuartburn WMA which forms part of the Manitoba Tall Grass Prairie Preserve),
- all or parts of 17 provincial parks protected under the *Provincial Parks Act*,
- all or parts of 7 park reserves protected under the *Provincial Parks Act*,
- part of 1 provincial forest protected under the *Forest Act*, and
- the Manitoba Tall Grass Prairie Preserve.

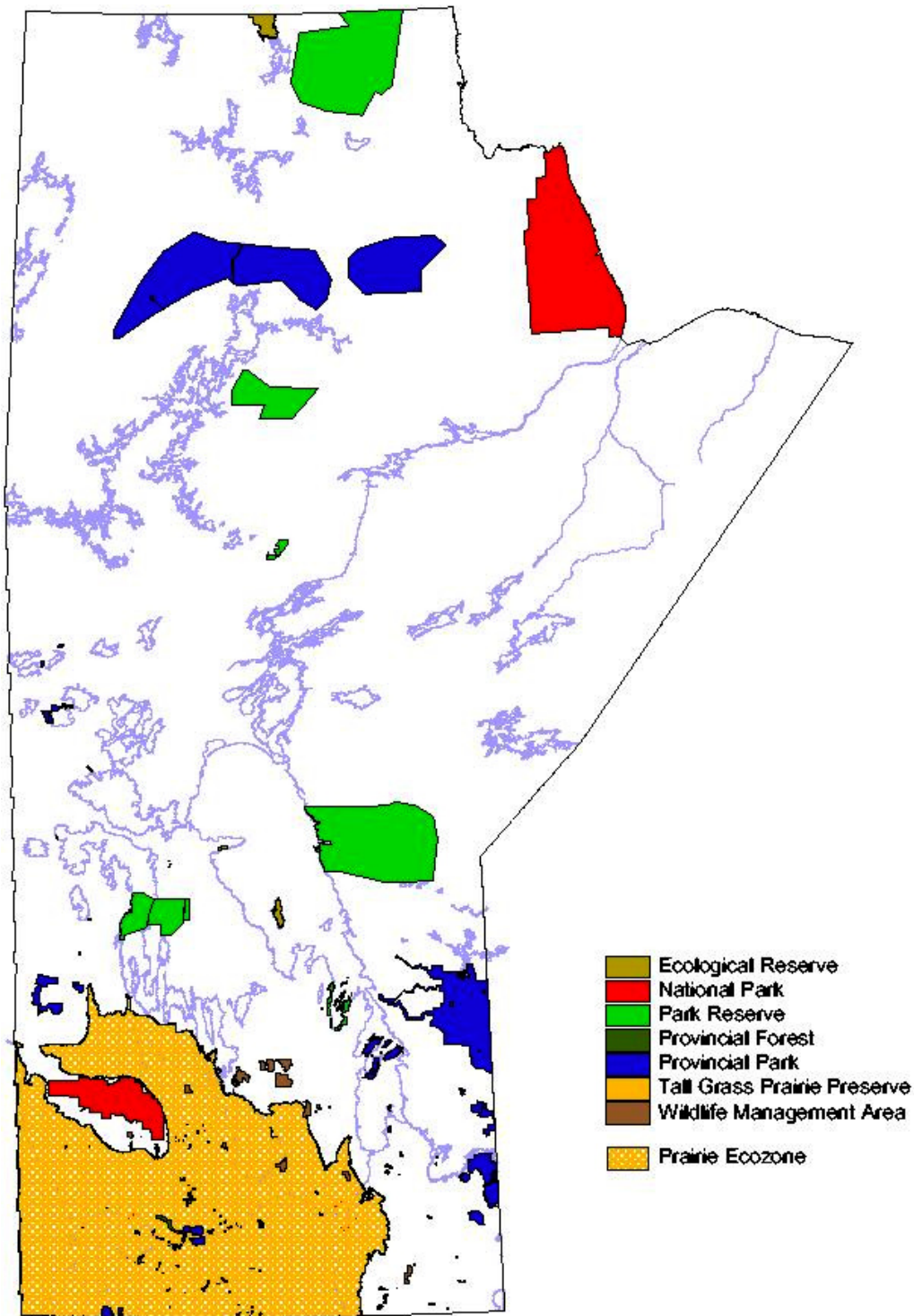


Figure 5. Protected Areas in Manitoba.

The Prairie Ecozone covers about 7 million hectares in southern Manitoba, or about 10.5% of the province (Smith *et*

al 1998). Including the Manitoba Tall Grass Prairie Preserve, there are 31 protected areas within the Prairie Ecozone (Table 2; Fig. 6).

Table 2. List of protected areas in Manitoba's Prairie Ecozone.

NAME	CATEGORY	AREA (ha)
Douglas Marsh	Provincial Forest	8400
Asessippi Provincial Park	Provincial Park	325
Beaudry Provincial Park	Provincial Park	474
Birds Hill Provincial Park	Provincial Park	2060
Spruce Woods Provincial Park	Provincial Park	21095
Turtle Mountain Provincial Park	Provincial Park	12050
Manitoba Tall Grass Prairie Preserve**	Tall-Grass Prairie Preserve	2170
Alonsa WMA	Wildlife Management Area	3626
Assiniboine Corridor WMA	Wildlife Management Area	3275
Brandon Hills WMA	Wildlife Management Area	722
C. Stuart Stevenson WMA	Wildlife Management Area	128
Cayer WMA	Wildlife Management Area	712
Deerwood WMA	Wildlife Management Area	262
Grants Lake WMA	Wildlife Management Area	395
Holmfield WMA	Wildlife Management Area	64
Lake Francis WMA	Wildlife Management Area	6782
Langruth WMA	Wildlife Management Area	1813
Little Saskatchewan WMA	Wildlife Management Area	323
Marshy Point WMA	Wildlife Management Area	975
Narcisse WMA	Wildlife Management Area	8000
Oak Hammock Marsh WMA	Wildlife Management Area	3581
Parkland WMA	Wildlife Management Area	194
Pembina Valley WMA	Wildlife Management Area	3187
Portage Sandhills WMA	Wildlife Management Area	1601
Rat River WMA	Wildlife Management Area	1054
Riverside WMA	Wildlife Management Area	96
Souris River Bend WMA	Wildlife Management Area	2196
Spruce Woods WMA	Wildlife Management Area	291
Stuartburn WMA**	Wildlife Management Area	329
Tiger Hills WMA	Wildlife Management Area	530
Whitemud Watershed WMA	Wildlife Management Area	5042
TOTAL:		91423**

** Manitoba Tall Grass Prairie Preserve Includes Stuartburn WMA

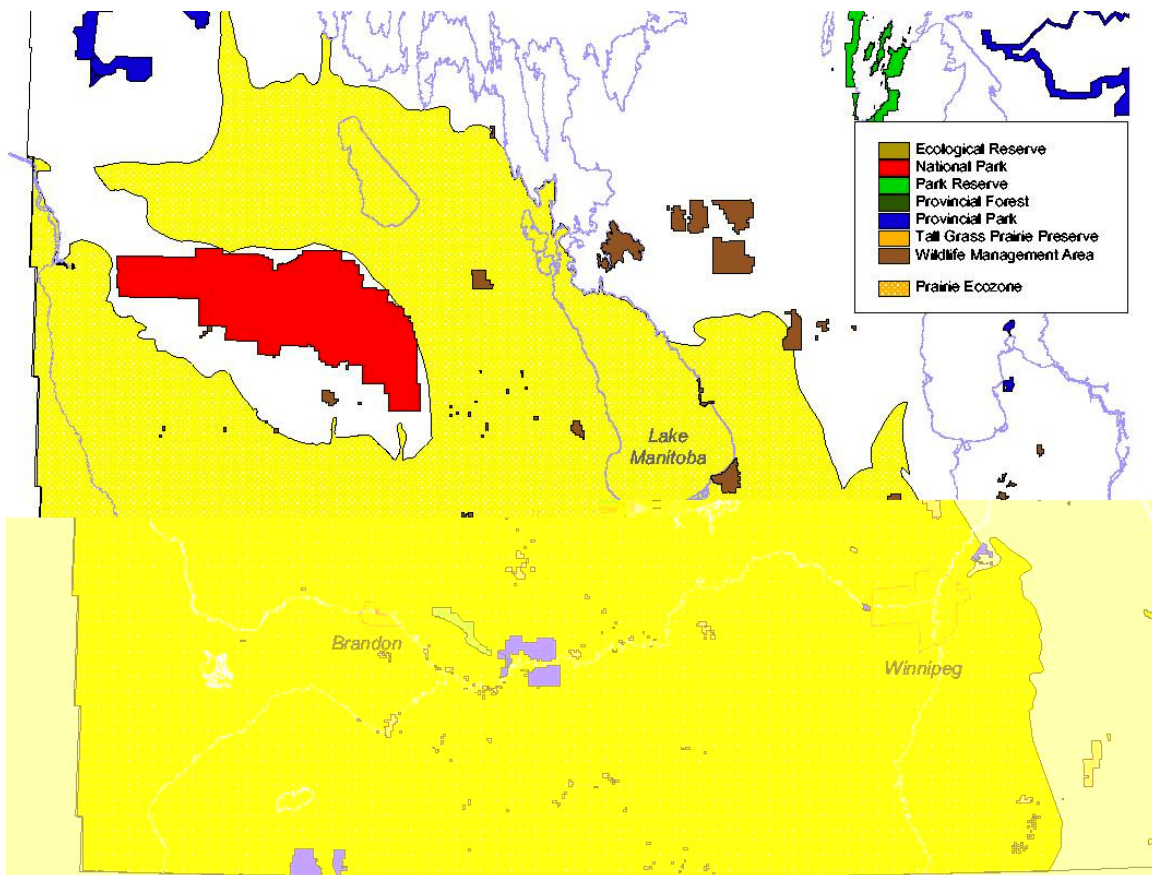


Figure 6. Location of protected areas in Manitoba's Prairie Ecozone.

Together, they cover almost 91,500 hectares or about 1.3 % of the Ecozone. They consist of all or parts of:

- 24 wildlife management areas totalling 45,178 ha or 49.4% of the area protected in the Ecozone,
- 5 provincial parks totalling 36,004 ha or 39.4% of the area protected in the Ecozone,
- 1 provincial forest totalling 8400 ha or 9.2% of the area protected in the Ecozone,
- the Manitoba Tall Grass Prairie Preserve (excluding the area of Stuartburn WMA) totalling 1841 ha or 2.0% of the area considered protected in the Ecozone.

All of these protected areas within the Prairie Ecozone contain 83 known occurrences of Manitoba's rare, threatened, or endangered species listed in Appendix 2. This represents only 4.8% of all the known occurrences of rare, threatened, or endangered species for the entire Ecozone. They consist of 28 different species; 4 animals, and 24 plants (Table 3). In contrast, elsewhere in Manitoba outside the Prairie Ecozone, 68 known occurrences of rare, threatened, or endangered species are found within protected areas, yet they represent 14.9 % of all occurrences in those ecozones.

Table 3. Known Rare, Threatened, or Endangered Species Found Within Protected Areas in the Prairie Ecozone*.

SCIENTIFIC NAME	COMMON NAME	GRANK	SRANK	MB ESA	COSEWIC
Animals:					
<i>Charadrius melodus</i>	Piping Plover	G3	S2B,SZN	END	END
<i>Eumeces septentrionalis</i>	Northern Prairie Skink	G5	S2		
<i>Hesperia dacotae</i>	Dakota Skipper	G2G3	S2S3	THR	
<i>Oarisma powesheik</i>	Powesheik Skipper	G2	S2		
Plants:					
<i>Andropogon hallii</i>	Sand Bluestem	G4	S1		
<i>Aristida longiseta</i>	Red Three-awn	G5?Q	S1		
<i>Asclepias verticillata</i>	Whorled Milkweed	G5	S2		
<i>Aster sericeus</i>	Western Silvery Aster	G5	S2	THR	THR
<i>Bouteloua curtipendula</i>	Side-oats Grama	G5	S2		
<i>Carex tetanica</i>	Rigid Sedge	G4G5	S2		
<i>Cycloloma atriplicifolium</i>	Winged Pigseed	G5	S2		
<i>Cypripedium candidum</i>	Small White Lady's-slipper	G4	S1	END	END
<i>Dalea villosa</i> var <i>villosa</i>	Silky Prairie-clover	G5T?	S2		THR
<i>Krigia biflora</i>	Cynthia	G5	S2		
<i>Mimulus glabratus</i>	Smooth Monkeyflower	G5	S1		
<i>Oenothera perennis</i>	Sundrops	G5	S1S2		
<i>Orobanche ludoviciana</i>	Louisiana broom-rape	G5	S2		
<i>Platanthera praeclara</i>	Western Prairie Fringed Orchid	G2	S1	END	END
<i>Polanisia dodecandra</i> ssp <i>dodecandra</i>	Clammyweed	G5T?	S1		
<i>Polanisia dodecandra</i> ssp <i>trachysperma</i>	Clammyweed	G5T?	S1		
<i>Polygala verticillata</i>	Whorled Milkwort	G5	S2		
<i>Polygala verticillata</i> var <i>isocycla</i>	Whorled Milkwort	G5T?	S2		
<i>Ranunculus cymbalaria</i> var <i>saximontanus</i>	Seaside Crowfoot	G5T5	S1S2		
<i>Solidago riddellii</i>	Riddell's Goldenrod	G5	S2		
<i>Spiranthes magnicamporum</i>	Great Plains Ladies'-tresses	G4	S1?	END	
<i>Sporobolus asper</i>	Tall Dropseed	G5	S1		
<i>Steironema quadriflorum</i>	Whorled Loosestrife	G5?	S2		
<i>Stipa richardsonii</i>	Richardson Needle Grass	G5	S1		
<i>Townsendia exscapa</i>	Silky Townsend-daisy	G5	S2		
<i>Veronicastrum virginicum</i>	Culver's-root	G4	S1		

*GRANK - Global Rank; SRANK- Provincial Rank (See Appendix 1 for definitions of GRANK AND SRANK); MBESA - Manitoba *Endangered Species Act*; COSEWIC - Committee On the Status of Wildlife in Canada; END - Endangered; THR – Threatened

All protected occurrences of rare, threatened, or endangered species in the Prairie Ecozone are found within 13 protected areas (Table 4) that cover a total of 63,597 hectares. The Manitoba Tall Grass Prairie Preserve protects the greatest number of known occurrences of rare, threatened, or endangered species. The 51 known occurrences

there consist of 12 different species. Spruce Woods Provincial Park is second, protecting 10 occurrences of 7 species. Oak Hammock Marsh WMA protects 6 occurrences and 6 species, while Narcisse WMA protects 4 occurrences of 2 rare, threatened, or endangered species. The other 9 protected areas contain either 1 or 2 occurrences.

Table 4. Protected Areas in the Prairie Ecozone Containing Occurrences of Known Rare, Threatened, or Endangered Species.

NAME	No. of KNOWN OCCURRENCES	No. of SPECIES
Assiniboine Corridor WMA	1	1
Beaudry Provincial Park	1	1
Birds Hill Provincial Park	2	1
Brandon Hills WMA	1	1
Douglas Marsh	2	2
Grants Lake WMA	1	1
Lake Francis WMA	1	1
Narcisse WMA	4	2
Oak Hammock Marsh WMA	6	6
Portage Sandhills WMA	2	2
Spruce Woods Prov. Park	10	7
Manitoba Tall Grass Prairie Preserve	51	12
Whitemud Watershed WMA	1	1

The remaining 1637 known occurrences of rare, threatened, or endangered species in the Prairie Ecozone are either found on private land or on unprotected Crown land. About 69% (n= 1186) of the known occurrences of rare, threatened, or endangered species in the Prairie Ecozone are found in the southwest corner of the province, in an area bordered by Provincial Trunk Highway (P.T.H.) #1 on the north and by P.T.H. #10 on the east (Fig. 7).

Although 56 rare, threatened, or endangered species occur in this area of

Manitoba, it only contains two small parcels of protected land (Riverside WMA, 82 ha; Upper Assiniboine WMA - Runnymede Unit, 63 h). Neither of these protected areas is known to contain rare, threatened, or endangered species. Almost all of the occurrences are found within the areas classified as grassland/rangeland from Manitoba Remote Sensing Centre (1994) Landsat Thematic Mapper imagery (Fig. 8-9). The grassland/rangeland category is defined by mixed native and/or tame prairie grasses and herbs. It may also include scattered stands of willow (*Salix* L.), choke cherry (*Prunus virginiana*), pin cherry

(*Prunus pensylvanica*) and saskatoon (*Amelanchier alnifolia*). Many of these areas are used for cutting of hay and grazing. Both upland and lowland meadows fall into

this class. There is normally less than 10% shrub or tree cover (Manitoba Remote Sensing Centre 1994).

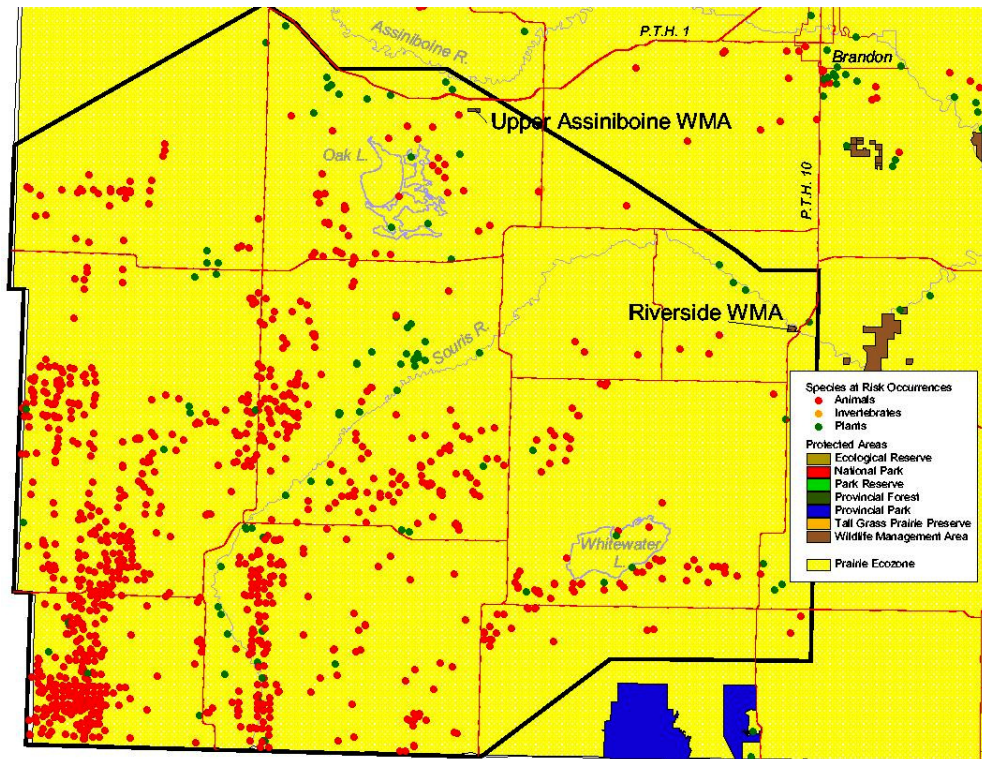


Figure 7. Concentration of known rare, threatened, or endangered species occurrences in the Prairie Ecozone.

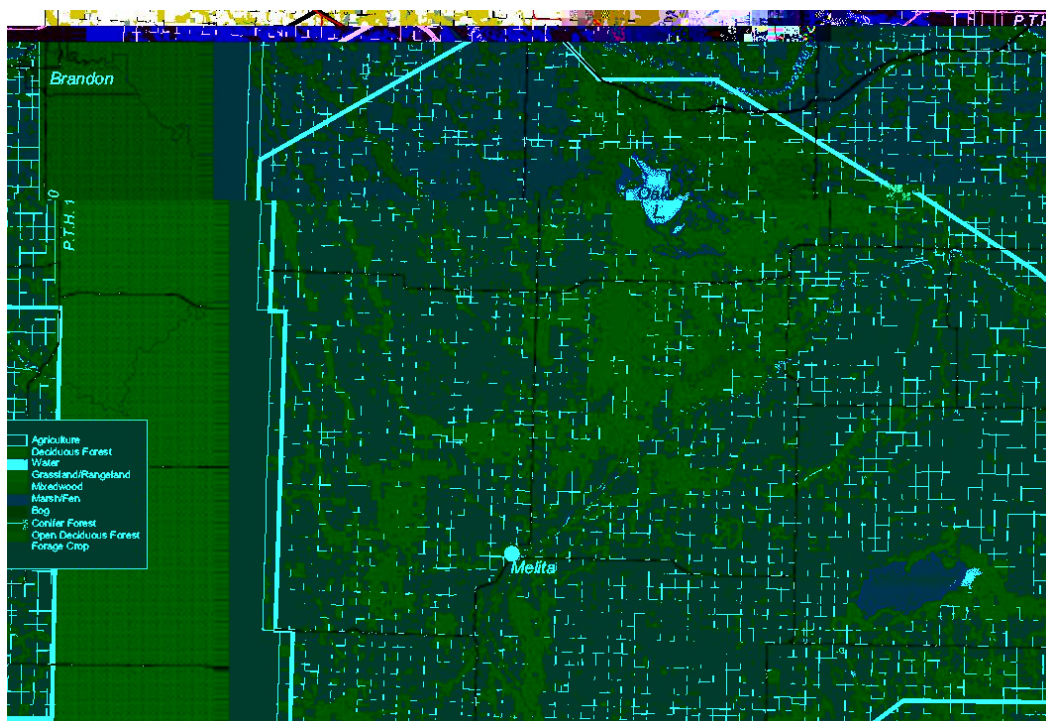


Figure 8. Land use / land cover as classified from Landsat imagery.

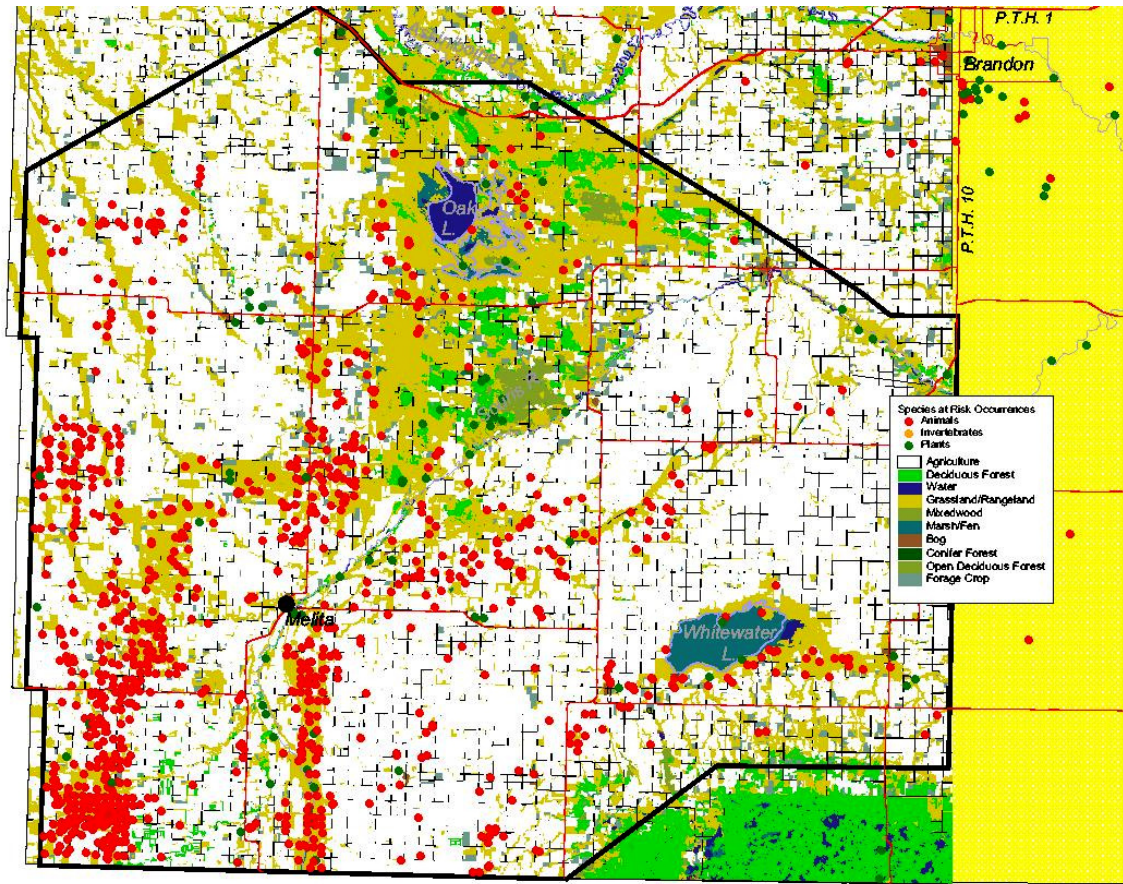


Figure 9. Rare, threatened, or endangered species distribution with respect to land use/land cover.

Status of the Species Listed Under the Manitoba *Endangered Species Act*

Of the 15 species listed under Manitoba's *Endangered Species Act*, 11 make up a total of 1294 known occurrences throughout the province (Table 5). Ninety eight percent of these

occurrences (1269) are within the Prairie Ecozone, and 83% are in the southwest (Fig. 10). Only 6 of the listed species have a total of 30 occurrences within a protected area. For these six species, 14% to 32% of their total number of known occurrences are within protected areas (Table 5).

Table 5. Extent of Protection throughout Manitoba for Known Occurrences of Species Designated under Manitoba's *Endangered Species Act*.

SCIENTIFIC NAME	COMMON NAME	ELEMENT OCCURRENCES		
		TOTAL	Extent of Protection	
			Number	%
Animals:				
<i>Ammodramus bairdii</i>	Baird's Sparrow	266	0	0.0
<i>Athene cunicularia</i>	Burrowing Owl	347	0	0.0
<i>Buteo regalis</i>	Ferruginous Hawk	178	0	0.0
<i>Charadrius melodus</i>	Piping Plover	29	4	13.8
<i>Lanius ludovicianus</i>	Loggerhead Shrike	372	0	0.0
<i>Hesperia dacotae</i>	Dakota Skipper	13	3	23.1
Plants:				
<i>Aster sericeus</i>	Western Silvery Aster	21	5	23.8
<i>Cypripedium candidum</i>	Small White Lady's-slipper	19	6	31.6
<i>Platanthera praeclara</i>	Western Prairie Fringed Orchid	30	8	26.7
<i>Spiranthes magnicamporum</i>	Great Plains Ladies'-tresses	15	4	26.7
<i>Tradescantia occidentalis</i>	Western Spiderwort	4	0	0.0

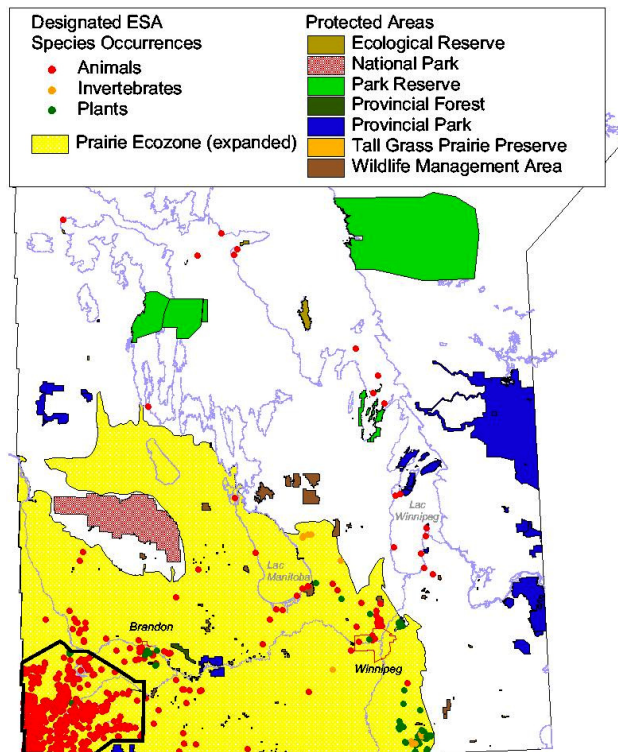


Figure 10. Distribution of known occurrences of rare, threatened, or endangered species in Manitoba.

DISCUSSION

The 7 million ha Prairie Ecozone is the most inhabited and the most impacted area of Manitoba (Manitoba Environment 1997). On satellite imagery, the Prairie Ecozone can be seen as a fragmented landscape dominated by agriculture, with scattered patches of natural habitat. Agricultural land accounts for about 53% of the total area of the Ecozone (Smith *et al* 1998). It is not surprising to find the majority of the rare, threatened, or endangered species in this area. Loss of habitat is one of the greatest threats to these species, together with the invasion of alien species that thrive in human-impacted environments and transform native habitats. Yet, the amount of protection in the Prairie Ecozone is very low, with only 1.3% of the total area protected by designated lands, and only 4.8% of the rare, threatened, or endangered species occurrences falling within those protected lands. Moreover, much of the land protection work started only in the last decade, well after most Crown land had already been turned over to private ownership. Today, only about 440,000 ha, or 6.2%, of the Ecozone is Crown land. Of this, about 21% has been protected.

Due to the complex nature of land ownership in the area, reaching agreement to protect additional areas is difficult. To date, much of the easy work has been done. Existing blocks of Crown land have, by and large, been reviewed and, wherever possible, portions have been protected.

Crown Land

Discussions are under way with the petroleum sector to examine ways of expanding protected Wildlife Management Areas into the "oil patch", and devising petroleum exploration and development

methods to conserve significant habitats, especially where there are known occurrences of rare, threatened, or endangered species. As a result of these discussions, it is anticipated that part of one partially protected WMA will become formally protected this spring, and petroleum exploration activities in the rest of the WMA will be limited. Other partially protected WMAs similarly are being evaluated. Protection of part of the new WMA expected this spring would add one more protected occurrence of rare, threatened, or endangered species in the Prairie Ecozone.

Discussions are also ongoing for protecting additional parts of the lease area of the Spruce Woods Provincial Forest not actively used for military purposes but acting as a buffer to military activity. Germany has terminated its contract to use Shilo for training German troops and withdrew in December 2000. The future of this area is now up for more intensive review, once Canada's decision on the future of the Base is announced.

Community Pastures make up the last remaining category of relatively large blocks of provincially-owned Crown lands that have yet to be evaluated for their contribution to protected areas and conservation efforts. Although provincially owned lands, Community Pastures are under Federal (PFRA) administration. Discussions have just begun on reviewing these Pastures with staff of the Manitoba Agriculture and Food and PFRA. Since most such lands are committed for grazing, data from the twice-over rotational grazing (Manitoba Habitat Heritage Corporation 2000) trials from the Manitoba Tall Grass Preserve and mixed grass prairie sites in southwestern Manitoba will be used to help with evaluations. Wildlife Branch staff also have carried out

inventories of several Pastures to assist PFRA in developing pasture management plans (Kowalchuk *et al.* 2000), and others are in preparation.

Lands Owned by Conservation Agencies or Under Conservation Agreements

Compilation and digitization of the conservation lands acquired by such entities as the Nature Conservancy of Canada, Manitoba Habitat Heritage Corporation, Ducks Unlimited (Canada) and the Manitoba Wildlife Federation's Wildlife Habitat Foundation Inc. is now under way. One of the issues associated with these lands relates to the fact that, while the agency may own the land, others often own the mineral rights. In some cases, the rights are still owned by the Crown, but in other cases they are privately held. Determining which is which is time consuming and difficult, but it is slowly being tackled. Further, where the Crown owns the mineral rights, it is necessary to gain agreement of the Mines and Petroleum Branches to concur that these should be withdrawn. An ongoing formal consultation process involving all parties with mineral interests including industry is now in place. Participants systematically review and assess mineral potential in candidate protected areas.

The contribution that privately owned lands can make to conserving and protecting habitat of rare, threatened and endangered species also needs to be taken into account. For example, at least one Conservation

Agreement is known to have been established to protect the habitat of a species and designated under Manitoba's *Endangered Species Act* (Manitoba Habitat Heritage Corporation, personal communication).

Future Protected Areas

The following is one model that could be used to establish new protected areas in the Prairie Ecozone. In 1998, a landowner approached Parks and Natural Areas Branch with an offer to partly sell and partly donate his land in the Pembina River valley to establish a park. Today, negotiations have been concluded. The Nature Conservancy of Canada raised funds to acquire the land (known as Martens property) and transfer of the title from NCC to Manitoba is in process. Manitoba's newest provincial park is expected to be formally designated this spring. This 450 ha area is in a key location that can be used to leverage a larger protected area (Fig. 11). Adjacent and southeast of this property sits a newly protected unit of Pembina Valley Wildlife Management Area. Immediately northwest, a Camp owns the land, and to the northwest of the Camp lies another protected unit of the WMA. If a Conservation Agreement can be obtained with the support of the owners of the Camp, it may be possible to protect a 3-4 km stretch of the Pembina Valley. The Pembina Valley and Hills are known to be floristically distinctive (Marshall 1989).

In a more proactive manner, areas containing good quality occurrences of rare, threatened and endangered species could be targeted for protection and a similar scenario

involving several conservation initiatives could be put forward to develop new protected areas.

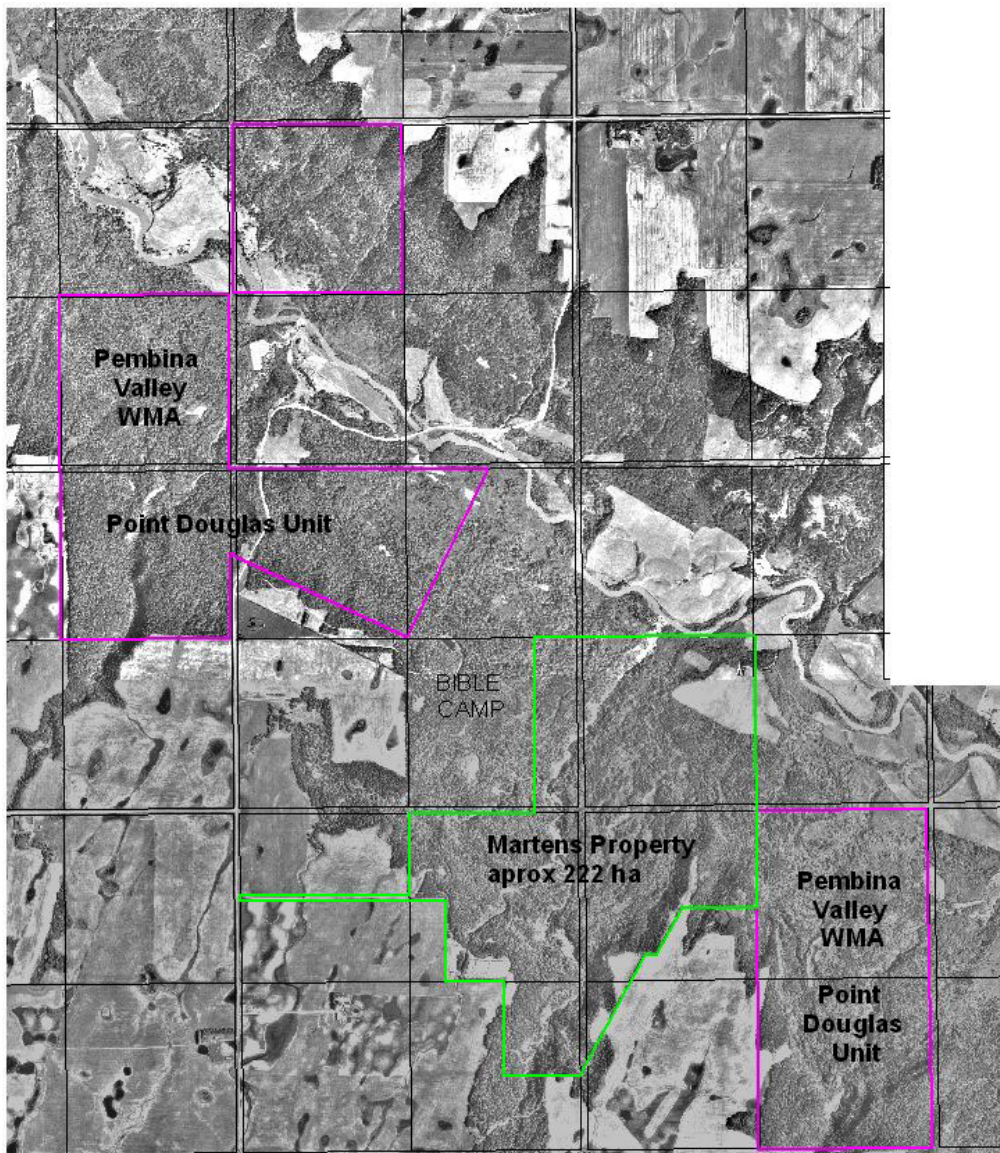


Figure 11. Creation of Protected Areas in the Pembina Valley.

SUMMARY AND CONCLUSIONS

The current network of protected areas captures only a small number of occurrences of rare, threatened, or endangered species in the province. This is especially true in the Prairie Ecozone which is the most populated and settled. It reflects the fact that protected areas in the Prairie Ecozone were developed opportunistically and primarily from designated lands that were set aside for purposes other than protecting rare, threatened, or endangered species habitats. Areas targeted to protect endangered ecosystems such as the Manitoba Tall Grass Prairie Preserve better capture rare, threatened, or endangered species which often occur in these ecosystem.

It is only recently that the Conservation Data Centre's database of species of special concern was developed to a functional size. It has shown to be an essential tool for conservation planning and has pointed to gaps in protected areas. Future conservation efforts in the Prairie Ecozone should focus in the grassland area of southwestern Manitoba where the greatest number of unprotected known occurrences of rare, threatened, or endangered species is found.

Fewer options for creating new protected areas exist in the Prairie Ecozone than in the more northerly areas due to the limited amount of Crown land available and the multiple interests on private land. However, there are remnants of near natural areas that contain good quality habitats for rare, threatened, or endangered species. Manitoba's Protected Areas Strategy is focusing on identifying these remnants and exploring opportunities to establish core protected areas, corridors, and buffers, in conjunction with a variety of partners to enlarge the network of protected areas in the Prairie Ecozone.

It is imperative that protected areas planning incorporates our best knowledge of rare, threatened and endangered species occurrences so as to capture the most significant habitats. Species inventories must continue in order to ensure the most complete and accurate coverage of Manitoba's biodiversity before habitats disappear. Known occurrences of rare, threatened, or endangered species must also be re-visited in order to ensure that we meet our protection objectives and that the information from which they are derived is up-to-date.

ACKNOWLEDGEMENTS

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In Parks and Natural Areas Branch, special thanks are due to Bill Watkins for the exchange of views and ideas on biological and ecological matters, and for pioneering and sharing with us his approach to enduring features analysis.

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We thank them all for sharing their data, providing input, and for reviewing and commenting on parts of this paper. Any errors and omissions, however, are ours.

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Appendix 1: List and Definition of the Possible Element and Conservation Status Ranks.

Rank	Definition
1	Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.
2	Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.
3	Uncommon throughout its range or in the province (21 to 100 occurrences).
4	Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).
5	Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially irradicable under present conditions.
U	Possibly in peril, but status uncertain; more information needed.
H	Historically known; may be rediscovered.
X	Believed to be extinct; historical records only, continue search.

Other Heritage Codes

Code	Definition
G#G# S#S#	Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

Subrank

Code	Definition
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species, e.g. G4T3.

Qualifiers

Code	Definition
A	Accidental in the province; including species (usually birds or butterflies) recorded very infrequently, hundreds or thousands of kilometers outside their usual range.
B	Breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperiled) in the province, non-breeding occurrences are not ranked in the province.
E	An exotic established in the province; may be native in nearby regions.
HYB	Element represents a hybrid of species.
N	Non-breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperiled) in the province, non-breeding occurrences are not ranked in the province.
P	Indicates the element may potentially occur in the province.
Q	Taxonomic questions or problems involved, more information needed; appended to the global rank.
R	Reported in the province, but lacking documentation which would provide a basis for either accepting or rejecting the report.
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.
Z	Ranking not applicable.
#	A modifier to SX or SH; the species has been reintroduced but the population is not yet established.
?	Inexact or uncertain; for numeric ranks, denotes inexactness.

Appendix 2. Rare, threatened, or endangered species in Manitoba. These include species listed as Threatened or Endangered under the Manitoba *Endangered Species Act* or by Committee On the Status of Endangered Wildlife In Canada, as well as those ranked as S1 or S2 by the Manitoba Conservation Data Centre.

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
Animals:					
<i>Aechmophorus clarkii</i>	Clark's Grebe	G5	S2B,SZN		
<i>Ammodramus bairdii</i>	Baird's Sparrow	G4	S2S3B,SZN	ENDANGERED	NOT AT RISK
<i>Anthus spragueii</i>	Sprague's Pipit	G4	S2S3B,SZN		THREATENED
<i>Athene cunicularia</i>	Burrowing Owl	G4	S1B,SZN	ENDANGERED	ENDANGERED
<i>Balaena mysticetus</i>	Bowhead Whale	G4	S1		
<i>Buteo regalis</i>	Ferruginous Hawk	G4	S2B,SZN	THREATENED	SPECIAL CONCERN
<i>Butorides virescens</i>	Green Heron	G5	S1S2B,SZN		
<i>Casmerodius albus</i>	Great Egret	G5	S2B,SZN		
<i>Charadrius melodus</i>	Piping Plover	G3	S2B,SZN	ENDANGERED	ENDANGERED
<i>Chen rossii</i>	Ross' Goose	G4	S2B,SZN		
<i>Coregonus zenithicus</i>	Shortjaw Cisco	G2	S3		THREATENED
<i>Delphinapterus leucas</i>	White Whale Or Beluga	G4	S2		
<i>Esox masquinongy</i>	Muskellunge	G5	S1		
<i>Eumeces septentrionalis</i>	Northern Prairie Skink	G5	S2		
<i>Falco peregrinus anatum</i>	Peregrine Falcon	G4	S1B,SZN	ENDANGERED	THREATENED
<i>Felis concolor</i>	Cougar	G5	S2		
<i>Fundulus diaphanus</i>	Banded Killifish	G5	S1		
<i>Gasterosteus aculeatus</i>	Threespine Stickleback	G5	S1		
<i>Grus americana</i>	Whooping Crane	G1	SXB,SZN	ENDANGERED	ENDANGERED
<i>Heterodon nasicus</i>	Western Hognose Snake	G5	S2		
<i>Ichthyomyzon fossor</i>	Northern Brook Lamprey	G4	S2		SPECIAL CONCERN
<i>Lanius ludovicianus</i>	Loggerhead Shrike - east pop'n - west pop'n	G5	S2S3B,SZN S2S3B,SZN	ENDANGERED ENDANGERED	ENDANGERED THREATENED
<i>Larus minutus</i>	Little Gull	G5	S1B,SZN		
<i>Lepomis gibbosus</i>	Pumpkinseed	G5	S1		
<i>Lepomis macrochirus</i>	Bluegill	G5	S1		
<i>Myotis lucifugus</i>	Little Brown Myotis	G5	S2N,S5B		
<i>Napaeozapus insignis</i>	Woodland Jumping Mouse	G5	S2		
<i>Nocomis biguttatus</i>	Hornyhead Chub	G5	S2		NOT AT RISK
<i>Notropis rubellus</i>	Rosyface Shiner	G5	S2		NOT AT RISK
<i>Numenius borealis</i>	Eskimo Curlew	G1	SAN	ENDANGERED	ENDANGERED
<i>Rana clamitans</i>	Green Frog	G5	S2		
<i>Rangifer tarandus caribou</i>	Caribou	G5T4	S4		THREATENED
<i>Rhodostethia rosea</i>	Ross' Gull	G3G4	S1B,SAN		SPECIAL CONCERN
<i>Birgella subglobosus</i>	Global Silt Snail	G3G4	S1		
<i>Cicindela fulgida westbournei</i>	Tiger Beetle	G5T4	S1		
<i>Euchloe olympia</i>	Olympia Marble	G4G5	S1		
<i>Euphydryas phaeton</i>	Baltimore Butterfly	G4	S1		
<i>Fossaria techella</i>	Snail	GUQ	S1		
<i>Hesperia dacotae</i>	Dakota Skipper	G2G3	S2S3	THREATENED	
<i>Hesperia nevada</i>	Nevada Skipper	G5	S1		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Hesperia ottoe</i>	Ottoe Skipper	G3G4	S1?		
<i>Hesperia uncas</i>	Uncas Skipper	G5	S1S2	ENDANGERED	
<i>Oarisma powesheik</i>	Powesheik Skipper	G2	S2		
<i>Pholisora catullus</i>	Common Sooty Wing	G5	S1?		
Plants:					
<i>Adlumia fungosa</i>	Climbing Fumitory	G4	S1		
<i>Adoxa moschatellina</i>	Moschatel	G5	S1?		
<i>Agalinis paupercula</i> var <i>borealis</i>	Small Flowerd Gerardia	G5T?	S1S2		
<i>Agrimonia gryposepala</i>	Common Agrimony	G5	S1S2		
<i>Agropyron psammophilum</i>		G3	S1		
<i>Agropyron violaceum</i>	Purplish Wheat Grass	G?	S2		
<i>Alisma gramineum</i>	Narrow-Leaved Water-Plantain	G5	S1		
<i>Allium tricoccum</i>	Wild Leek	G5	S1		
<i>Alopecurus alpinus</i>	Alpine Foxtail	G5	S2		
<i>Amorpha fruticosa</i>	False Indigo	G5	S1S2		
<i>Andropogon hallii</i>	Sand Bluestem	G4	S1		
<i>Antennaria plantaginifolia</i>	Plantain-Leaved Everlasting	G5	S2?		
<i>Arabis alpina</i>	Alpine Rock-Grass	G5	S1S2		
<i>Arabis lyrata</i>	Lyre-Leaved Rock Cress	G5	S2?		
<i>Aralia racemosa</i>	Spikenard	G4G5	S2		
<i>Arenaria humifusa</i>	Sandwort	G4	S2?		
<i>Arenaria macrophylla</i>	Large-Leaved Sandwort	G4	S1S2		
<i>Arenaria peploides</i>	Seabeach Sandwort	G5	S2		
<i>Arenaria rubella</i>	Sandwort	G5	S2		
<i>Arethusa bulbosa</i>	Swamp Pink; Dragon's Mouth	G4	S2		
<i>Arisaema triphyllum</i>	Jack-In-The-Pulpit	G5	S2		
<i>Aristida longiseta</i>	Red Three-Awn	G5?Q	S1		
<i>Aristida purpurea</i>	Red Three-Awn	G5	S1		
<i>Armeria maritima</i>	Thrift	G5	S1		
<i>Arnica cordifolia</i>	Heart-Leaf Arnica	G5	S1		
<i>Arnica fulgens</i>	Shining Arnica	G5	S2?		
<i>Artemisia cana</i>	Silver Sagebrush, Hoary Sagebrush	G5	S2		
<i>Artemisia tilesii</i>	Herriot's Sage	G5	S2		
<i>Asclepias lanuginosa</i>	Hairy Milkweed	G4?	S1		
<i>Asclepias verticillata</i>	Whorled Milkweed	G5	S2		
<i>Aster macrophyllus</i>	White Wood Aster	G5	S1		
<i>Aster modestus</i>	Large Northern Aster	G5	S2		
<i>Aster sericeus</i>	Western Silvery Aster	G5	S2	THREATENED	THREATENED
<i>Astragalus aboriginum</i>	Indian Milkvetch	G5	S1?		
<i>Astragalus bodinii</i>	Milkvetch	G4	S1		
<i>Astragalus gilviflorus</i>	Cushion Milkvetch	G5	S1		
<i>Astragalus lotiflorus</i>	Low Milkvetch	G5	S1		
<i>Astragalus neglectus</i>	Milkvetch	G4	S1		
<i>Atriplex argentea</i>	Saltbrush, Silvery Atriplex	G5	S2		
<i>Atriplex glabriuscula</i>	Orach	G4	S2		
<i>Bartsia alpina</i>	Velvet Bells, Alpine Bartsia	G5	S2		
<i>Bidens amplissima</i>	Beggar-Ticks	G3	S1		
<i>Botrychium matricariifolium</i>	Daisy-Leaf Moonwort	G5	S1		
<i>Botrychium minganense</i>	Mingan Moonwort	G4	S1S2		
<i>Botrychium pallidum</i>	Pale Moonwort	G2G3	S1		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Bouteloua curtipendula</i>	Side-Oats Grama	G5	S2		
<i>Brasenia schreberi</i>	Water-Shield, Purple Wen-Dock	G5	S2		
<i>Braya humilis</i>	Low Braya	G5	S2		
<i>Buchloe dactyloides</i>	Buffalo Grass	G4G5	S1		SPECIAL CONCERN
<i>Calamagrostis deschampsoides</i>	Reed Grass	G4	S2		
<i>Calamagrostis lapponica</i>	Reed Grass	G5	S2?		
<i>Calamagrostis purpurascens</i>	Purple Reed Grass	G5?	S2		
<i>Callitriche heterophylla</i>	Larger Water-Starwort	G5	S2		
<i>Calopogon pulchellus</i>	Swamp-Pink	G5	S2		
<i>Campanula uniflora</i>	Alpine Bluebell	G4	S1		
<i>Cardamine bulbosa</i>	Spring Cress	G5	S1		
<i>Carex adelostoma</i>	A Sedge	G4	S1		
<i>Carex arcta</i>	Narrow Sedge	G5	S1		
<i>Carex arctata</i>	Black Sedge	G5?	S1		
<i>Carex athrostachya</i>	Long-Bracted Sedge	G5	S1		
<i>Carex atrofusca</i>	Dark-Brown Sedge	G5	S1		
<i>Carex bicolor</i>	Two-Coloured Sedge	G5	S2		
<i>Carex blanda</i>	Pleasing Sedge	G5?	S1		
<i>Carex conoidea</i>	Field Sedge	G5	S1		
<i>Carex cristatella</i>	Crested Sedge	G5	S2		
<i>Carex cryptolepis</i>	A Sedge	G4	S1		
<i>Carex cumulata</i>	Clustered Sedge	G4?	S1		
<i>Carex emoryi</i>	Emory's Sedge	G5	S2?		
<i>Carex garberi</i>	Elk Sedge	G4	S1?		
<i>Carex glareosa</i>	Weak-Clustered Sedge	G4G5	S1		
<i>Carex gravida</i>	Heavy Sedge	G5	S1		
<i>Carex heleonastes</i>	Hudson Bay Sedge	G4	S2		
<i>Carex hookeriana</i>	Hooker's Sedge	G4?	S1		
<i>Carex loliacea</i>	Rye-Grass Sedge	G5	S2		
<i>Carex mackenziei</i>	Mackenzie Sedge	G4?	S2		
<i>Carex maritima</i>	Seaside Sedge	G4G5	S2		
<i>Carex merritt-fernaldii</i>	A Sedge	G5	S1		
<i>Carex michauxiana</i>	Long-Fruited Sedge	G5	S2		
<i>Carex microglochin</i>	False Uncina Sedge	G5?	S2		
<i>Carex oligosperma</i> var <i>churchilliana</i>	Few-Fruited Sedge	G4T?	S1?		
<i>Carex paleacea</i>	Chaffy Sedge	G5	S1		
<i>Carex projecta</i>	Necklace Sedge	G5	S2?		
<i>Carex rufina</i>	Reddish Sedge	G3	S1		
<i>Carex rupestris</i>	Rock Sedge	G5	S2		
<i>Carex salina</i> var <i>kattegatensis</i>	Salt Sedge	G4	S1?		
<i>Carex sterilis</i>	A Sedge	G4	S2		
<i>Carex stricta</i>	Tussock Sedge	G5	S1		
<i>Carex subspathacea</i>	Hoppner's Sedge	G4	S2		
<i>Carex supina</i>	Weak Sedge	G5	S2?		
<i>Carex tetanica</i>	Rigid Sedge	G4G5	S2		
<i>Carex tribuloides</i>	Prickly Sedge	G5	S2?		
<i>Carex williamsii</i>	William's Sedge	G4	S2		
<i>Castilleja pallida</i> ssp <i>septentrionalis</i>	Labrador Indian Paintbrush	G5	S1?		
<i>Caulophyllum thalictroides</i>	Papoose-Root	G4G5	S2		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Celtis occidentalis</i>	Hackberry, Nettle-Tree	G5	S1		
<i>Cerastium alpinum</i>	Alpine Chickweed	G5?	S2		
<i>Cerastium arcticum</i>	Arctic Chickweed	G5	S2		
<i>Ceratophyllum echinatum</i>	Hornwort	G4?	S1		
<i>Chenopodium subglabrum</i>	Smooth Goosefoot	G3G4	S1		SPECIAL CONCERN
<i>Circaea quadrisulcata</i> var <i>canadensis</i>	Large Enchanter's-Nightshade	G5T5	S2		
<i>Cirsium discolor</i>	Field Thistle	G5	S1		
<i>Cirsium undulatum</i>	Pasture Thistle	G5	S1?		
<i>Cladium mariscoides</i>	Twig Rush	G5	S2		
<i>Clematis ligusticifolia</i>	Western Virgin's-Bower	G5	S1		
<i>Clematis virginiana</i>	Virgin's-Bower	G5	S2		
<i>Collinsia parviflora</i>	Blue-Eyed Mary	G5	S1		
<i>Conopholis americana</i>	Cancer-Root	G5	S1		
<i>Convolvulus spithameus</i>	Low Bindweed	G4G5	S1?		
<i>Coreopsis tinctoria</i>	Common Tickseed	G5	S1		
<i>Corispermum nitidum</i>	Bugseed	G5	S2		
<i>Crepis elegans</i>	Youngia	G5	S1S2		
<i>Cryptotaenia canadensis</i>	Honewort	G5	S2?		
<i>Cuscuta cephalanthi</i>	Dodder	G5	S1		
<i>Cuscuta pentagona</i>	Dodder	G5	S1?		
<i>Cycloloma atriplicifolium</i>	Winged Pigseed	G5	S2		
<i>Cyperus aristatus</i>	Awned Cyperus	G5	S2		
<i>Cyperus erythrorhizos</i>	Red-Root Flatsedge	G5	S1		
<i>Cyperus houghtonii</i>	Houghton's Umbrella-Sedge	G4?	S2		
<i>Cyperus schweinitzii</i>	Schweinitz's Flatsedge	G5	S2		
<i>Cyperus strigosus</i>	Straw-Colored Flatsedge	G5	S2		
<i>Cypripedium arietinum</i>	Ram's Head Lady's-Slipper	G3	S2?		
<i>Cypripedium candidum</i>	Small White Lady's-Slipper	G4	S1	ENDANGERED	ENDANGERED
<i>Dalea villosa</i>	Silky Prairie-Clover	G5	S2		
<i>Danthonia intermedia</i>	Timber Oat Grass	G5	S2?		
<i>Delphinium virescens</i>	Larkspur	G5T5	S1		
<i>Deschampsia atropurpurea</i>	Mountain Hairgrass	G5	S1		
<i>Descurainia sophioides</i>	Northern Flixweed	G5	S2		
<i>Diapensia lapponica</i>	Northern Diapensia	G5	S2		
<i>Dicentra cucullaria</i>	Dutchman's-Breeches	G5	S1		
<i>Draba aurea</i>	Golden Whitlow-Grass	G5	S1?		
<i>Draba incana</i>	Whitlow-Grass	G5	S2?		
<i>Draba lactea</i>	Milky Whitlow-Grass	G4	S2?		
<i>Draba nivalis</i>	Yellow Arctic Whitlow-Grass	G5	S1		
<i>Drosera linearis</i>	Slender-Leaved Sundew	G4	S2		
<i>Dulichium arundinaceum</i>	Three-Way Sedge	G5	S2		
<i>Elatine triandra</i> var <i>americana</i>	Mud-Purslane	G4	S1		
<i>Eleocharis engelmannii</i>	Engelmann's Spike-Rush	G4?	S1		
<i>Eleocharis halophila</i>	Spike-Rush	G4	S1		
<i>Eleocharis obtusa</i>	Blunt Spike-Rush	G5	S1		
<i>Elodea nuttallii</i>	Waterweed	G5	S1		
<i>Elymus diversiglumis</i>	Various-Glumed Wild Rye	G3?Q	S2?		
<i>Elymus hystrix</i>	Bottle-Brush Grass	G5	S2		
<i>Elymus mollis</i>	Sea Lyme-Grass	G5	S2?		
<i>Epilobium paniculatum</i>	Annual Willowherb	G5	S1S2		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Erigeron caespitosus</i>	Tufted Fleabane	G5	S2		
<i>Erigeron uniflorus</i> var <i>unalaschkensis</i>	Purple Fleabane	G4	S1		
<i>Eriocaulon septangulare</i>	White-Buttons	G5	S1		
<i>Eriophorum callitrix</i>	Beautiful Cotton-Grass	G5	S2		
<i>Eriophorum scheuchzeri</i>	One-Spike Cotton-Grass	G5	S2?		
<i>Escobaria vivipara</i>	Pincushion Cactus	G5	S2		
<i>Euphorbia geyeri</i>	Prostrate Spurge	G5	S1		
<i>Euphrasia vinacea</i>	Eyebright	G?Q	S1		
<i>Eurotia lanata</i>	Winterfat	G5	S2		
<i>Eutrema edwardsii</i>	No Common Name	G4	S1		
<i>Festuca obtusa</i>	Nodding Fescue	G5	S1		
<i>Festuca richardsonii</i>		G5T4	S1		
<i>Franseria acanthicarpa</i>	Sandbur	G5	S2		
<i>Galium aparine</i>	Cleavers, Goosegrass	G5	S2		
<i>Gentiana puberulenta</i>	Downy Gentian	G4G5	S2		
<i>Gerardia aspera</i>	Rough Purple Agalinis	G5	S1S2		
<i>Glyceria canadensis</i>	Rattlesnake Grass	G5	S1		
<i>Glyceria pulchella</i>	Graceful Manna Grass	G5	S2		
<i>Goodyera tessellata</i>	Tesselated Rattlesnake Plantain	G5	S2		
<i>Gymnocarpium robertianum</i>	Limestone Oak Fern	G5	S1		
<i>Hackelia floribunda</i>	Large Flowered Stickseed	G5?	S2		
<i>Hedeoma hispida</i>	Mock Pennyroyal	G5	S1		
<i>Helianthus nuttallii</i> ssp <i>rydbergii</i>	Tuberous-Rooted Sunflower	G5T5	S2		
<i>Heliotropium curassavicum</i>	Seaside Heliotrope	G5	S2		
<i>Hepatica americana</i>	Liverleaf	G5	S1		
<i>Heteranthera dubia</i>	Water Star-Grass	G5	S2		
<i>Hieracium canadense</i>	Canada Hawkweed	G5	S2?		
<i>Hierochloe alpina</i>	Holy Grass	G5	S2		
<i>Hierochloe pauciflora</i>	Arctic Holy Grass	G4G5	S2		
<i>Hutchinsia procumbens</i>	Prostrate Hutchinsia	G5	S1		
<i>Impatiens noli-tangere</i>	Western Jewelweed	G?	S2		
<i>Juncus canadensis</i>	Canada Rush	G5	S1?		
<i>Juncus interior</i>	Inland Rush	G4G5	S1		
<i>Juncus stygius</i>	Moor Rush	G5	S1?		
<i>Kalmia microphylla</i>	Bog-Laurel	G5	S2?		
<i>Kobresia bellardii</i>	Bellard's Kobresia	G5	S1		
<i>Kobresia simpliciuscula</i>	Simple Bog-Sedge	G5	S1		
<i>Koenigia islandica</i>	'No Common Name'	G4	S1		
<i>Krigia biflora</i>	Cynthia	G5	S2		
<i>Lactuca floridana</i>	Woodland Lettuce	G5	S1		
<i>Lactuca ludoviciana</i>	Western Lettuce	G4G5	S2?		
<i>Lechea intermedia</i>	Pinweed	G5	S1		
<i>Lemna turionifera</i>	Duckweed	G5	S1		
<i>Lesquerella arctica</i>	Northern Bladderpod	G4	S2		
<i>Linum lewisii</i> var <i>lepagei</i>	Lewis Wild Flax	G4G5T2	S1		
<i>Listera auriculata</i>	Auricled Twayblade	G3	S1		
<i>Listera borealis</i>	Northern Twayblade	G4	S2		
<i>Lobelia dortmanna</i>	Water Lobelia	G4	S2		
<i>Lomatium orientale</i>	White-Flowered Parsley	G5	S1		
<i>Luzula alpinopilosa</i>	Wood-Rush	G5	S2?		
<i>Luzula groenlandica</i>	Greenland Wood-Rush	G4	S1		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Luzula spicata</i>	Spiked Wood-Rush	G5	S1		
<i>Lychnis apetala</i>	Nodding Cockle	G4	S2		
<i>Lychnis furcata</i>	Mountain Cockle	G5	S2		
<i>Lycopodium clavatum</i> var <i>clavatum</i>	Running-Pine	G5T?	S2		
<i>Lycopodium inundatum</i>	Bog Club-Moss	G5	S1		
<i>Lycopodium lucidulum</i>	Shining Club-Moss	G5	S1		
<i>Lycopodium sitchense</i>	Ground-Fir	G5	S1		
<i>Lycopodium tristachyum</i>	Ground-Cedar	G5	S2		
<i>Lygodesmia rostrata</i>	Annual Skeletonweed	G5?	S1S2		
<i>Maianthemum racemosum</i>	False Spikenard	G5	S2?		
<i>Malaxis brachypoda</i>	White Adder's-Mouth	G4Q	S2?		
<i>Malaxis paludosa</i>	Bog Adder's-Mouth	G4	S1		
<i>Malaxis unifolia</i>	Green Adder's-Mouth	G5	S2?		
<i>Mentzelia decapetala</i>	Gumbo-Lily	G5	S1		
<i>Mertensia lanceolata</i>	Tall Lungwort	G5	S2		
<i>Mertensia maritima</i>	Gray Oysterleaf, Seaside Lungwort	G5	S2		
<i>Microseris cuspidata</i>	Prairie False Dandelion	G5	S1		
<i>Milium effusum</i>	Millet Grass	G5	S2		
<i>Mimulus glabratus</i>	Smooth Monkeyflower	G5	S1		
<i>Monotropa hypopithys</i>	Pinesap	G5	S1		
<i>Montia fontana</i>	Water-Blinks	G5	S1		
<i>Muhlenbergia andina</i>	Foxtail Muhly	G4	S1		
<i>Musineon divaricatum</i>	Leafy Musineon	G5	S2		
<i>Myosurus minimus</i>	Least Mousetail	G5	S1		
<i>Myriophyllum alterniflorum</i>	Water-Milfoil	G5	S2?		
<i>Myriophyllum farwellii</i>	Farwell's Water-Milfoil	G5	S1		
<i>Nymphaea odorata</i>	Fragrant Water-Lily	G5	S2		
<i>Nymphaea tetragona</i>	Small Water-Lily	G5	S2		
<i>Oenothera cespitosa</i>	Tufted Evening-Primrose	G5	S1		
<i>Oenothera perennis</i>	Sundrops	G5	S1S2		
<i>Ophioglossum pusillum</i>	Northern Adder's-Tongue	G5	S1		
<i>Orobanche ludoviciana</i>	Louisiana Broom-Rape	G5	S2		
<i>Oryzopsis canadensis</i>	Canadian Rice-Grass	G5	S1		
<i>Oryzopsis hymenoides</i>	Indian Rice Grass	G5	S2		
<i>Oryzopsis micrantha</i>	Little-Seed Rice Grass	G5	S2		
<i>Osmorhiza claytonii</i>	Wooly Or Hairy Sweet Cicely	G5	S2		
<i>Osmorhiza depauperata</i>	Blunt-Fruited Sweet Cicely	G5	S2?		
<i>Ostrya virginiana</i>	Hop-Hornbeam	G5	S2		
<i>Oxytropis arctica</i>	Arctic Locoweed	G4	S1		
<i>Oxytropis campestris</i> var <i>johannensis</i>	Late Yellow Locoweed	G5T4	S1?		
<i>Oxytropis sericea</i>	Early Yellow Locoweed	G5	S1		
<i>Panicum linearifolium</i>	White-Haired Panic-Grass	G5	S2		
<i>Panicum perlongum</i>	Long-Stalked Panic Grass	G?	S2?		
<i>Panicum wilcoxianum</i>	Sand Millet	G5	S2		
<i>Parnassia parviflora</i>	Small Grass-Of-Parnassus	G4	S1		
<i>Pedicularis flammea</i>	Flame-Coloured Lousewort	G3G5	S2		
<i>Pedicularis parviflora</i>	Purple Lousewort	G4	S2		
<i>Pellaea glabella</i>	Purple Cliff-Brake	G5	S2		
<i>Penstemon nitidus</i>	Smooth Blue Beard-Tongue	G5	S2		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Penstemon procerus</i>	Slender Beard-Tongue	G5	S1S2		
<i>Penthorum sedoides</i>	Ditch-Stonecrop	G5	S1S2		
<i>Phyllodoce caerulea</i>	Purple Mountain-Heather	G5	S2		
<i>Pinus strobus</i>	Eastern White Pine	G5	S2		
<i>Plagiobothrys scouleri</i>	Scouler's Allocarya	G5	S1		
<i>Plantago elongata</i>	Linear-Leaved Plantain	G4	S2		
<i>Plantago maritima</i>	Seaside Plantain	G5	S2		
<i>Platanthera hookeri</i>	Hooker's Orchis	G5	S2		
<i>Platanthera lacera</i>	Fringed Orchid	G5	S2		
<i>Platanthera praeclara</i>	Western Prairie Fringed Orchid	G2	S1	ENDANGERED	ENDANGERED
<i>Platanthera psycodes</i>	Small Purple-Fringed Orchid	G5	S1		
<i>Poa arctica</i>	Arctic Blue Grass	G5	S2?		
<i>Poa cusickii</i>	Mutton-Grass	G5	S2		
<i>Poa fendleriana</i>	Mutton Grass	G5	S2		
<i>Poa tolmatchewii</i>	Blue-Grass	G5	S1?		
<i>Pogonia ophioglossoides</i>	Rose Pogonia	G5	S1		
<i>Polanisia dodecandra</i>	Clammyweed	G5	S1		
<i>Polygala verticillata</i>	Whorled Milkwort	G5	S2		
<i>Populus grandidentata</i>	Large-Toothed Aspen	G5	S1S2		
<i>Potamogeton amplifolius</i>	Large-Leaved Pondweed	G5	S2?		
<i>Potamogeton illinoensis</i>	Illinois Pondweed	G5	S2		
<i>Potamogeton pusillus</i> var <i>tenuissimus</i>	Small Pondweed	G5T5	S2		
<i>Potamogeton robbinsii</i>	Robbin's Pondweed	G5	S2		
<i>Potamogeton spirillus</i>	Fennel-Leaved Pondweed	G5	S2		
<i>Potentilla egedii</i>	Cinquefoil	G5	S2		
<i>Potentilla gracilis</i> var <i>flabelliformis</i>	Graceful Cinquefoil	G5?	S1		
<i>Potentilla hookeriana</i>	Snow Cinquefoil	G4	S1		
<i>Potentilla nivea</i>	Snow Cinquefoil	G5	S1		
<i>Potentilla plattensis</i>	Low Cinquefoil	G4	S2		
<i>Potentilla pulchella</i>	Pretty Cinquefoil	G4G5	S2		
<i>Puccinellia lucida</i>	Salt-Meadow Grass	G4?	S2		
<i>Pyrola rotundifolia</i>	Round-Leaved Pyrola	G5	S2		
<i>Ranunculus cymbalaria</i> var <i>saximontanus</i>	Seaside Crowfoot	G5T5	S1S2		
<i>Ranunculus fascicularis</i>	Early Buttercup	G5	S1		
<i>Ranunculus hispidus</i>	Hispid Buttercup	G5	S2		
<i>Ranunculus hyperboreus</i>	Boreal Buttercup	G5	S1		
<i>Ranunculus pallasii</i>	Pallas Buttercup	G5	S2		
<i>Ranunculus pedatifidus</i>	Northern Buttercup	G5	S2		
<i>Ranunculus septentrionalis</i>	Swamp Buttercup	G5T5	S2		
<i>Ranunculus trichophyllus</i> var <i>eradicatus</i>	White Water Crowfoot	G5T?	S2		
<i>Rhododendron lapponicum</i>	Lapland Rose-Bay	G5	S2		
<i>Rhynchospora capillacea</i>	Horned Beakrush	G5	S2		
<i>Rumex arcticus</i>	Arctic Sorrel	G5	S1		
<i>Sagina caespitosa</i>	Tufted Pearlwort	G5	S2		
<i>Sagittaria rigida</i>	Sessile-Fruited Arrowhead	G5	S2		
<i>Salicornia borealis</i>	Arctic Glasswort	G1	S1		
<i>Salix alaxensis</i>	Alaska Willow	G5	S2		
<i>Salix fuscescens</i>	A Willow	G5	S1S2		

SCIENTIFIC NAME	COMMON NAME	GRANK ¹	SRANK ²	MB_ESA ³	COSEWIC ⁴
<i>Salix herbacea</i>	Dwarf Willow	G5	S1S2		
<i>Sanguinaria canadensis</i>	Blood-Root	G5	S2		
<i>Saxifraga aizoides</i>	Yellow Mountain Saxifrage	G5	S2		
<i>Saxifraga caespitosa</i>	Tufted Saxifrage	G5	S1		
<i>Saxifraga cernua</i>	Nodding Saxifrage	G4	S1S2		
<i>Saxifraga cespitosa</i> ssp <i>exaratooides</i>	Tufted Saxifrage	G5T3?	S1		
<i>Saxifraga hirculus</i>	Yellow Marsh Saxifrage	G5	S2		
<i>Saxifraga oppositifolia</i>	Purple Mountain Saxifrage	G4G5	S1S2		
<i>Saxifraga pensylvanica</i>	Swamp Saxifrage	G5	S1		
<i>Saxifraga rivularis</i>	Alpine Brook Saxifrage	G5?	S1		
<i>Schedonnardus paniculatus</i>	Tumble-Grass	G5	S2		
<i>Scirpus heterochaetus</i>	Slender Bulrush	G5	S1		
<i>Scirpus nevadensis</i>	Nevada Bulrush	G4	S1		
<i>Scirpus rufus</i>	Red Bulrush	G5	S2		
<i>Scirpus torreyi</i>	Torrey's Bulrush	G5?	S1?		
<i>Scutellaria parvula</i> var <i>leonardii</i>	Skullcap	G4T4	S1		
<i>Selaginella selaginoides</i>	Northern Spike-Moss	G5	S2		
<i>Sisyrinchium mucronatum</i>	Michaux's Blue-Eyed Grass	G5	S1?		
<i>Solidago juncea</i>	Sharp-Toothed Goldenrod	G5	S2?		
<i>Solidago riddellii</i>	Riddell's Goldenrod	G5	S2		
<i>Spiranthes magnicamporum</i>	Great Plains Ladies'-Tresses	G4	S1?	ENDANGERED	
<i>Sporobolus asper</i>	Tall Dropseed	G5	S1		
<i>Steironema quadriflorum</i>	Whorled Loosestrife	G5?	S2		
<i>Stipa richardsonii</i>	Richardson Needle Grass	G5	S1		
<i>Subularia aquatica</i>	Water Awl-Wort	G5	S2?		
<i>Thalictrum revolutum</i>	Waxleaf Meadow-Rue	G5	S1		
<i>Thelypteris phegopteris</i>	Northern Beech Fern	G5	S2		
<i>Thermopsis rhombifolia</i>	Golden Bean	G5	S2		
<i>Torreyochloa pallida</i>	Pale Manna Grass	G5?	S2		
<i>Townsendia exscapa</i>	Silky Townsend-Daisy	G5	S2		
<i>Tradescantia occidentalis</i>	Western Spiderwort	G5	S1	THREATENED	THREATENED
<i>Uvularia sessilifolia</i>	Small Bellwort	G5	S2		
<i>Vaccinium caespitosum</i>	Dwarf Bilberry	G5	S2		
<i>Verbena urticifolia</i>	White Vervain	G5	S1		
<i>Vernonia fasciculata</i>	Western Ironweed	G5	S1?		
<i>Veronicastrum virginicum</i>	Culver's-Root	G4	S1		
<i>Viola novae-angliae</i>	New England Blue Violet	G4Q	S1		
<i>Viola selkirkii</i>	Long-Spurred Violet	G5?	S2		
<i>Wolffia columbiana</i>	Water-Meal	G5	S1		
<i>Woodsia alpina</i>	Northern Woodsia	G4	S1		
<i>Woodsia glabella</i>	Smooth Woodsia	G5	S2		
<i>Woodsia oregana</i>	Blunt-Lobed Or Large Woodsia	G5	S1		
<i>Zostera marina</i>	Eelgrass	G5	S2		

- Note:
1. Global rank. Refer to Appendix 1 for definitions.
 2. Provincial rank. Refer to Appendix 1 for definitions.
 3. Manitoba *Endangered Species Act*.
 4. Committee On the Status of Endangered Wildlife In Canada

BIOTECHNOLOGY AND PRAIRIE CONSERVATION

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Abstract: Biotechnology is a hot issue for which there are strong views and assertions, but insufficient impact studies. It is a field still at early stages with respect to both full scientific and public understanding. Public views in Europe tend to be more cautious about biotechnology applications than in either Canada or the USA. Developing countries have their own set of concerns, including the possibility of losing out on a potential means of enhancing food production if biotechnology applications are curtailed. There are trade issues, with some similarity to discussions surrounding invasive species, a very significant concern for both the USA and Canada.

From a conservation perspective, the most obvious potential benefits of biotechnology include reduced plowing, reduced application of chemical pesticides and other inputs such as chemical fertilizers and water. "Designer plants" that can increase production from good lands could free marginal areas for conservation uses. The potential cost side of biotechnology includes possible collateral damage, exemplified by the Bt corn/Monarch butterfly toxicity experiments, escape of modified genes into wild relatives, and possible competitive superiority and spread of GMOs to become pests. One of the least studied concerns is the impact of rapid, widespread adoption of GM crops across large landscapes like the Great Plains. These effects might be long-term and subtle, for example, influencing soil biology. It is not clear that current scientific and monitoring practices address this type of widely distributed introduction or cumulative effects.

We are also likely to see an increasing number of biotechnology initiatives seeking preservation of endangered species of plants and animals through mechanisms such as cloning. Such work, while potentially of value, should not be considered as an alternative to protecting vital natural habitat.

There is much work underway internationally and some in Canada to address the benefits and costs associated with various aspects of biotechnology, and to address related social, ethical and environmental issues. Most addresses conservation only indirectly. Assessing impacts requires good science, which is not always available, and controversy can be expected in the application of the precautionary principle. Therefore expect to see more confusion and concern in the years immediately ahead, even as "pharmafoods" and other new biotechnology wonders become more available.

Art Hanson is Distinguished Fellow and Senior Scientist at the International Institute for Sustainable Development in Winnipeg, Canada. From

1992 to 1998 he served as President and CEO of IISD. Currently he also serves as Ocean Ambassador reporting to Canada's Minister of Fisheries and Oceans, as a Core Faculty Member of the Sustainable Enterprise Academy in the Schulich School of Business at York University, as a Member of the Canada Foundation for Innovation, the Canadian Biotechnology Advisory Committee, the China Council for International Cooperation on Environment and Development (Beijing) and as an advisor to various other Canadian and international bodies.

Dr. Hanson has served on Canada's National Round Table on Environment and Economy, and earlier, chaired the Canadian Environmental Assessment Research Council. He is an international consultant and has served as project director with organizations such as the World Bank, CIDA and UNDP and, in Canada, as consultant with government departments and private sector organizations. He was Professor and founding Director of the School for Resource and Environmental Studies, and a Research Director of the Dalhousie Ocean Studies Programme at Dalhousie University in Nova Scotia and has served on the faculty of other universities, including the University of Michigan and the Bogor Agricultural University in Indonesia. He pioneered the development of environmental management programs in Indonesia and elsewhere in Asia while working with the Ford Foundation and other international bodies.

His research interests include integrated marine and coastal resource use, environmental planning management and governance, sustainable development policy and practices, sustainable natural resource management, and nature protection. He holds a PhD in fisheries ecology from the University of Michigan and a BSc and MSc from the University of British Columbia.

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HABITAT ASSESSMENT AND CONSERVATION THROUGH THE NATIVE PRAIRIE STEWARDSHIP PROGRAM

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Abstract: Since 1995, the Saskatchewan Wetland Conservation Corporation (SWCC) has conducted field surveys of remnant native prairie parcels in highly cultivated areas of the prairie ecozone of Saskatchewan. Over 14 million acres of the prairie landscape have been surveyed, with just over 1% of the area remaining in upland native prairie vegetation. Most native prairie in these heavily cultivated areas exists as small fragments on private lands and is threatened by: cultivation; exotic vegetation; overgrazing, and/or idling. Native prairie vegetation is adapted to our extreme climate and provides excellent forage for livestock. It also provides habitat for native birds and wildlife. It is important that the remaining prairie be identified, conserved, managed, and, where possible, restored to function as an ecosystem. The Native Prairie Stewardship Program was initiated by SWCC to cooperate with landowners in addressing these issues. As the majority of the surveyed prairie parcels are privately owned, the attitude of the landowner is a crucial element in assessing the future threats to the habitat. A 1996 survey of landowners showed a majority favoured conserving their land. The same survey found that the most efficient and effective method of signing up new Voluntary Stewards was to make personal visits to each individual. This method has shown good success since the initial survey; over 50% of the landowners approached have joined the program. Currently, over 360 landowners have made Voluntary Stewardship Agreements with SWCC to conserve approximately 150,000 acres of native prairie. Extension work that focuses on improving understanding of the value and proper

management of native prairie is essential to maintaining and improving the health of these increasingly threatened ecosystems. Workshops about native prairie management and health are held in locations around the province. Various publications, including a management guide – “Managing Your Native Prairie Parcels”, fact sheets, and brochures, are available to those who are interested.

HABITAT ASSESSMENT

Since 1995, the Saskatchewan Wetland Conservation Corporation (SWCC) has conducted field surveys of remnant native upland prairie in highly cultivated areas of the prairie ecozone of Saskatchewan. Approximately 14.3 million acres of the prairie landscape have been fully surveyed, with just over 1% (160,234 ac) of the area remaining in upland native prairie vegetation. Another 12,500 ac of upland prairie have been assessed outside of the fully surveyed area.

Field survey methodology includes walking each site to determine the boundaries of the parcel and the composition of the grassland community, which is described in terms of dominant plant species (comprising more than 15% of the biomass) and subdominant plant species (comprising 5 to 15% of the biomass). Range condition of the uplands is visually estimated based on grazing intensity and the extent of native and introduced species. General notes are also made regarding topography, bare soil, club moss, wildlife sightings and extent of woody and exotic species cover. Threats to grassland and reasons for the land remaining uncultivated are noted. A photograph is taken to indicate the general condition of the parcel or to illustrate a special feature.

Most native prairie in these heavily cultivated areas exists as small fragments on private lands. A brief synopsis of the survey highlights is as follows:

Utilization: 12% of the area is under light to light-moderate grazing pressure, 36% is under moderate to moderate-heavy pressure, 35% is under heavy grazing pressure, 2% is being hayed, and 14% is idled.

Range Condition: 26% of the area is in poor to poor-fair range condition, 31% is in fair to fair-good condition, 23% is in good condition, and 20% is in good-excellent to excellent condition.

Threats: 76% of the area is threatened by the potential for cultivation of at least some portion of the parcel, 66% is threatened by exotic species, 53% is threatened by degradation from past or present overgrazing, 9% is threatened by the effects of long-term idling, 8% is threatened by shrub/bush expansion.

Reasons for Remaining Uncultivated: cultivation has been inhibited on 44% of the area because of stoniness, 28% because of wetlands or high water table, 24% because of topography, 16% because of salinity, and 13% because of soil texture. However, there seems to be no physical reason for not cultivating at least portions of 46% of the area, in spite of some of these limiting factors.

LANDOWNER STEWARDSHIP

Native prairie vegetation is adapted to our extreme climate and provides excellent forage for livestock. It also provides habitat for native birds and wildlife. It is important that the remaining prairie be identified, conserved, managed, and, where possible, restored to function as an ecosystem.

The Native Prairie Stewardship Program was initiated by SWCC to cooperate with landowners in addressing these issues. As the majority of the surveyed prairie parcels are privately owned, the attitude of the landowner is a crucial element in the conservation of the habitat. A 1996 survey of landowners showed a majority favoured conserving their land. A field test in 1997 found that the most effective method of enrolling Voluntary Stewards was to make personal visits to each individual. This method has shown good success since the initial survey - approximately 75% of the landowners we have visited with in person have joined the program. Currently, over 500 landowners have made Voluntary Stewardship Agreements with SWCC to conserve more than 190,000 acres of native prairie.

Extension work that focuses on improving understanding of the value and proper management of native prairie is essential to maintaining and improving the health of these increasingly threatened ecosystems. Working in partnership with landowners and with other agencies, the Native Prairie Stewardship Program implements enhancement demonstration projects and coordinates workshops dealing with native prairie management and health in locations

around the province. We are also initiating urban stewardship through prairie restoration projects. Various publications, including a management guide (*Managing Your Native Prairie Parcels*), fact sheets, and a quarterly newsletter, are available to voluntary stewards and others who are interested.

It is necessary, but difficult, to evaluate the success of the program in terms of participant attitudes, understanding and behaviour. We have just completed a telephone survey with approximately 150 of the voluntary stewards who joined the program in 1997 and 1998. The purpose of the survey was to evaluate the success of the program in terms of attitudinal and behavioural change, as well as to identify the usefulness of several aspects of the program.

At the time of writing, we are in the process of analysing the results. Results will be incorporated into program delivery.

PRECARIOUS FUTURE OF THE NORTHERNMOST KANGAROO RATS: THE ISSUE OF SMALL AND DYNAMIC POPULATIONS

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Abstract: Most wild, mammalian species in the prairies are rare or uncommon and becoming increasingly threatened by factors of human population. These species present particular difficulties for capture and monitoring, research activities, and strategic conservation and management. I studied the population demography and overwinter behaviour of one rare and vulnerable population of mammals, the northernmost Ord's kangaroo rats (*Dipodomys ordii*), from 1994 through 2000 in the "Middle Sand Hills" of southeastern Alberta. My main objectives were to quantify (1) endemic traits of the Canadian population; and (2) demographic parameters for ecological models. Using georeferenced mark-recapture, radio telemetry, and surgical implantation of miniature dataloggers, I found that northern kangaroo rats have many distinct traits relative to more southern populations. These data reinforce the global significance of the northern population for biodiversity. I collected empirical data describing population density, distribution, seasonal survival, reproduction, growth, dispersal, home ranges, and interactions between these characteristics and heavy infestations of macroparasites (botfly larvae) of kangaroo rats. I am capitalizing on these relatively long-term data by building population and energetic models that integrate these variables with stochastic variation, to assist in management/recovery planning for this species and its habitats. All evidence points towards an extremely precarious continued persistence of this unique mammal in Canada.

THE ROCKY MOUNTAIN FRONT PROJECT

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Abstract: The Foothills Fescue is a subregion of the Grassland Natural Region of Alberta and is located along the flanks of the Rocky Mountain foothills. It covers an area of 15,000 km² with the majority (90%) of it being in private ownership. It is also a highly disturbed subregion with a major city, many towns, and major stretches of highway. The major land use is farming and ranching. Some of the most severe losses in native prairie have occurred in this subregion in which at least 72% of the area has 50% or less native prairie. In 1997, The Nature Conservancy of Canada (NCC) embarked upon a project to conserve native prairie in this subregion by working with landowners and using tools such as land purchase and conservation easements. To date, the NCC has been able to secure 12,572 acres in this subregion. An additional 16,662 acres are currently under negotiation with a 50% or greater probability of being protected.

THE DECLINE OF DELTA MARSH, AN INTERNATIONALLY SIGNIFICANT WETLAND IN SOUTH- CENTRAL MANITOBA

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Abstract: Delta Marsh is one of the largest and most well known freshwater marshes in North America, and it was once widely recognized as habitat for waterfowl and other wildlife. However, the marsh has changed dramatically over the past 40 years. Changes have included: 1) decreased area of the marsh occupied by submersed plants, 2) encroachment of cattails (*Typha X glauca*) into shallow inshore areas, 3) disappearance of emergent plant "islands" that dampen the erosional force of wind and waves, 4) markedly increased water turbidity, and 5) decreased waterfowl use. Two phenomena may explain most, if not all, of these changes. Water level variation in the marsh has decreased due to artificial regulation of adjacent Lake Manitoba and bottom-feeding carp (*Cyprinus carpio*), which were introduced to the system in the early 1950s, have flourished. We have conducted studies for the past four years to determine the magnitude of these changes. Water samples from sites throughout the marsh have been analyzed for a full suite of water chemistry and clarity parameters in preparation for manipulation experiments to begin in 2001, and to assess the extent of change as compared to corresponding data from the early 1970s. We have also measured changes in marsh ponds and islands over a 50-year period using a series of high-resolution aerial photographs. Fish populations in the marsh have been monitored at key locations, and movements of individual fish have been tracked using radiotelemetry. Collectively, these studies illustrate the current state of Delta Marsh and the need for remedial action to reverse the decline of an internationally significant natural resource.

INTRODUCTION

Wetlands cover an estimated 41% of the total land area of Manitoba (Halsey et al. 1997), higher than any other part of Canada. Much of this is contributed by extensive peatland complexes across the north.

Manitoba is also known for its large lakes, Winnipeg, Manitoba, and Winnipegosis, that collectively cover 35,000 km² of the province. Less well known are the wetlands associated with the shorelines of these lakes, hereafter called "coastal wetlands." The number and extent of Manitoba coastal

wetlands is unknown. Also largely unknown is the threat to them from encroachment of residential development (homes, cottages, etc.) and the associated introduction of foreign plant and animal species, waste products, and physical disturbance; destruction from dredging and harbor construction; and disruption of their hydrology due to water level regulation of the adjoining lakes for purposes of hydroelectric power generation and flood control.

Delta Marsh, a 18,500-hectare coastal wetland on the south shore of Lake Manitoba (Figure 1), is recognized locally, nationally, and internationally as an ecologically important site. Designated under the Ramsar convention as a “Wetland of International Significance” in 1982, as a “Heritage Marsh” in 1988 under a program of the Province of Manitoba, the Manitoba Naturalists Society, the Manitoba Wildlife Federation, Ducks Unlimited Canada, and Wildlife Habitat Canada, and as a “Important Bird Area” in 1999, Delta Marsh was probably first visited by humans over 2,000 years ago when the Assiniboine River flowed through on its way to Lake Manitoba (Last 1980). Aboriginal people were probably attracted by its close proximity to fresh water and prairie game, as well as the abundant waterfowl that stopped during their annual migrations. As European settlers spread outward across the prairie in the mid-1800s, the plentiful waterfowl of Delta Marsh provided an appealing opportunity for hunting, both for recreation and subsistence. Long before bag limits were imposed by the government to prevent overexploitation, it was not uncommon for hundreds of ducks to be taken in a single day. Hunters were drawn from far and wide, including such early dignitaries as the Governor-General of Canada, Lord Minto, in 1900 and the Prince of Wales (later crowned King George V) in 1901. More recently, Hollywood celebrities,

prominent politicians, and a broad cross-section of the medical and legal professions spent time hunting and relaxing by the marsh. Research on the characteristics of the marsh began as early as the 1930s with the establishment of the Delta Waterfowl Research Station, followed by the Delta Marsh Field Station of the University of Manitoba in the mid-1960s. Monitoring of long-term trends in songbird abundance was initiated by the Delta Marsh Bird Observatory in the early 1990s.

Regrettably, Delta Marsh is one of many coastal wetlands of Lake Manitoba that have changed profoundly over the past three decades (Shay et al. 1999). Erosion of islands and shorelines, infilling of shallow peripheral ponds, increased turbidity of the water column, and declining numbers of waterfowl have all been observed. Three phenomena explain many, if not all, of the changes in Delta Marsh since the early 1960s. These include the reduced frequency of high and low water levels due to human regulation of the adjoining lake since 1961 (Figure 2), invasion of the marsh by common carp (*Cyprinus carpio*) starting in the late 1950s, and increasing enrichment of the marsh by nutrients from domestic sewage, agricultural manures and fertilizers over the past 50 years. In this paper, we describe some of supporting data for these changes. We also discuss the predicted rate and extent of further changes and the need for management to reverse the decline of a globally significant wetland resource.

DELTA MARSH MONITORING AND ASSESSMENT PROJECT

In 1997, renewed interest in the health of the marsh brought together Ducks Unlimited Canada, the Institute for Wetland and Waterfowl Research, Delta Marsh Field Station (University of Manitoba), Delta Waterfowl Foundation, and the Manitoba

provincial government to reevaluate the current condition of Delta Marsh. This new initiative became known as the Delta Marsh Monitoring and Assessment Project, which has the following three objectives:

1. **Characterization:** A range of physical, chemical and biological characteristics of the marsh were measured for comparison with corresponding data collected in the past. The purpose of this work was to provide quantitative evidence of changes in the marsh, and to substantiate assessments that had previously been based on limited, anecdotal information.
2. **Expanded knowledge:** Marsh restoration will require comprehensive information on all aspects of the ecosystem. Through a census of available historical data on the marsh, key knowledge gaps would be identified as a guide to further research. For example, concerns about fish use of Delta Marsh were identified in previous management plans but these were never addressed adequately (Wrubleski 1988) because there was no information on the assemblage of larger fish species of the marsh. This knowledge gap was addressed by studies initiated in 1999 on fish community composition and abundance.
3. **Restoration:** Ultimately, the goal of all work is to use the acquired knowledge to guide the development of a restoration plan for Delta Marsh within the context of management in the entire Lake Manitoba watershed,

including other degraded coastal wetlands.

SUBMERSED VEGETATION

Hunters in the marsh during the 1950s typically remark that the sediments of most areas were densely covered by submersed plants that provided habitat for aquatic invertebrates that were, in turn, food for waterbirds and other marsh fauna. By comparison, there are now relatively few areas in the open marsh where submersed plants are abundant, providing an anecdotal indication that marsh plants have declined dramatically over the past 40 years or more. In 1973-74, Anderson and Jones (1976) mapped the areal extent of submersed aquatic plant beds in the east unit of the marsh. In order to quantify the apparent decline, a new survey was done in 1997. Following similar methods as used in the previous survey, aquatic plant beds were mapped in the east unit of the marsh by a combination of ground survey and aerial photography (Wrubleski and Anderson 1999). Color and infrared aerial photographs were obtained for this purpose on 13 August 1997. The infrared photos were also used to construct a high-resolution photomosaic of the entire marsh and a map of emergent marsh plants and neighboring terrestrial vegetation (Grosshans 2001).

In 1973-74, submersed plants occupied 126 hectares, or 27% of the open-water area of the east marsh (Table 1). In 1997, total area of submersed plants was 562 ha, or 13% of the open-water area. This represents a 54% decline in area occupied by aquatic plants over a period of 24 years. Also of interest, the open-water area of the east Delta Marsh declined by about 8%, from 4,619 ha in 1974 to 4,247 ha in 1997.

WATER QUALITY

Evaluating long-term changes in marsh water quality is difficult for two reasons. First, we have found virtually no data collected prior to the 1960s which means there is no direct information prior to imposition of stable water levels and invasion by carp, when people visiting the marsh reported its water to be exceptionally clear in most areas. There are indirect ways of inferring past water quality by, for instance, collecting intact columns of sediment and analyzing samples along their length for a variety of chemical and biological parameters that relate to water quality. This paleolimnological approach has been used widely in lakes throughout Canada, including Lake Manitoba (Last 1980) and to a limited extent in the marsh (Sproule 1972) but it is confounded by the shallowness of the marsh and the tendency of sediments to be disturbed by water movement and animals. A second problem is that, where historical water quality data exist, differences in analytical methods and units of measurement between studies mean that data are often not intercomparable so trends over time are difficult or impossible to deduce. Most historical studies tended to include at least one variable relating to water quality, a major structuring influence on aquatic plants and other marsh organisms with which they interact, although the specific variable often differed. As a way of addressing the latter problem, we selected a set of these variables and measured them all at each of over 40 sites throughout the marsh at 2-4 week intervals in 1998 and 1999. Then we looked for correlations between individual variables that we could use in inter-converting inconsistent old data. For example, Secchi depth is the depth at which a white and black metal disk disappears from view as it is lowered into the water. It is easy to measure and remarkably consistent between observers so it is a widely used

metric of water clarity. We found that measurements of Secchi depth were well correlated with other water clarity indicators, such as the mass of suspended solids in a known volume of water (total suspended solids), the scattering of a light beam sent through an intact water sample (turbidity), the transmittance of light through an intact water sample, and the amount of suspended algae in the water that is typically one of the largest contributors to water turbidity in the marsh. By making the reasonable assumption that these correlations also applied in the past, we can use mathematical formulae relating pairs of variables to inter-convert units, thereby enabling comparisons between studies that measured different variables. By this approach, we found clear evidence of an increase in marsh turbidity since the 1970s. Measurements of water clarity at 30 sites around the east marsh, made in 1974 by Anderson (unpublished data), were converted into turbidity values for comparison with data from the same sites re-visited in 1998 and 1999 (Table 2). In 1974, the average turbidity in early July at these sites was 2.7 NTU versus 9.6 NTU in 1998 and 19.6 NTU in 1999. Also noteworthy from the modern data set is the high spatial and temporal variation in water clarity that occurs in the marsh, presumably due to such factors as the orientation of a specific site with respect to prevailing winds that resuspend bottom sediments, the site depth, the nature and abundance of submersed and emergent plants that shelter the site, and the extent to which carp activities increase sediment resuspension. In early spring 2000, we visited a set of ponds around the periphery of the marsh that lacked direct overland connections to the main marsh and therefore lacked carp. With virtually no exceptions, these isolated sites had markedly clearer water (Table 3), and more abundant submersed plants and invertebrates as compared to the surrounding marsh. Follow-up studies on some of these

isolated ponds, as compared to nearby connected sites, is continuing in 2001 as a prelude to planned manipulation experiments in 2002 whereby carp will be given access to a few isolated ponds after a one-year period of detailed background characterization.

Especially troubling with respect to the high turbidity in the marsh water column is the fact that, during most of the ice-free season, organic matter and more specifically algae is the largest constituent of suspended particles in the water column. Such algal blooms respond positively to nutrient enrichment from the surrounding landscape (agricultural fertilizers and sewage) and compete with submersed plants, contributing to their decline by reducing the amount of light reaching the sediment from which plants develop. There are observations from the 1970s that algal blooms were not uncommon in the marsh, made up of such species as *Aphanizomenon flos-aquae*, the “grass clipping algae” that resembles large green flakes in the water. *A. flos-aquae*, along with other cyanobacterial species, can (but does not always) produce potent nerve and liver poisons that kill numerous wildlife and domestic animals annually. Human mortality is very rare but the extent to which such algal toxins cause chronic health problems is unknown. We will carry out periodic screening of marsh water for algal toxins in 2001.

MARSH MORPHOMETRY

Aerial photography provides an excellent proxy means of assessing changes in the areal distribution of emergent plants and overall changes in marsh morphology. The first aerial photography of Delta Marsh was carried out in the east unit by an RCAF Vickers Viking floatplane in September 1925. More regular overflights of the marsh during pilot training for the Second World

War provide patchy and sporadic photographic coverage from the early 1940s. The first high-quality photography of the entire marsh was done in 1948 and was redone at irregular intervals during the 1950s, 1960s and 1970s, usually in black and white but occasionally in true or infrared color. Prior to our photography in 1997, no high-resolution work had been done since the early 1980s, resulting in a regrettable gap in the excellent chronology that can be reconstructed from time-series analysis of the whole set of photographs. Photography is available for subsets of the marsh during this period, such as the entire 930-hectare property of the Delta Marsh Field Station which has been photographed at 2-3 year intervals since 1987.

In 1999, we selected a set of 37 ponds around the periphery of the marsh whose perimeters were easily definable from aerial photographs so their open-water area, as affected by encroachment of hybrid cattails, could be measured. Selecting a subset of the full photographic dataset, measurements were done in 1948, 1964, 1979, and 1997. Using 1964 as a reference point (pond size average = 48,345 m²), being the year nearest to when stabilization of Lake Manitoba water levels began, we found that nearly all ponds were smaller in 1979 (average = 42,973 m²; 90% of 1964) and 1997 (29,469 m²; 53% of 1964) (e.g., Figure 3). Indeed, only three ponds, presumably the deepest ones least prone to plant invasion, were unchanged over this 35 year period. The ponds showing the most marked change were those that were smallest in 1964, including several that were completely overgrown in 1997, having no remaining open water where submersed plants could persist. The ecological consequences of the decline in pond area and the ensuing impacts on submersed plants, their associated epiphytic algae and invertebrates, and the higher trophic levels such as waterbirds and

muskrats that use them for food, are likely profound but have not been studied. At the same time that peripheral ponds were disappearing, emergent plant islands (sometimes called tules) that once proliferated in shallow water in many of the large, open bays throughout the marsh were disappearing under the stable water regime imposed in 1961. Ladle Island, at the northern end of Simpson Bay in the east unit, is typical of the erosion that has occurred since the 1960s (Figure 3) and other more extreme examples where entire islands are now gone are common. These islands helped to decrease wind fetch (the maximum distance over which wind can blow) and thereby reduced sediment resuspension so their gradual loss is exacerbating the turbidity change arising from carp disturbance of the bottom, loss of submersed plant cover, and algal blooms resulting from local nutrient enrichment.

EMERGENT VEGETATION

The infrared aerial photography taken in August 1997 was used to develop a full emergent vegetation map for the entire marsh (Grosshans 2001). Earlier maps were constructed in 1965 by Miller and Moore (1967) and in 1979 by Ducks Unlimited Canada. To facilitate comparison between these maps, the earlier paper maps were scanned, georeferenced and redrawn using ArcView GIS software, to assess quantitative changes in the emergent plant communities between years.

The Center Marsh unit (also known as the School Bay unit) is a good example of the changes that have occurred in the emergent plants of the marsh over the past 35 years. Here, a dramatic shift is seen from a marsh dominated by giant reed (*Phragmites australis*) to one overgrown by hybrid cattails (*Typha x glauca*) between 1965 and 1997 (Table 4, Figure 4). *Phragmites*

continues to dominate uplands, dykes, and eroded shorelines by producing thick stands with abundant litter but its coverage has decreased from 266 ha in 1965 to 100 ha in 1997. At the same time, cattail abundance increased dramatically, occupying only 37 ha in 1965, increasing to 182 ha in 1979, to 340 ha in 1997. Consequently, despite the site being a large bay, its open water area declined from 290 ha in 1965 to less than 235 ha in 1997. Also in dramatic decline are Bulrush (*Scirpus acutus*) stands that decreased in area within Center Marsh from 43 ha in 1965 to less than 2 ha in 1997. Most bulrush patches present now are small and sparse, often represented by only a few dozen shoots per square meter. They are reported to be the preferred food resource for muskrats which are themselves rare in most of the marsh. It may be significant, in view of stable water levels now prevailing in the marsh, that the only location where bulrushes remain abundant is within the channel of the Portage Diversion (Grosshans 2001). This is the only part of the marsh subject to inundation at times when the Diversion is used for flood relief in the Assiniboine River basin.

FISH COMMUNITY

Delta Marsh is the largest coastal wetland on Lake Manitoba and it has been regarded as important to the sport and commercial fisheries of the lake (Ducks Unlimited Canada 1981, 1986). Historical accounts indicated that Delta Marsh supported sizeable fish populations, at least during the summer (Hochbaum and Ward 1964). However, the current value of the marsh as fish habitat in light of the changes described earlier is unknown (Wrubleski 1998). The results of our limited sampling in the late 1990s suggest that the marsh is of little spawning value to the two most commercially important fish, walleye (*Stizostedion vitreum*) and sauger (*S.*

canadense). Limited movement into the marsh has been reported, spawning habitat is apparently lacking, and no fry or juveniles have been collected (Lapointe 1986, Wrubleski 1998). Yellow perch (*Perca flavescens*) and northern pike (*Esox lucius*) do spawn in the marsh and some production of young takes place. Carp are abundant but they are generally viewed as detrimental to the marsh (Hochbaum and Ward 1964). Large numbers of fathead minnows (*Pimephales promelas*), shiners (*Notropis* spp.), sticklebacks (*Culaea inconstans*, *Pungitius pungitius*), carp, white suckers (*Catostomus commersoni*), and bullhead (*Ameiurus* spp.) are produced in the marsh (Wrubleski 1998). These fish are forced out of the marsh in winter due to freezing. While present in Lake Manitoba they are likely to provide some forage for commercially important fish species. Thus the information available at present suggests that the marsh functions primarily as a producer of forage fish for Lake Manitoba.

Large fish species have not been sampled in the marsh although Lapointe (1986) did examine movement of larger species into and out of the marsh through Cram Creek. To better understand the fish community present in the marsh a gill-netting survey was undertaken in 1998 and 1999. This survey was intended to document the occurrence of the larger fish species, as well as their seasonal and spatial use of the marsh. Special emphasis was placed on walleye and sauger due to their importance in the commercial fishery of Lake Manitoba.

Gill nets were set in four large bays of the east unit of the marsh. Cadham and Clandeboye Bays were selected because they are connected to Lake Manitoba via channels through the beach ridge (Figure 1). Waterhen Bay was selected because it, along with Clandeboye Bay, possesses gravel and rock substrates that might be used by

walleye and sauger for spawning (Scott and Crossman 1973). Simpson Bay and Blackfox Lake were selected because they are at the center of the marsh and we were interested in the extent of fish movement into the marsh. Three sites were sampled within each bay, except in May when two sites were sampled. For each bay, one site was sampled each week, requiring three weeks to complete each month's sampling.

A standardized gill net was used for this study. The net consisted of six randomly linked nets (3.8, 5.1, 7.6, 8.9, 10.8, and 12.7 cm mesh), each 22.9 m long and 1.8 m deep. Each net was set perpendicular to the shore, generally within 100 m of the shore, and in water that ranged from 1.0 to 1.75 m deep. Each net was set in the morning and retrieved 24 hours later. Following removal of fish from the net it was immediately reset at a new site. Carp abundance in Delta Marsh was underestimated in this survey. Carp regularly ripped large holes in the net and few of the larger individuals were caught even though they were readily observed. During July, carp moved from the littoral edges of the marsh into the submersed plant beds of the bays. During this period they were especially destructive to the net, particularly the larger-meshed sections. Consequently, the 10.8 and 12.7 cm mesh sections were not used in July. The remaining small-meshed sections had to be replaced at frequent intervals to ensure that they were still functioning properly.

Fourteen species of fish were caught in the marsh (Table 5). Rock bass (*Ambloplites rupestris*) had not been recorded previously from Delta Marsh (Wrubleski 1998). This species is present in the Assiniboine River (Scott and Crossman 1973) and it probably entered the marsh through the Assiniboine River Diversion. No sauger were caught during the regular gill net survey although one was caught during additional sampling

in September 1999. This contrasts with Lapointe's (1986) observation of more sauger than walleye entering the marsh through Cram Creek in 1983. Other large fish species previously reported from the marsh but not caught in this survey included goldeye, silver redhorse sucker, channel catfish, and burbot (Wrubleski 1998).

A total of 6,715 fish were caught in 1998 and 7,716 in 1999 (Table 5). Dominant species in terms of numbers of fish caught were perch, carp, and bullhead during both years. These three species accounted for about three-quarters of the fish caught in the marsh each year. Total biomass was 2,663 kg in 1998 and 3,220 kg in 1999. Dominant species in terms of biomass were carp, freshwater drum, and northern pike, and as was the case for numbers, these three species accounted for about three-quarters of the biomass. As noted above, carp numbers and biomass are underestimates.

Walleye represented only 1.6 to 2.7% of the numbers of fish caught in Delta Marsh each year (Table 5). However, during the month of May, walleye were a major component of the fish community, generally ranking third in importance. Walleye were primarily caught on the east side of the marsh, with 80 to 89% of all walleye caught in Clandeboye and Waterhen Bays. A high proportion (73-91%) of these fish were male. All female walleye caught in May were spent, having already released their eggs. Additional sampling in April 2000 caught 18 female walleye, all of which were ripe. It appears that some female walleye do enter the marsh ready to spawn shortly after ice is off the marsh. However, the number of females is considerably less than males, and may indicate that the marsh is not a significant spawning habitat for Lake Manitoba walleye. It more likely functions as feeding habitat for post-spawning fish from the lake.

Walleye and carp movements in Delta Marsh were examined further with radio telemetry. In 1999, 22 walleye and 6 carp were implanted with radio-transmitters. An additional ten walleye were implanted in the spring of 2000. Telemetry observations confirmed our gill net findings, that walleye primarily used Clandeboye and Waterhen Bays. Only two of our 32 implanted walleye moved beyond these areas of the marsh. Walleye caught and implanted in the marsh generally remained until early to mid-June and then returned to Lake Manitoba. Only one walleye made a return trip to the marsh, and that was in the third week of September in 1999.

Carp moved greater distances in the marsh than walleye and all tagged carp made return trips to Lake Manitoba. For example, a 70 cm (fork length) female carp released in Clandeboye Bay on 19 May 1999 spent the next month in the Riley Bay area, 4 km east of Clandeboye Channel, then left the marsh on 25 June (Figure 6). It returned to the marsh the next day and was not found for almost three weeks. It was subsequently located in north Simpson Bay, approximately 11 km west of Clandeboye Channel. Five days later this fish swam all the way back to Clandeboye Channel and left the marsh, not to return for the remainder of the year. Carp move greater distances in the marsh than was originally believed. That they move regularly between the marsh and Lake Manitoba was also a surprise. Our radio telemetry studies of carp are only a beginning, and further work is needed to better understand how these fish use Delta Marsh. More information on surgical and telemetry procedures, as well as maps of individual fish movements, can be found at the Ducks Unlimited Canada website (www.ducks.ca/wt2000).

CONCLUSION

The changes in Delta Marsh have occurred as a result of complex interplay between three primary factors: proliferation of carp throughout the marsh, stabilized hydrology of the lake to which the marsh connects, and nutrient enrichment from the surrounding landscape (Figure 7). It is likely that changes in water quality and submersed plants have resulted from interactions between these factors, and the resulting loss of habitat has lead ultimately to fewer waterfowl using the marsh for breeding and feeding. The vast flocks that once drew people to Delta Marsh have diminished drastically to the extent that waterfowl hunting, already in decline across Canada as a recreational pastime, is an increasingly futile pursuit.

It is clear that management will be needed to reverse the changes that have occurred in Delta Marsh over the past four decades. With respect to carp, the marsh is sufficiently shallow that fish probably do not over-winter anywhere except a few small, deep areas that do not freeze to the sediments. Preventing carp from moving from the lake into the marsh in the spring, by constructing barriers that permit water flow and movement of small biota but preclude larger animals, seems the only feasible option. Whether this is done on a marsh-wide scale, such as occurred in the past when fences were constructed at each of the four connecting channels to the lake, or in restricted areas where the benefits are likely to be most immediate, requires consideration of the associated economic costs. These costs include not only the structures themselves but also the possible corollary impacts on sport and commercial fisheries on Lake Manitoba. Exclusion of large fish through construction of fences will not be confined to carp but will inevitably impact populations of other large fish species using the marsh to feed and spawn.

Reversal of the effects of stabilized water levels will require resumption of a wider range of water levels. Whether this is imposed via engineering or not will require consideration of the associated costs, both financially and politically. Full de-regulation of Lake Manitoba, so it resumes its traditionally random fluctuations of high and low water over periods of years or decades, is not likely to find favor with the majority of stakeholders. Cottagers whose access is blocked during periods of high water will be understandably hostile to the idea, as will farmers who have come to depend on annual access to marsh vegetation as a source of hay for their livestock. Restoration of a widened range of water level variation may, however, be effective at reversing the encroachment of hybrid cattails, if high water levels occur during periods of low stakeholder use and maximum impact on marsh vegetation (e.g., winter), and combined with other treatments such as mowing or burning. Resumption of highly variable water levels in the marsh, independent from the lake, would require an extensive network of earthen dikes such as has been proposed intermittently over the past thirty years by agencies such as Ducks Unlimited. The experience of constructing and maintaining dike-works during the ten-year Marsh Ecology Research Program at Delta Marsh in the 1980s, however, indicates that a more extensive network could be prohibitively expensive to construct and protect from the damaging effects of burrowing muskrats and wave action, and would likely require costly ongoing maintenance and continual pumping to maintain high water levels behind dikes of porous marsh soil against a hydraulic gradient.

Development of management plans for Delta Marsh should involve all interested stakeholders to ensure that adverse socio-

economic impacts are minimized while ecological integrity of the marsh is restored to the maximum extent possible. The province of Manitoba has hinted for the past two years that it intends to form a Water Resource Commission to consider water-related issues in the entire Lake Manitoba basin, including increased demand for agricultural irrigation water, under which effects of water levels and carp on coastal wetlands would presumably be considered. We hope that this will occur soon, as there is no basis for optimism in the event that current conditions in Delta Marsh are allowed to continue. In the meantime, research continues on the rate of change, and small-scale studies are planned to test the likely success of remediation. In 2001, a study of 13 ponds around the periphery of the marsh will commence. Some of the ponds have been connected to the surrounding marsh and have, therefore, hosted numerous carp for at least 20 years. Others are isolated from it and are considered representative of the condition of the marsh as a whole prior to carp invasion. Some ponds will be rendered inaccessible to carp by means of installation of mesh barriers across their sole connection. Others will be isolated completely by placing sandbag dikes across the connection. At the same time, some isolated ponds will have small channels excavated to them, some of which will also have mesh barriers deployed to permit input of water but not fish. Monitoring of water quality, and abundance and composition of algae, plants, invertebrates, fish, and water birds will be done over a period of one summer prior to the experimental manipulation, and at least one year following it. We anticipate the results will demonstrate unequivocally the impact of carp on marsh water clarity and, concurrently, the benefit of carp exclusion from Delta Marsh.

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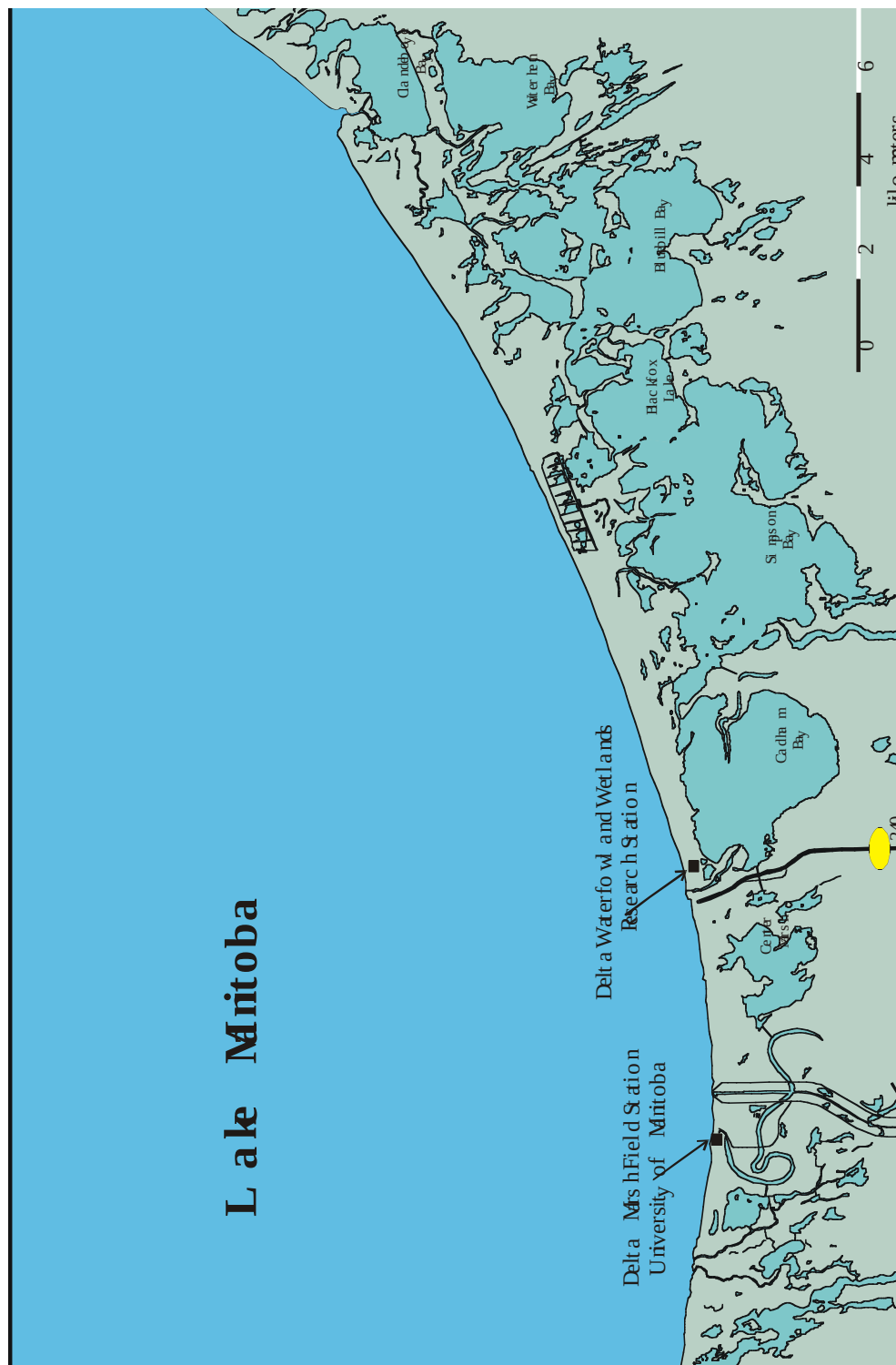


Figure 1. Map of Delta Marsh, a 18,500-hectare wetland in south-central Manitoba. The names of some component water bodies are also shown.

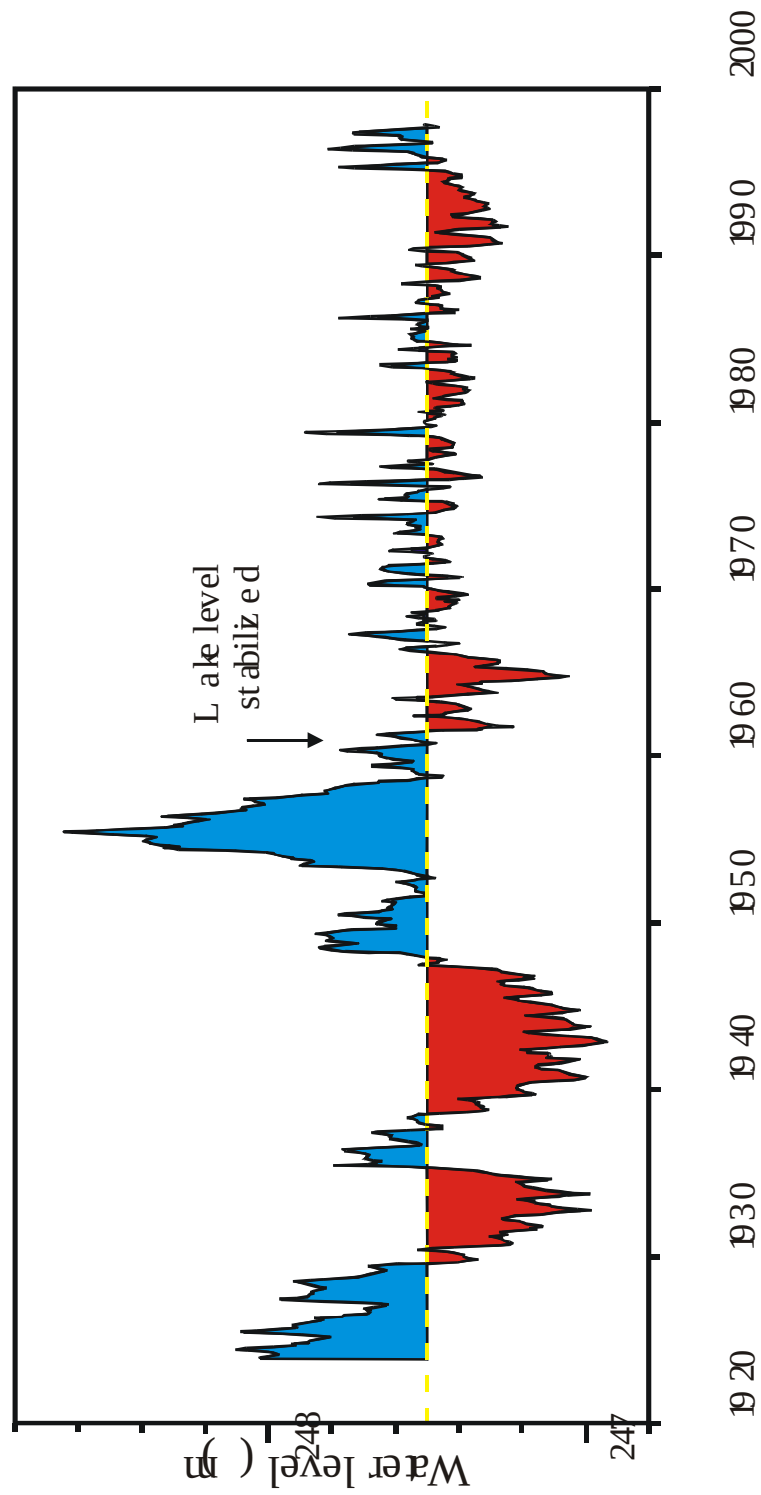


Figure 2. Water level (meters above sea level) recorded at the Steeprock Gauging Station in Lake Manitoba (1923 to present). A control structure at the northern outlet of the lake at Fairford, which stabilizes the lake level, was installed in 1961.

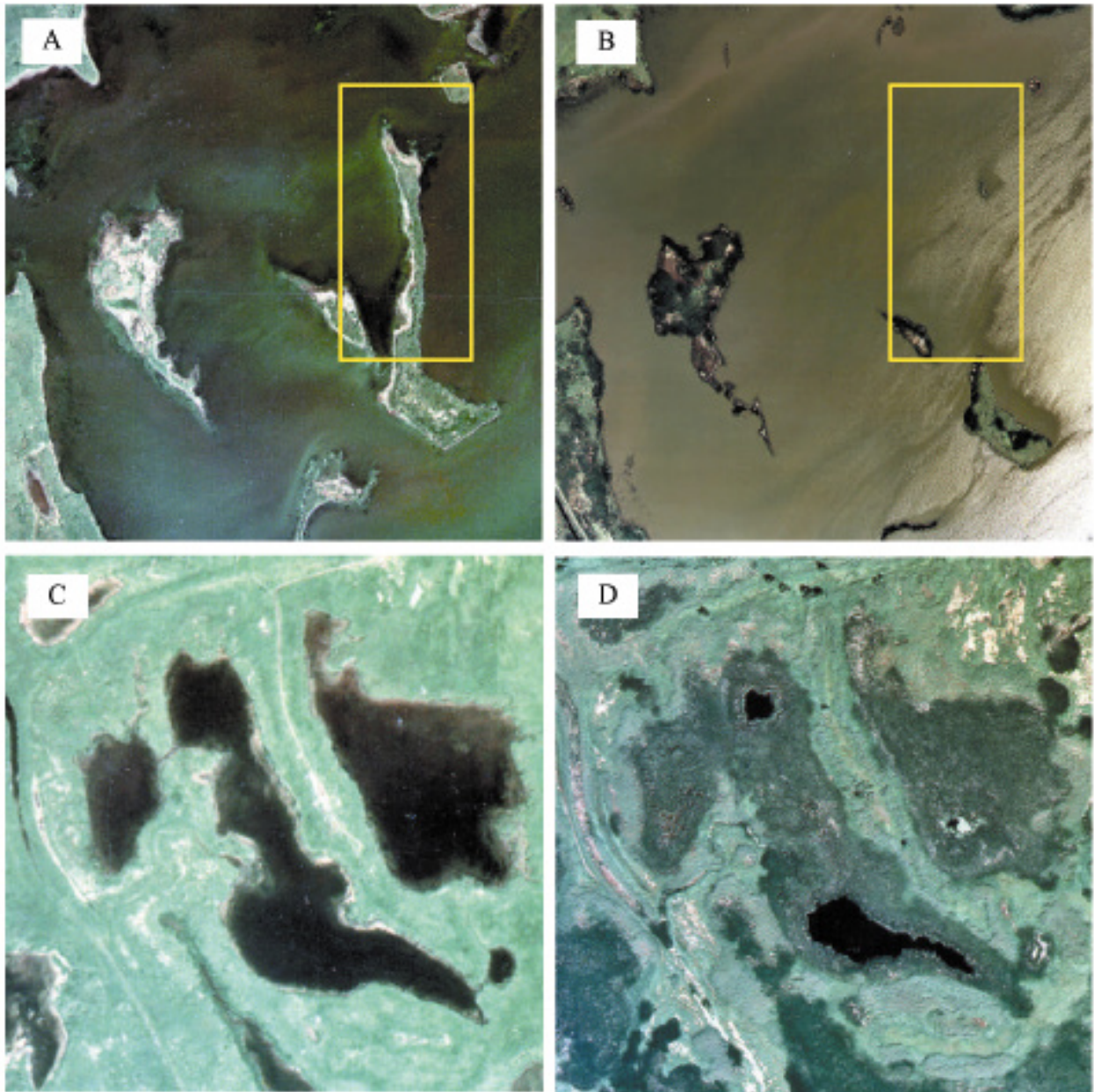


Figure 3. Aerial photographs of selected areas in Delta Marsh, taken in 1965 and 1997, that illustrate the erosion of emergent plant islands (panels A, B: Ladle Island) and encroachment of peripheral ponds (panels C, D: Hutchinson's Pothole) by hybrid cattails.

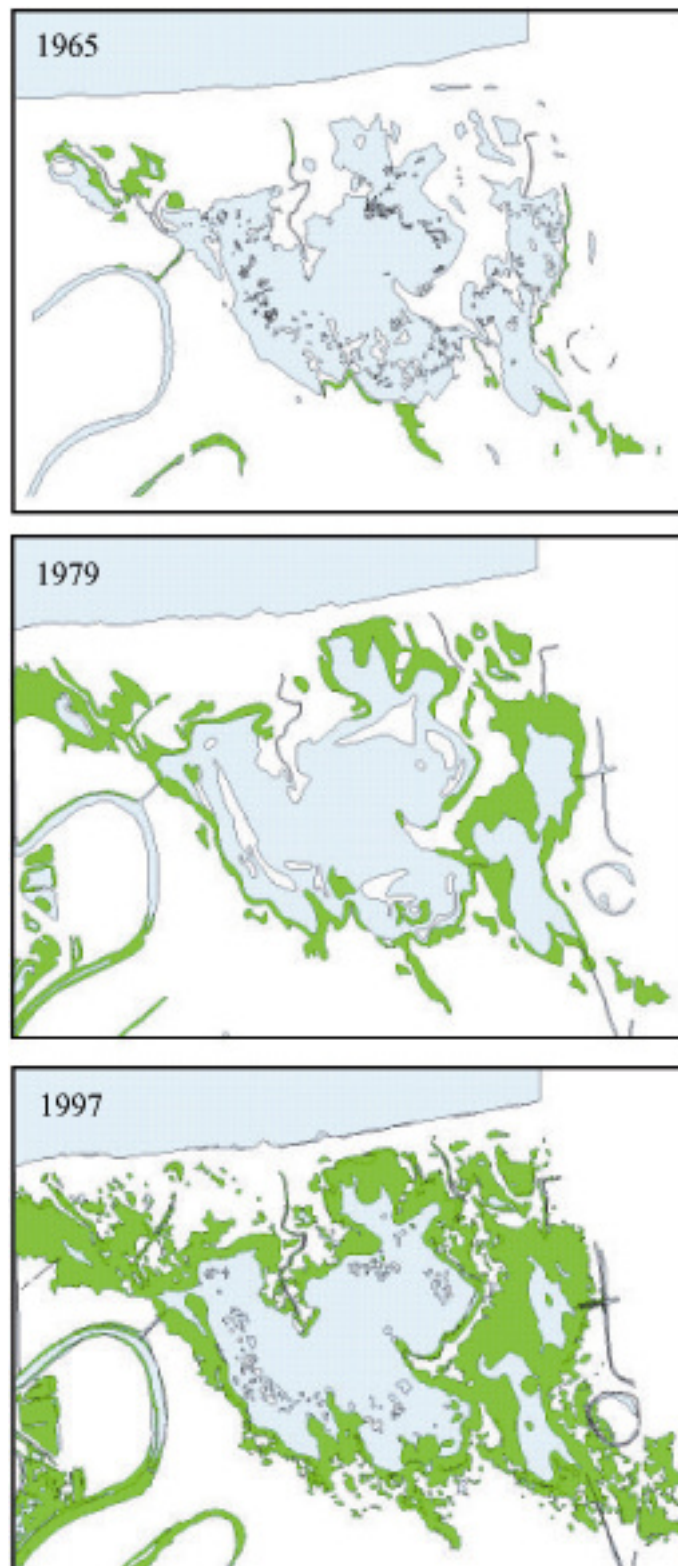


Figure 4. Vegetation maps of the central section of Delta Marsh (Center Marsh) that illustrate the encroachment by hybrid cattails (shaded areas) that has occurred between 1965 and 1997.

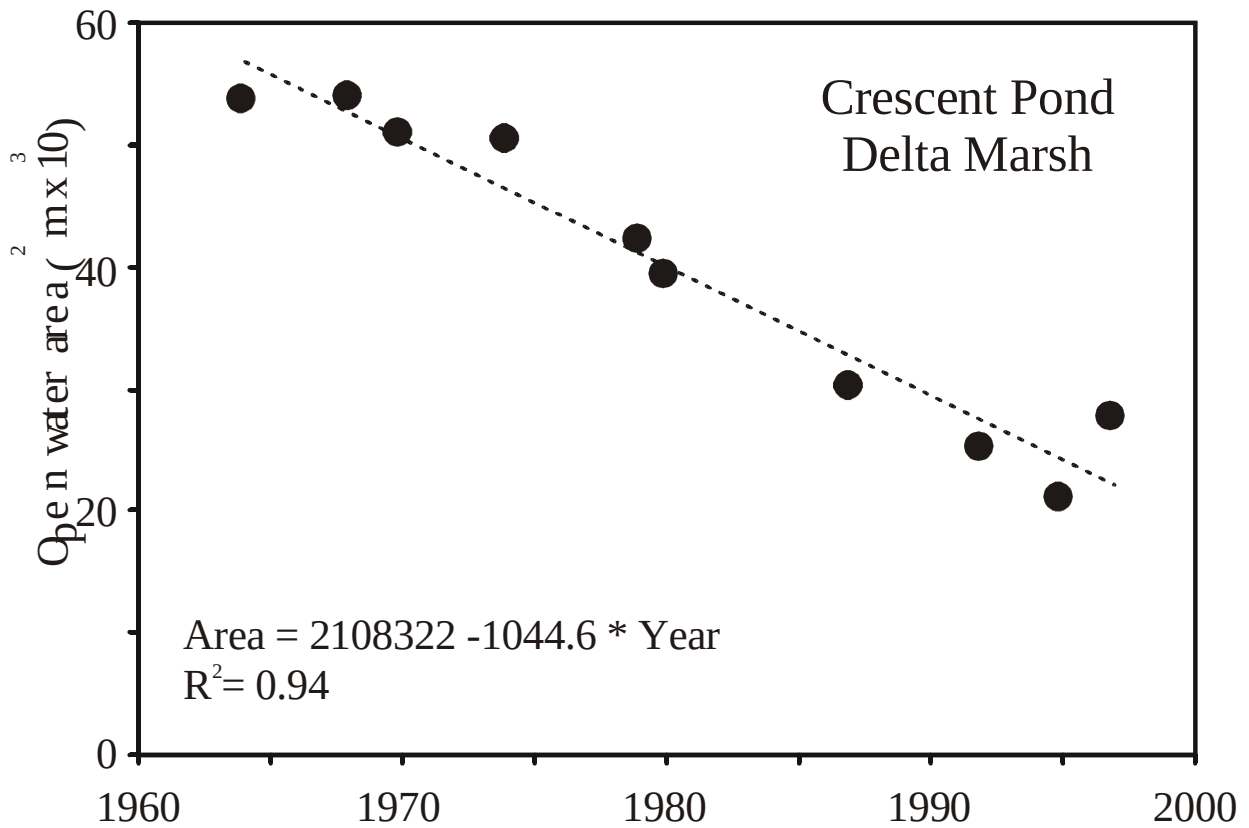


Figure 5. Decline in the open-water area of Crescent Pond, a 2,000-year-old paleochannel of the Assiniboine River in Delta Marsh, between 1964 and 1997 due to encroachment by hybrid cattails.

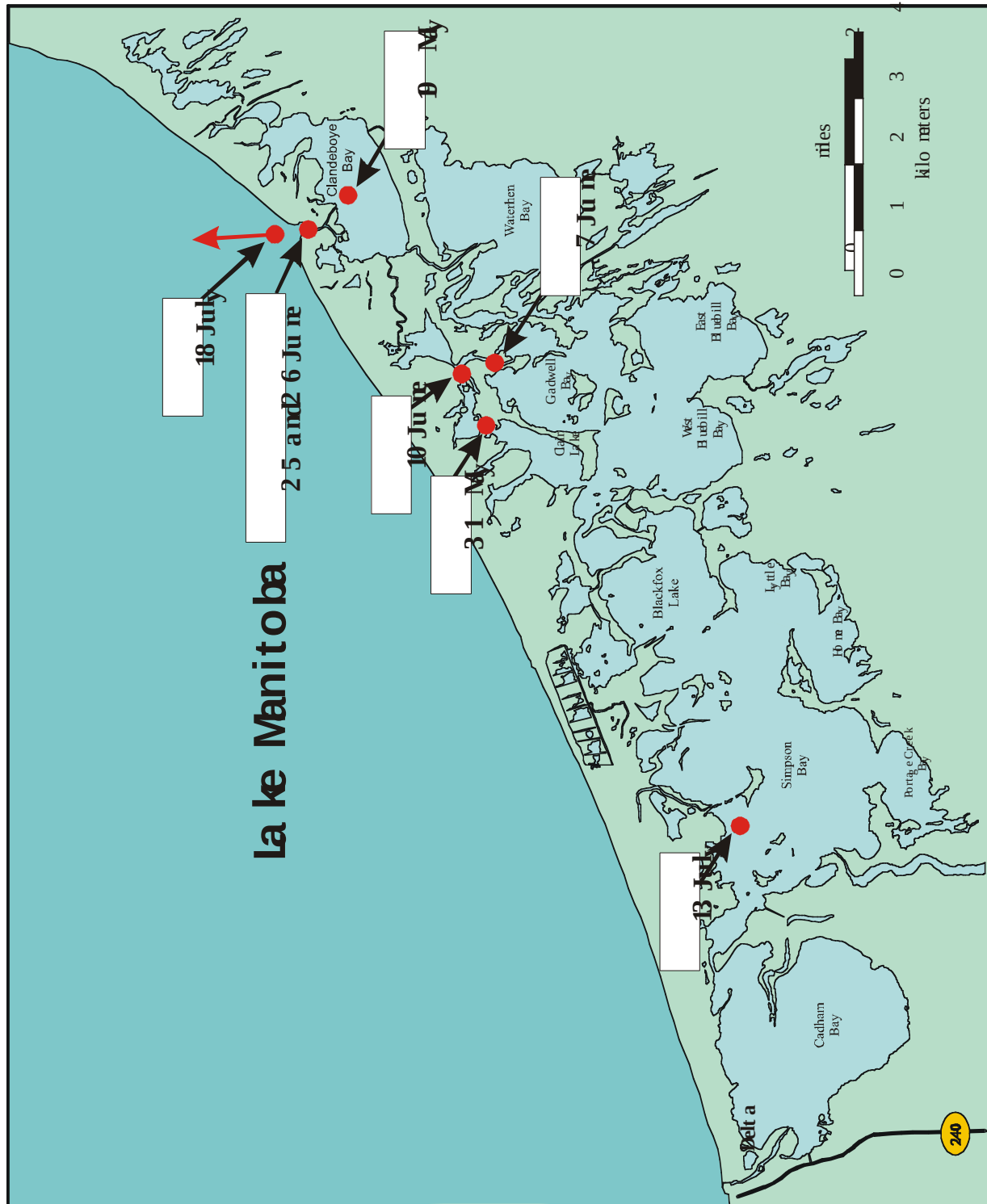


Figure 6. Locations of a 70 cm female carp implanted with a radio transmitter in Clandeboye Bay on 19 May 1999, released and followed subsequently by radiotelemetry.

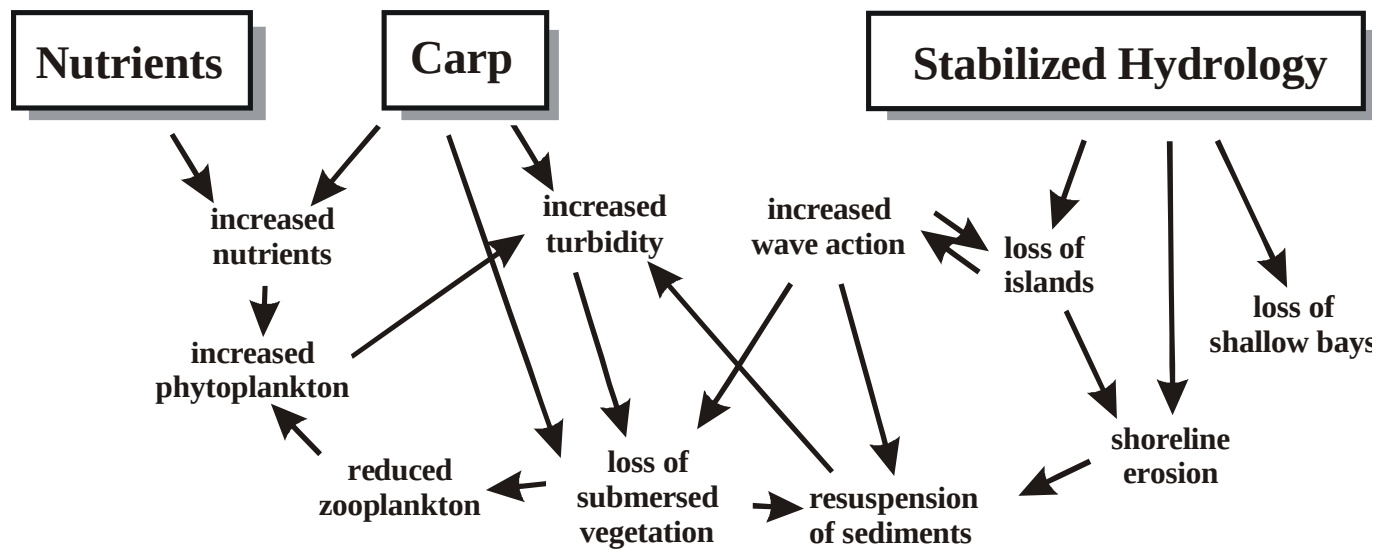


Figure 7. Flow chart that describes the interacting influences on nutrients from agricultural fertilizers and domestic sewage, carp, and stabilized water levels in Lake Manitoba, on the characteristics of the Delta Marsh ecosystem.

Table 1. Changes in area of open water and submersed plants between 1974 and 1997, east Delta Marsh.

	<i>Open water area (ha)</i>	<i>Submersed plant area (ha)</i>	<i>% vegetated</i>
1974	4,620	1,226	27
1997	4,247	562	13
Change	-372	-664 (-54%)	

Table 2. Water clarity measurements in Delta Marsh, based on sampling at 47 sites in 1998 and 1999.

<i>Parameter</i>	<i>Mean</i>	<i>Range</i>
Secchi depth (cm)	35	12 - 135
Turbidity (NTU)	21	1 - 77
Total suspended solids (mg/L)	50	1 - 314
Organic suspended solids (mg/L)	32	0 - 121
Transmittance % (450 nm)	78	41 - 96
Total chlorophyll (µg/L)	155	7 - 1,067

Table 3. Turbidity (nephelometric turbidity units, NTU) of water from 14 ponds around the periphery of Delta Marsh, some of which were connected to the surrounding marsh and others which were isolated from it (9-11 May 2000).

	<i>Mean</i>	<i>Range</i>
Isolated ponds (n = 8)	2.4	1.4 – 6.1
Connected ponds (n = 6)	10.6	3.4 – 22.0

Table 4. Area of open water and dominant emergent plant communities in the Centre Marsh unit of Delta Marsh in 1965, 1979, and 1997.

	<i>1965 Area (ha)</i>	<i>1979 Area (ha)</i>	<i>1997 Area (ha)</i>
<i>Habitat</i>			
open water	290.2	273.8	234.3
cattail	36.9	181.3	339.3
bulrush	43.3	25.3	1.4
giant reed	266.0	227.2	100.4

Table 5. Total number and biomass of fish captured, and percentage species composition, in Delta Marsh, 1998 and 1998. Based on 12 net sets each month, except in May when there were 8 net sets. July samples did not include 10.8 and 12.7 cm mesh nets. t = trace; ¹ all bullheads examined were black bullheads (*A. melas*) although brown bullheads (*A. nebulosus*) may have been present too.

Fish Species	Numbers				Biomass			
	1998		1999		1998		1999	
	number	%	number	%	kg	%	kg	%
walleye (<i>Stizostedion vitreum</i>)	108	1.6	169	2.2	72.5	2.7	139.0	4.3
northern pike (<i>Esox lucius</i>)	253	3.8	517	6.7	294.3	11.0	613.4	19.1
yellow perch (<i>Perca flavescens</i>)	2148	32.0	2734	35.4	158.4	5.9	252.1	7.8
carp (<i>Cyprinus carpio</i>)	1431	21.3	1877	24.3	1044.7	39.2	1470.3	45.7
freshwater drum (<i>Aplodinotus grunniens</i>)	1020	15.2	629	8.2	617.2	23.1	320.8	10.0
white sucker (<i>Catostomus commersoni</i>)	304	4.5	255	3.3	198.8	7.4	182.4	5.7
shorthead redhorse (<i>Moxostoma macrolepidotum</i>)	2	t	2	t	1.0	t	0.8	t
quillback (<i>Carpionodes cyprinus</i>)	38	0.6	23	0.3	34.4	1.3	26.8	0.8
bigmouth buffalo (<i>Ictiobus cyprinellus</i>)	64	1.0	23	0.3	24.8	0.9	12.2	0.4
bullhead (<i>Ameiurus</i> spp.) ¹	1271	18.9	1420	18.4	201.1	7.6	195.5	6.1
tadpole madtom (<i>Noturus gyrinus</i>)	1	t	0	0	t	t	0	0
tullibee (<i>Coregonus artedii</i>)	68	1.0	62	0.8	14.1	0.5	6.6	0.2
mooneye (<i>Hiodon tergisus</i>)	1	t	1	t	0.2	t	0.1	t
rock bass (<i>Ambloplites rupestris</i>)	6	0.1	4	0.1	1.4	0.1	0.3	t
Totals	6715		7716		2662.9		3220.3	

THE SOCIO-ECONOMIC CONTEXT FOR WILDLIFE CONSERVATION ON THE PRAIRIES OF CANADA

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Abstract: The success of wildlife conservation programs on the Canadian prairies ultimately depends upon cooperative partnerships that include land users and owners. Those partnerships will be negotiated within the context of past, current, and future human activities on the prairies. Wildlife conservation programs can therefore benefit from examination of human activities that have or are influencing habitat changes. This paper provides an overview of land cover changes on the prairies of Canada and the socio-economic context within which those changes are occurring. The ecological setting of the prairies is described and estimates of land cover and remaining native prairie are summarized. Information is presented on human population change, land use and socio-economic issues. The importance of placing wildlife conservation objectives and programs within a socio-economic context is stressed and wildlife conservationists are urged to adopt transdisciplinary approaches in the development of conservation programs.

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He is currently directing a multi-year, interdisciplinary study of the social cohesion of rural communities on the prairies of Saskatchewan, and is also co-directing an international training program in regional sustainable development with Chile and Costa Rica. Dr. Gauthier's current research areas include:

- _ Rural social cohesion
- _ Ecological indicators for sustainable communities
- _ Protected ecological areas planning and management
- _ Applications of GIS in natural resources management
- _ Ecological land classification
- _ Human adaptations to climate change

He has taught a variety of courses at the university including natural resource management, environmental issues, geographical information systems (GIS) and spatial statistics, biogeography and physical geography. Recently, he organized the first graduate course at the University of Regina on transdisciplinary approaches to environmental sustainability.

Among his many affiliations, he is a Member of the Board and Treasurer of the Canadian Council on Ecological Areas, a Trustee of the Nature Conservancy of Canada, a North American member of the World Commission on Protected Areas, a member of the National Atlas of Canada Steering Committee, a member of the Grasslands National Park Management Planning Committee, and a member of the Saskatchewan Prairie Conservation Action Plan Steering Committee. He directs the University of Regina Press, and serves as an editorial board member for the Great Plains Journal. He administers GIS service bureaus for the national parks in Saskatchewan. He is also a member of numerous professional organizations.

INTRODUCTION

Resource management and planning activities from over the last century have largely neglected the survival of many wild species and the importance of habitat values in Canada (Gauthier and Wiken, *in press*). Endangered wildlife and habitats that occur across much of the southern latitudes of Canada are the legacies of land and water developments that have overly favoured resource exploitation and production. Dealing with the aftermath of habitat degradation and loss occupies much of the agenda concerning wildlife management activities today. More importantly, it also tests the directions of conservation ethics for tomorrow. While surveys often show that Canadians show a substantial interest in nature-related activities (Environment Canada 1999) and have traditionally placed

and continue to place a high value on wildlife (Filion *et al.* 1993), substantial habitat alteration and degradation have occurred in many areas of the country. This chapter argues that much greater attention needs to be given by conservation biologists to the larger context of economic, social and demographic factors within which human values and actions to conserve wildlife are centred. The necessity for considering such broader contextual factors has been cogently argued in relation to the prairies of the U.S.

by authors such as Popper and Popper (1987, 1994a, 1994b) and Licht (1997). Thus, while the primary focus of this book is Swift Fox ecology and management, the broader contextual factors outlined in this chapter apply across many taxa.

The Prairie Ecozone is one of the most severely impacted ecosystems in Canada, particularly in relation to changes in the extent, distribution and composition of native prairie habitat for wildlife (Gauthier and Henry 1989). Conversion of native prairie to cropland, as well as the expansion of urban areas and transportation systems have been important factors altering the majority of prairie (Government of Canada 1996). "Farming, which monopolizes vast tracts of land, is one of the human activities that has the greatest impact on wildlife.....the replacement of indigenous plants with other crops, the drying of wetlands and the use of insecticides and herbicides have reduced the populations and areas of distribution of numerous species and also resulted in the introduction of new species" (Statistics Canada 2000a). McRae *et al.* (2000) conclude that agriculture, through habitat alteration, effects on soil and water quality and the loss of plant varieties, has contributed to losses in biodiversity on the prairies. The fragmentation, reduction in geographic area and isolation of many native wildlife habitats create impediments for

habitat management, species re-introductions and large area ecological restoration on the prairies. The reality for wildlife in the Prairie Ecozone today is that they must use combinations of agricultural lands and any remaining native habitats to meet their needs (Neave and Neave 1998). On the Canadian prairies, efforts to conserve remaining native prairie habitat are widespread involving multiple jurisdictions and levels of government, numerous non-government organizations and private stewardship initiatives. Those conservation efforts are conducted within a socio-economic milieu of human activity that will ultimately determine their success or failure. That humanistic context is at least important as the biophysical context in securing successful conservation planning. Thus, conservation programs have many information needs that ultimately require an integration of multiple sources of information that need to be treated within a transdisciplinary framework.

The continued survival of the Swift Fox, for example, in the prairies of the 21st Century depends on the extent to which society supports their conservation in consideration of the multitude of other factors affecting land use decisions. Thus, successfully managing for that and other species is dependent on the answers to many questions. Where is the remaining native habitat that will support the survival of the Swift Fox on the prairies of Canada? Who controls or manages that habitat and for what other purposes can it be used? Is potential habitat for the Swift Fox under threat from human activities and what are the types and intensities of those activities? Is there a sufficiently detailed understanding of Swift Fox habitat distribution and quality on the prairies and factors affecting changes in those elements, both short-term and long-term, to insure the success of re-introduction programs? Will the re-introduction of the

Swift Fox hinder economic development in regions of the prairies or will it have an economic benefit? In the humanistic context of public concerns regarding reduced rural access to health care facilities, reduced or negligible profits on farming operations, declining rural road quality, declining drinking water quality and many other issues of concern to people on the prairies (Environment Canada 1996), to what extent should public funds and resources be applied to the conservation of the Swift Fox or any other wildlife? The answers to these questions require not only detailed biological and ecological knowledge related to Swift Foxes. They also require a dialogue among many sectors of human society that extends beyond the special interests of any one group. This paper encourages the further development of that dialogue within the context of broad societal concerns and aims to provide a brief overview of social and economic conditions on the prairies of Canada as part of that contextual basis. It provides an overview of landscape changes on the Canadian prairies and human factors driving those changes. The ecological setting of the prairies is described and estimates of land cover and remaining native prairie are summarized. Information is also presented on human population change and land use activities on the prairies. It is hoped that wildlife biologists will find this regional context of some value in considering the management implications of their work and that stronger links can be forged among researchers and managers of various disciplines to integrate their work in the context of sustainability of prairie ecosystems.

REGIONAL SETTING

North American Great Plains

The North American Great Plains ecological region extends over the widest latitudinal

range of any single ecological region on the continent and it is the only contiguous ecological region common to the three countries of North America (Figure 1). The Great Plains extend for about 4,200 km from Alberta, Saskatchewan and Manitoba in Canada, south through the United States to southern Texas and adjacent Mexico, and approximately 1,300 km east to west (from Manitoba through Alberta in Canada, western Indiana to the foothills of the Rockies in the U.S., and into northeastern Mexico) (CEC 1997). Canada contains 16% of the Great Plains of North America. The Great Plains of North America cover in whole or in part 20 state or provincial jurisdictions: three in Canada, 14 in the USA and three in Mexico, as well as the three federal jurisdictions (Gauthier and Wiken 1998). Understandably, coordinated management across such a large geographic space involving such a large number of jurisdictions is complicated.

Prairie Ecozone of Canada

The Prairie Ecozone of Canada spans an area of 520,000 square kilometers, approximately 5% of the area of Canada (ESWG 1995). The relief is typically subdued, consisting of low-lying valleys and plains sloping eastward. With its base along the Canada-United States border, the ecozone stretches from the Rocky Mountains in Alberta to the Red River valley in Manitoba, reaching across the southern third of the Prairie provinces.

Seven ecoregions comprise the Prairie Ecozone (Figure 2). Only the Aspen Parkland occurs across the three prairie provinces and it is the single largest ecoregion in the Prairie Ecozone (Table 1). The three smallest ecoregions are unique to a particular province. The Moist Mixed and the Mixed Grassland ecoregions together comprise almost half of the Prairie Ecozone. It is the Mixed Grassland ecoregion that is of

particular importance as habitat for Swift Foxes.

HUMAN ACTIVITY

History

Historians recognize three general eras of European incursion onto the Canadian prairies: exploration and fur trade, ranching, and agricultural settlement (Friesen 1984). Between 1670 and 1870, the Hudson's Bay Company was granted exclusive fur trading rights to the area drained by the rivers flowing into Hudson Bay, then called Rupert's Land (Innis 1970). The earliest significant human modification of the native prairie ecosystems was spurred by European demand for products of the fur trade, particularly those from bison (Rich 1967). The killing of thousands of bison each year by European settlers led to the virtual elimination of free-roaming bison by the 1880s (Geist 1996).

The southern prairies of Canada were first extensively explored by the John Palliser expedition from 1857 to 1860 and Henry Youle Hind from 1857-1858 (Spry 1963). The general conclusion was that much of the southern region was unfit for settlement. A later expedition in wetter years by John Macoun (1879-1881) countered these earlier assessments and claimed that the region was a fertile grassland belt with great potential for agriculture. Macoun's report was an important information source in the decision regarding the route of the Canadian Pacific Railroad, changing the destiny of this region (McDougall 1968). Settlement and landscape modification greatly increased after 1870, when the Hudson's Bay Company surrendered its charter and sold Rupert's Land to Canada (Morton 1973). To secure the area against potential encroachment by the United States, Canada

encouraged land development. In the early part of this century, following the completion of the transcontinental railway in 1885, a massive migration saw more than 200,000 homesteaders stake claims.

The first pioneers to come were the ranchers (Breen 1983). In the early 1880's, the Canadian Government leased large tracts of land to individuals and companies wishing to raise cattle. This era lasted for about 25 years until the rush of agricultural settlers arrived between 1900 and 1921. During that period, homesteaders poured into the region increasing the population over four-fold. Railways played a leading role in defining the pattern of development. Towns emerged along the rail line as collection points for grain and livestock exports and as distribution points for incoming supplies.

The introduction of widespread agriculture and ploughing transformed much of the prairie region into a mosaic of pastures and croplands. The conversion of native prairie into agricultural fields powered much of Canada's economic growth in the early 1900's to mid 1950's (Government of Canada 1996). During this time the social and economic systems constructed on the prairies were based on cash crops (grain). By 1916, for example, Canada was leading the world in wheat exports. Twenty-five years later, 60% of the Prairie Ecozone was under cultivation and many areas of the Prairies began to resemble a checkerboard (Gauthier and Henry 1989).

Drought has played an important role in the development of the Prairie Ecoregion (Jones 1987). Many of the native plants and animals that were adapted to periodic drought were displaced by genetically similar fields of grains and oilseeds. The droughts of the 1910's and early 1920's, however, left few homesteaders prepared for the dust bowl of the 1930's. That period

marked the greatest mass out migration of settlers from the region, where over half a million people moved out of the ecozone. This set the stage for the establishment of the Prairie Farm Rehabilitation Administration (PFRA) which spearheaded a monumental effort to improve farming operations in the region (Friesen 1984).

Within the Prairie ecozone, agriculture has changed significantly in the past 100 years. Improved equipment and farming techniques have revolutionized the way crops are grown. Further, the types of crops have diversified considerably, from the traditional grain crops to more oilseed crops (such as canola, flax, and sunflowers) to legumes. Producers have increasingly adopted more sustainable farming practices, including conservation tillage and reduced summerfallow, reducing the risk of water and wind erosion.

Agroecosystems

Today, the Prairie Ecozone reflects a culturally molded system. Agricultural land use dominates the ecozone (Figure 3), occupying 90% of the land base in cropland, pasture and rangelands (Government of Canada 1996). Termed the Breadbasket of Canada, the Prairie Ecozone contains the majority of the country's productive agricultural cropland, rangeland, and pasture. The area is the source of much of the country's food and, as a result of the export of grains, oilseeds, and animal products, is an important source of foreign exchange (Wilson and Tyrchniewicz 1995). Agriculture is the most important economic activity as well as the dominant land use and the main stressor for this region (Government of Canada 1996). The conversion of grassland to agricultural lands has created an agro-ecosystem on the prairies today. Agro-ecosystems are biophysical and solar driven systems that are under direct or indirect influences of

agricultural processes. Within agroecosystems, humans are a significant structuring force affecting the survival and distribution of plant and animal populations. Those forces include cultivation, species introductions, intensive pasturing, gene manipulations, chemical applications, urban expansion and alteration of species composition (Samson and Knopf 1996). The Canadian Prairie is now a highly managed ecosystem, with far-reaching human socioeconomic dimensions, in which much of the primary production is channeled into human consumption. It is within that context that wildlife re-introduction and conservation programs must be considered.

Native Biodiversity

Over the past 100 years, native biodiversity of the Prairie ecozone has been greatly reduced as a cost of agricultural, urban and industrial expansion. The native grassland has been altered, fragmented, or eliminated, with corresponding decreases in native species assemblages (Biodiversity Science Assessment Team 1994). Two of the main perils affecting the region are habitat destruction and environmental contamination (Government of Canada 1996). Loss of habitat is the most critical threat to the flora and fauna. Millions of hectares of marshes and wetlands, important for breeding grounds for waterfowl, watering holes for mammals, and habitat for fish, have already been altered for other purposes. They have been drained or filled in for farmland, highways, airports, housing, industrial complexes, or flooded behind large power dams. Dams and reservoirs have been constructed on all the major river systems in the Prairie ecozone. Wetlands, which provide critical habitat for 50% of North America's waterfowl, have been reduced by 50% from the pre-settlement wetland area (Adams 1988, Batt 1996). Today, the Prairie ecozone is home to

relatively high numbers of threatened and endangered wildlife species and its native ecosystems are among the most endangered natural habitats in Canada. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identifies 14% of the 353 species at risk in Canada as occurring in the Prairie ecozone (COSEWIC 2000). COSEWIC listed the Swift Fox as extirpated in 1978. With an estimated population of 290 animals in Alberta and Saskatchewan (Carbyn 1998) they were downlisted to endangered in 1998 (RENEW 1999).

RANGELAND, CROPLAND AND REMAINING NATIVE PRAIRIE HABITAT

Cultivation and industrial development of key mixed-grass prairie habitats are considered major concerns for the continued viability of Swift Fox populations (Carbyn 1998; RENEW 1999). Census information, interpretation of satellite imagery, and site-specific ground studies contribute to determining the amount and distribution of remaining native prairie within the Prairie Ecozone of Canada. The vast majority of contiguous rangeland and pasture occurs in the Mixed Grassland Ecoregion of southeastern Alberta and southwestern Saskatchewan (Figure 4). Between 1971 and 1996 the area in cropland in the Prairies increased by 28% (48,720 km²) and the area of improved pasture by 48% (7,248 km²) (Statistics Canada 1996). However, the rate of land conversion had slowed by the 1990's. Between 1991 and 1996 the area of cropland expanded by only 1.4% and that improved pasture and grazing lands increased by 3% (Table 2). The area of unimproved lands (i.e. rangeland), however, decreased by 6%.

Approximately one-quarter of the Prairie Ecozone consists of rangeland or grazing lands (Table 3). The majority of any

remaining native prairie can be expected to occur within those remaining rangeland, pasture and grazing lands. Important issues are how much of that land remains as native prairie, the size of the remaining sites, the condition or quality of those sites, the threats to their continued survival, and, in the context of Swift Foxes, the extent to which their survival is dependent on native prairie. Baydack (1993) points out that prairie species live within a mixture of native and non-native habitats and that the amount and mix of those habitats that is important for maintaining different species is poorly understood. Attempts to improve that understanding include Agriculture and Agri-Food Canada's (AAFC) assessment of habitat quantity through their Agri-Environmental Indicator Program (McRae *et al.* 2000). That study has provided a useful coarse scale analysis of habitat quantity but lacks sufficient detail for proper assessments of habitat quality. More detailed land cover assessments based on finer scale satellite imagery or aerial photographs, combined with ground surveys are helping to improve understanding of both habitat quantity and quality. Alberta has produced a comprehensive database of information about remaining native prairie. Saskatchewan has completed a detailed satellite image analysis of the Saskatchewan prairies. That information will be combined with that from Alberta, and eventually with information from Manitoba to produce an integrated picture of native prairie across the three prairie provinces.

In addition, some site specific surveys have been conducted that help to build a more accurate picture for particular areas. For example, Saskatchewan Wetland Conservation Corporation's (SWCC) native prairie stewardship program has surveyed areas of the province cultivated to a level of 90% or more (42 rural municipalities) to determine how much of the pre-settlement

grassland remains (Reimer *et al.* 1997). Of 4,000 sites surveyed and assessed, only 623 (16%) were considered representative of native prairie. Remnant sizes ranged from one to 640 acres, and most were less than 80 acres in size. They found that the major threats to those 623 remnant parcels were exotic plant and brush invasion, cultivation, heavy grazing and idling of the land. Of those 623 sites, 28% were in poor or poor-fair range condition, 52% were in fair-good condition and only 20% were in high-good to excellent condition. They found that only 16% of sites surveyed could be considered as native prairie, most were less than 80 acres in size, and only 3% of the remaining native prairie sites that they surveyed were in high-good to excellent condition. While these are sobering figures, SWCC's surveys concentrated on areas that have been intensively cropped. Equally detailed surveys need to be conducted across less intensively cropped regions and in rangelands and grazing lands.

SOCIO-ECONOMIC CHARACTERISTICS OF THE PRAIRIES

Human Population Characteristics¹

Remaining native prairie and biodiversity are nested within an ecological region dominated by human activity. Approximately 75% of the land cover of the Canadian prairies has been substantially altered. Within that context, shifts and trends in human populations and activities are useful indicators of continued potential stresses to the environment.

Despite the dominance of agricultural activities on the landscape, the majority of

¹ The demographic figures for 1991 and 1996 were taken from Statistics Canada (1991a, 1991b, 1991c, 1996, 1997).

the population are found in urban communities. In 1936, farmers represented 50% of the population. Today that number has fallen to less than 10% (Statistics Canada 1996). Population decline in the rural areas and growth in the urban areas has been the general rule since the 1950s. The view of a predominantly rural population in the prairies is a myth. The proportion of the urban population is 81% compared to 76% for all of Canada, a remarkable figure given that agricultural activities dominate the landscape and that urban land use occupies only 0.3% of the ecozone (Government of Canada 1996). Although urban use of land is tiny in terms of area (0.3%), it remains an important influence on the ecozone. In 1991, the total population of the Prairie Ecozone was approximately 3.84 million, an increase of 25% since 1971. By 1996 that figure had grown to approximately 3.97 million people occupying the seven ecoregions of the Prairie Ecozone of Canada, a growth of 3.3% or approximately 130,000 people between 1991 and 1996 (Figure 5). The vast majority of that growth (over 120,000 people) occurred in the Alberta portion of the Prairie Ecozone, with the remainder in Manitoba. Saskatchewan's Prairie Ecozone showed a net loss of approximately 3,000 persons between 1991 and 1996.

Alberta's Fescue Grassland and Aspen Parkland ecoregions accounted for the greatest increases in population, followed by the Mixed and Moist Mixed grasslands (Figure 5). Saskatchewan's Moist Mixed Grassland also showed an increase, but it was over-shadowed by decreases in the Aspen Parkland and Mixed Grassland. Manitoba showed substantial increases in the Lake Manitoba Plain ecoregion followed by an increase in the Aspen Parkland and a slight decrease in the S.W. Manitoba Uplands.

There have been decreases in rural populations throughout Canada since 1990 and projections are for that decline to continue (Figure 6). The decline is largely a result of out-migration from rural to urban areas (Statistics Canada 1996). The majority of the urban areas for the Prairie Ecozone are in the Fescue Ecoregion of Alberta and the Aspen Parkland and Moist Mixed Grassland Ecoregions of the three provinces (Figure 7). The only decrease in overall rural populations on the prairies for 1991 and 1996 is in Saskatchewan (Figure 8). Recent analysis indicates 12% higher out-migration from Saskatchewan in the third quarter of 1997 compared to a year earlier (QED Information Systems Inc. 1998). The slight increases in Alberta and Manitoba are largely artifacts of small communities less than a thousand in size developing around established urban areas.

The age distributions among the three provinces are fairly similar, except that Saskatchewan has the lowest proportion of the rural population of under 14 year olds, and the lowest proportion of 19-64 year olds (Figure 9). For only the Mixed Grassland Ecoregion Alberta and Saskatchewan, Saskatchewan has the highest proportion of 65 and over ages. That value is twice the proportion of Alberta, i.e. Saskatchewan has an older-aged rural population in the Mixed Grassland Ecoregion. Not surprisingly, communities that offer limited employment opportunities have larger proportions of their populations in the 65 and over age class and have shown the largest net out-migration over time (Olfert and Stabler 2000).

A process of farm consolidation on the prairies is evidenced by a decline in the total number of farms between 1991 and 1996, a slight decrease in the total area of farms, and a substantial decrease in the number of individual or family holdings (Table 4). The substantial percentage increase in corporate

holdings is at least partly a function of many family farms incorporating.

In summary, the Prairie Ecozone reflects the following demographic characteristics: (1) increases in total populations in Alberta and Manitoba, with much of that increase occurring in urban areas; (2) decrease in the total population in the Prairie Ecozone of Saskatchewan; (3) increasing proportion of the population in urban areas throughout the Prairie Ecozone; (4) relatively stable or declining rural population; (5) increasingly elderly rural population, particularly in Saskatchewan; and (6) a trend toward fewer, larger, farms and fewer number of farmers. Olfert and Stabler (2000) predict that rural communities will continue to decline in number as they lose population and that economic activity will continue to concentrate in major urban centres and a relatively few larger rural communities. That prediction is not unique to the Canadian prairies. Popper and Popper (1994a, 1994b) and Licht (1997) have presented similar conclusions for the U.S. Great Plains.

Economic Structure

The above demographic characteristics of the prairies should be considered within the economic structure of the ecozone which reflects a dependence on the primary industries of agriculture, mining, and gas and oil extraction. The Prairie Ecozone provides 19% of Canada's total resource-based employment, with agricultural activities and food processing accounting for nearly 62% of the total (Government of Canada 1996). Its minerals industry (fossil fuels and related products) accounts for a substantial portion (nearly a third) of Canada's total employment in this sector. In 1991, the Prairie Ecozone had an estimated Gross Domestic Product of roughly \$91 billion, representing about 15% of Canada's total GDP. The economic importance of prairie resources to Canada cannot be

overstated, and the reliance of that economic production on surface and sub-surface resources is substantial. Management policies or programs that call for shifts in resource use to accommodate wildlife conservation need to be carefully considered within the context of the economic base.

Agriculture

Farming in the Prairie ecozone has been traditionally characterized by a limited variety of crops. Only 15 field crops (grain, oilseeds, and pulses) and even fewer forage crops occupy more than 95% of the cropped area. With the exception of canola, which has recently surpassed wheat in the amount of area seeded, these crops have been the mainstay of production since European settlement. Beef and dairy cattle, swine, horses, chickens, and turkeys are the primary domesticated animals. In the 1980s, agriculture generated about \$5 billion, or 25% of all exports from the region. This accounted for 2% of global grain, rice and vegetable oil output. Currently, about 75% of production of the Prairies is exported.

Despite technological advances and increased government support payments, recent years have seen a decline in net farm income in the three prairie provinces, largely as a result of lower commodity prices for grains and oilseeds in Saskatchewan and Manitoba and higher livestock expenses in Alberta (Statistics Canada 2000b). Off-farm employment has become an increasingly important form of economic support for farm families (Swidinsky *et al* 1998) and has increased the dependency of farm families on larger rural communities. It would not be surprising if the immediate concerns of farm families facing economic difficulties overshadowed their concerns about wildlife conservation.

Agricultural producers have often argued that they are expected by society to privately absorb the cost for the conservation of a public good, i.e. wildlife species and habitat, at the expense of losses to crop depredation or lost opportunity costs. Faced with economic pressures and taxation policies that have traditionally favoured land conversion to achieve economic production objectives, there have in the past been few incentives for landowners to maintain wildlife habitats.

The advances in mechanization, genetics, nutrient science and irrigation that contributed to increases in agricultural productivity have also led to reductions in wildlife habitat and have contributed to serious soil and water erosion problems. Neave *et al.* (2000) stress that the availability of wildlife habitat in agricultural landscapes is a function of many factors including changes in agricultural land use resulting from changes in world market demands and domestic policies, crop prices, availability of new crop varieties, new technology, and the growing use of conservation farming techniques. Farmers have adapted their cropping practices to include methods such as conservation tillage and precision farming. In the Prairie Ecozone, lands under conventional tillage declined by 22% between 1991 and 1996 while lands under conservation tillage increased by 20% (Statistics Canada 1996). The reduction in area under summerfallow and the expansion of tame or seeded pasture between 1981 and 1996 has increased the availability of habitat for some species (Neave *et al.* 2000). Changes in policies are occurring that recognize the ecological value of lands and encourage land owners to conserve wildlife habitat, for example, through stewardship agreements, conservation easement legislation, and programs such as the North American Waterfowl Management Plan and PFRA's

Permanent Cover Program (Agriculture and Agri-Food Canada 1997, Reimer 1993).

Mineral Production

Mining, particularly the production of fuels, is the second most important industry on the prairies. The Prairie ecozone contains vast amounts of a wide range of non-renewable resources including oil, natural gas, potash, coal, sodium sulphate and clay products. Alberta and Saskatchewan are Canada's two largest producers of oil and Saskatchewan is the world's single largest producer of potash, accounting for 40% of the world's trade. There are currently 14,000 active oil wells in the prairie ecozone and over 7,000 active gas wells.

Mineral and fossil fuel exploitation and other goods and services generate \$15 billion annually. Although the value of mineral production increased in both Saskatchewan and Alberta between 1976 and 1991, land use for oil production has declined over the past decade, reflecting changes in world prices and incentives for exploration and development. By 1991, the value of mineral production in the Alberta portion of the ecozone made up 46% of Canada's total mineral activity.

Service Industries

The service-based sectors have assumed increasing importance in the Prairie economy, servicing primary and secondary industries that are geared mainly at processing food, wood, metals, chemicals, and petrochemicals. This ecozone has a higher proportion of its labour force in secondary industries than the national average, reflecting the importance of its major urban centres in serving national and international markets. It also reflects the value-added opportunities related to the region's resource base through agricultural processing, petroleum products, and

complementary industries such as agricultural implements, pipeline products, and petroleum industry hardware.

Forestry and Fishing

Forested lands in the Prairie Ecozone are scattered, occurring in gullies, ravines and areas of higher elevation. Generally the use of such forests has been for recreation or as a source of fuel wood. There is relatively limited commercial fishing activity in this zone. Commercial aquaculture, gill netting and harvesting of brine shrimp, minnows and leeches occur on selected prairie lakes. There are several private trout hatcheries. The prairie ecozone is a popular destination for some anglers. In Saskatchewan it provides for almost half of all recreational fishing. Twenty-two percent of the trapping harvest for Saskatchewan occurs from this ecozone as well as over half of the provincial total of hunting of big game and more than 80% of the hunting for bird species.

Impacts

The human impacts on the Prairie Ecozone can be characterized by:

- Substantial habitat alteration resulting from wide-spread monoculture crop production to meet human food needs.
- The impacts from urban and industrial development both within and external to grasslands, ranging from localized pollution from wastes, pesticides and chemical pollution to long-term impacts resulting from global climate change.
- The loss of the ecological effects of many of the native grazers such as bison and their native predators
- The loss of the ecological role of fire in sustaining prairie grasslands.
- The impacts of introduced species, including the use of non-native plant

species as forage to improve cattle productivity, and genetically modified crops.

Wildlife conservation therefore needs to be framed within quite a different ecological reality than was in place 150 years ago on the prairies. Over that time period the Prairie ecozone has undergone development by natural resource industries, largely agriculture, but also oil and gas extraction and refining, hydroelectric power generation, and mining. Major environmental issues for the prairies include the loss of habitat and wildlife, urban sprawl, climate change and variability, streamflow regulation, floods and droughts, and degradation of land, air, and water quality. More recent issues that have emerged include the inadvertent introduction of foreign species and impacts on riparian systems or riverside vegetation and the impacts of genetically modified crop organisms. Some 90 per cent of the rough fescue grassland in Canada has been ploughed, and much of the remaining 10 per cent has been significantly modified by livestock grazing and haying. Almost all of the tall-grass prairie is gone. Less than 20% of the once-abundant short-grass prairie remains in its native state, about one-quarter of the mixed grass prairie and aspen parkland. Approximately 50% of the original wetlands have been converted to agricultural use.

Most of the water systems in the ecozone have been modified and developed. Reservoirs have been constructed on virtually every major river system to supply water, prevent flooding, and generate power. Eutrophication is possibly the single most important issue concerning water quality in the Prairies ecozone. Most Prairie surface waters experience some degree of natural eutrophication. However, nutrient amounts are augmented by point source pollution, such as municipal sewage from urban areas

and industries. Nutrients also come from non-point sources, chiefly associated with agriculture, such as runoff from fertilized lands and livestock (cattle and hog) feedlots. As a result, the most significant causes of water degradation in the ecozone are urban sewage and runoff from fertilized agricultural lands.

Temperature increases in the Prairies ecozone have exceeded the overall global rise, particularly in the past 15 years. Some climate forecasts predict as much as 5–7°C rise in annual surface temperature for the Prairie provinces over the next 50 years, causing greater and longer shortages in water supplies (Brklacich *et al.* 1998). Wheaton and Arthur (1989) have reported on the substantial economic and social costs associated with the last major drought episode in the 1980's. Those authors noted that:

- during the severe droughts of 1936 and 1937, there were significant reductions in agricultural output in Saskatchewan (39%) and Manitoba (18%).
- agricultural losses from the drought of 1988 amounted to \$1.8 billion, with a decline in production of major grain crops by 29% from 1987 levels and a 40% decline in specialty crops.
- in 1988, there was a decline in grain transportation of 41% that affected between 600 to 900 employees.
- the cost of water-related services to mitigate the drought in Saskatchewan and Manitoba in 1988 was over \$14 million.
- Manitoba Hydro lost over \$26 million in net income as a result of the 1988 drought because of the need to purchase fossil fuels to meet the energy demands of consumers.
- as a result of the 1988 drought, there was a 50% decline in wetland area with a 16% decrease in duck populations and an increase in waterfowl disease that

resulted in \$5 million in hunting revenue losses.

These types of losses and costs have a direct, significant economic impact upon land use decisions. However, costs associated with the loss or decline of a particular wildlife species or habitat or the value of ecological services provided in a region are often more difficult to quantify in terms that are as readily understandable or acceptable to people. Thus, those species, habitat or ecological values are often discounted and political decision-making tends to focus more on issues of economic productivity than on issues of wildlife conservation.

CONCLUDING COMMENTS

In general, conservation is a difficult concept on which to reach agreement in society, and more difficult to action in a broad sense.

People in prairie rural communities struggle with concerns over issues such as rural health care, renewal of rural road infrastructure, off-farm employment opportunities, drought, transportation costs, fuel prices, isolation, depopulation, taxation rates, farm safety, impacts of global subsidies on commodity prices, high volatility in relation to future economic security, education opportunities for their children, care of the aged, factors affecting the social cohesion of their communities, and many other issues. The conservation of wildlife species and habitat is only one factor among many that are often regarded as having higher priority.

There are also other factors that work against ease of implementation of conservation programs. In such areas as the boreal forest, or arctic tundra, government is the largest land holder. In the prairies it is a very different story. Approximately one third of all the private land in Canada is found in the prairies. On a regional scale it is certainly

one of the most “owned” landscapes in Canada, and so conservation programs must deal with a multiplicity of owners. The pattern of settlement and ownership on the prairies has been positive in some respects, in that the stewardship provided by several generations of ranchers and livestock producers has helped to preserve the native prairie, as much as is found intact at this time. It also means that implementing conservation programs in the prairies requires working with a large number of private owners, lessees, rural and urban municipalities, the provincial and federal governments, and a host of interest groups in an atmosphere of scarcity and uncertainty (Gauthier 1994). The experiences of organizations such as PFRA, Wildlife Habitat Canada, Ducks Unlimited, Saskatchewan Wetland Conservation Corporation, Manitoba Habitat Heritage Corporation, Nature Conservancy of Canada, Canadian Council on Ecological Areas and others strongly suggest that agricultural producers must be active partners with conservation organizations in developing and promoting habitat and species conservation programs. However, the wide variety of conservation programs and organizations can appear disconnected to people outside of those programs and organizations and seem unrelated to their immediate concerns. In that sense conservation organizations in the prairies could benefit from more coordinated approaches to wildlife and habitat conservation. Examples of coordinated approaches include the Prairie Conservation Action Plans of the Prairie Provinces (Manitoba Natural Resources 1998, PCAP 1998, Prairie Conservation Forum 1997), Ducks Unlimited’s habitat management programs, NAWMP, and Wildlife Habitat Canada’s Countryside Canada program. Those initiatives include the development of partnerships with local interests that focus

on common objectives and sharing of resources.

Addressing wildlife and habitat conservation issues in the Prairie ecozone of Canada requires the combined skills of biologists, ecologists, agronomists, political scientists, economists, climatologists, sociologists, philosophers and other disciplinary experts. They require dialogue with decision-makers in industry, business, government and First Nations. They require dialogue with landowners and land users. Thus while the study of the biology and ecology of species such as the Swift Fox belongs in the capable hands of biologists, the future of those species and their habitats is dependent upon a much larger partnership of interests. A sufficient number of people need to share a common understanding of the biology of prairie species, the status of wildlife habitat, the ecology of prairie systems, the role of people in affecting those systems, and the impact of conservation programs in meeting human needs and wants. Management that stresses the need to ‘think, plan and act’ in terms of ecosystems (Wiken *et al.* 1996) necessarily involves transdisciplinary approaches². Species re-introductions and restoration programs are one part of biodiversity conservation, which is one of many necessary components to ecosystem management. Transdisciplinary, ecosystem-based studies that integrate socio-economic and biophysical research should be an important approach utilized by conservation biologists. The challenge of a sustainable approach will be for producers, consumers, and society as a whole to balance resource production requirements with the need to conserve the land, water, and overall ecological integrity of the Prairie ecozone. This is an important concern given the

² Such an approach is implicit in Licht’s (1997) call for increased cooperation among the U.S. and Canada to develop international grassland reserves.

history of past impacts of human activities in this ecozone.

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Table 1. Area and distribution of ecoregions in the Prairie Ecozone, Canada.

Ecoregion	Alberta km ² (%)	Saskatchewan km ² (%)	Manitoba km ² (%)	Prairie Ecozone Total km ² (%)
Aspen Parkland	58,638.4 (33.5%)	81,514.5 (46.6%)	34,667.4 (19.8%)	174,820.3 (37.1%)
Fescue Grassland	15,948.8 (100%)	Nil	Nil	15,948.8 (3.4%)
Moist Mixed Grassland	31,402 (31.6%)	67,836.6 (68.4%)	Nil	99,238.6 (21.1%)
Mixed Grassland	47,715.1 (35.6%)	86,444.3 (64.4%)	Nil	134,159.4 (28.5%)
Cypress Upland	3,265.7 (39.4%)	5,022.1 (60.6%)	Nil	8,287.8 (1.8%)
Lake Manitoba Plain	Nil	Nil	36,905.4 (100%)	36,905.4 (21.1%)
Southwest Manitoba Upland	Nil	Nil	1,462.6 (100%)	1,462.6 (0.3%)
Total	156,970.1	240,817.6	73,035.4	470,823

Table 2. Cropland and improved and unimproved land for pasture, grazing and hay, Prairie Ecozone of Canada.

Region	Land in Crops (ha) 1996	Improved Land for Pasture, Grazing (ha) 1996	Unimproved Land for Pasture, Grazing, Hay (ha) 1996
Alberta	6,894,942	1,268,064	5,183,947
Saskatchewan	14,398,651	1,233,307	5,093,601
Manitoba	4,378,025	316,535	1,454,088
Prairie Ecozone	25,671,618	2,817,906	11,731,636
Change between 1991 and 1996	+1,127,921 (+1.4%)	+285,874 (+3%)	-563,643 (-6%)

Source: Statistics Canada (1996).

Table 3. Estimates of Rangeland in the Prairie Ecozone of Canada.

Rangeland, Grazing Lands	SAMA 1987 Saskatchewan	Satellite Data 1989 Prairie Ecozone	Agriculture Census 1996 Prairie Ecozone	Statistics Canada Census 1996 Prairie Ecozone
Improved	1.8%	-	5.2%	~6%
Unimproved	24.5%	-	21.1%	~25%
Total	26.3%	24.4%	26.3%	~31%

Sources:

SAMA: Saskatchewan Assessment Management Agency (1998).

1989 Satellite Data: Manitoba Centre for Remote Sensing (1989).

1996 Agriculture Census Prairie Ecozone: Statistics Canada (1996).

1996 Statistics Canada Census: Statistics Canada (1997).

Table 4. Farm holdings, Prairie Ecozone of Canada.

Region	Total Number of Farms 1996	Total Area of Farms (ha) 1996	Number of Individual or Family Holdings 1996	Corporation (family or non- family) Holdings 1996
Alberta	40,368	15,278,434	24,155	4,867
Saskatchewan	56,995	26,569,061	40,418	4,189
Manitoba	22,249	7,045,573	13,887	1,956
Prairie Ecozone	119,612	48,893,068	78,460	11,012
Change between 1991 and 1996	-2,727 (-2.2%)	-225,678 (-0.5%)	-5,793 (-6.9%)	+10,067 (+1,065%)

Sources: Statistics Canada (1991a, 1991b, 1991c, 1996, 1997).

ECTOPARASITES ASSOCIATED WITH BIRDS AT RISK IN CANADIAN PRAIRIE HABITATS

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Abstract: With the continued degradation, fragmentation and destruction of natural prairie habitats in Canada, there is an increasing number of species of birds for which continued survival is in jeopardy. Although considerable attention has been drawn to these species, for example by their identification and analysis of the status of their populations in the list published by the Committee on the Status of Endangered Wildlife in Canada, little consideration has been given to their parasites. Our knowledge of the ectoparasites is sadly lacking, and it is entirely possible that species of birds may disappear without many of the ectoparasites having been recorded. For example, the greater prairie chicken is known to harbour two species of chewing lice, *Amyrsidea perdicis* (Denny, 1842) and *Goniodes cupido* Rudow, 1870. Only the latter of these was ever recorded from this host in Canada. Considering that the greater prairie chicken hasn't been reported here since 1987, it may be safe to say that we will never know more about these lice on this host. The status of ectoparasites known to occur on listed prairie birds in Canada will be reviewed and assessed. These ectoparasites may play an important role in the long-term fitness and evolution of host populations. Under certain circumstances, wildlife managers should consider preservation of ectoparasite populations as well as those of their hosts, and evaluate the potential for introducing parasites into re-established host populations.

DETERMINING EFFECTIVE ASPEN MANAGEMENT STRATEGIES FOR ENHANCING BIODIVERSITY IN MANITOBA'S INTERLAKE

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Abstract: Aspen encroachment into land areas historically found as grass or shrub cover types has altered the habitat constitution of much of Manitoba's Interlake, particularly on Wildlife Management Areas. This land base historically supported populations of sharp-tailed grouse and other wildlife, many of which appear to be redistributed to other areas of the region. The diversity of the aspen parkland communities within the Interlake has been altered, possibly to the detriment of humans and wildlife. The need for a cost-effective and biologically efficient management strategy for this dynamic area has been identified by various agencies. This paper will report on the initial phases of a project designed to provide answers to the aspen management dilemma. Five aspen treatment options, including rolling, bark scraping, herbiciding, fire, and flecco-chopping, are being investigated as primary and/or secondary methods for effectively controlling aspen encroachment. Preliminary results will be presented which compare effects of treatments to control areas and to each other. A draft management strategy will be discussed.

INTRODUCTION

Fire was historically a natural ecological disturbance that frequently swept the Canadian prairie region (Strauss 1994). As well, 30 to 75 million plains bison (*Bison bison bison*) used to roam the prairie region. These herds were drawn to the young

grasses and trembling aspen (*Populus tremuloides*) shoots found in these recently burned areas (Strauss 1994). The combination of these two processes, fire events and foraging of aspen shoots, restricted aspen from spreading. However, the demise of the bison population and decreased frequency of fire events as well as

fire suppression, resulted in aspen woodlands gradually taking over the landscape through successional processes.

This forestation event has been occurring throughout the aspen parkland, which includes the Manitoba Interlake region. It is hypothesized, that in the past, the Manitoba Interlake had a mixture of 1/3 grassland, 1/3 shrub land, and 1/3 woodland (primarily aspen) (Sexton 2000). The intertwining, mosaic structure of these three habitat types likely provided the optimal habitat diversity for Sharp-tailed Grouse (*Tympanuchus phasianellus*). However, due to fire suppression and changes in land use and management, grassland areas, which are important sites for Sharp-Tailed Grouse dancing grounds, have significantly decreased. Some historic dancing grounds are no longer used due to aspen encroachment. Therefore, it appears that this landscape cannot be effectively managed by removing and suppressing all forms of disturbances.

OBJECTIVES

The purpose of this project is to identify in an experimental setting the most biologically and cost effective method to restrict aspen spread onto former grassland areas with limited aspen regeneration. The applied treatments include: burning, mowing, herbicide, and scraping. Upon completion of the project, the most effective treatment can then be selected and applied to enhance and increase Sharp-tailed Grouse habitat diversity throughout Manitoba's Interlake region.

STUDY SITE

The research site is located approximately 1.5 hours north of Winnipeg, Manitoba, just west of the town of Chatfield, in the

Narcisse Wildlife Management Area (NWMA). The NWMA is classified as an aspen parkland plant community, and covers almost 12,000 ha of land (Gylywoychuk 1993). Approximately 230 acres of established aspen woodland was rolled in June 1997. A bulldozer was used to pull the 8,000 lb drum roller. The blade was positioned just above the ground to minimize soil disturbance and still scrape the bark of the aspen trees. The scraped trees were immediately compressed by the roller.

The treated site was inspected in September 1998. The disturbance appeared to be only effective in killing 3-6 metre aspen, while younger aspen shoots were not greatly impacted. In addition, there was significant aspen suckering found throughout the treated site. This signified the need for further aspen treatment.

METHODS

The study site is located in the Narcisse Wildlife Management Area (NWMA) near Chatfield, Manitoba. Pre-treatment aspen and vegetation surveys were conducted on the burn sites. Four application treatments, prescribed burning, mowing, scraping, and herbicide, were applied during the spring of 2000. Control sites (where no treatments were applied) were also established. Each treatment and control was replicated three times. All treatment and control plots contain a sampling grid of 6 x 4, specifically 24 sampling sites represented by a 12-inch spike. Post treatment surveys include: enumerating woody aspen (where applicable), new aspen shoots, new aspen resprouts, and vegetation surveys utilizing the Daubenmire cover class method.

The health of aspen woody stems was also enumerated. Health of the aspen was a

qualitative observation to determine the impact the treatment had on the tree. It was then quantified using a scale from 1 through 5: 1 = largely unaffected by the treatment, 2 = lightly impacted, 3 = moderately impacted, 4 = heavily impacted, and 5 = dead. Health was not enumerated in the mowing site because everything was mowed down to 12 - 13 cm, or in the control because no treatment was applied.

PRELIMINARY DATA RESULTS

Each treatment induced a different response from aspen in the production of new shoots (*i.e.* shoots originating from the shallow roots) and resprouts (*i.e.* shoots growing from the treated woody stem). The smallest number of new shoots was found in the control plots (Figure 1). All four treatments resulted in a significantly higher production of new shoots than the control sites (Figure 1). The number of resprouts found in the control sites was also very low (Figure 2). Only prescribed burning resulted in fewer resprouts.

Fire appeared to cause aspen to produce the greatest number of new shoots (Figure 1). This was only the case if one included all three fire treatment plots in blocks A, B, and C. According to Dr. Caldwell (2000), the first prescribed burn, in Block C, appeared not to burn as hot as the other burn sites in blocks A and B, which were burned later in the afternoon.

Research has shown that low to medium intensity burns stimulate aspen suckering, while frequent low to medium intensity burns or a high intensity burn reduce aspen suckering (Quintilio *et al* 1991). Table 1 shows that block C has many more new shoots in the 10 to 20 cm and 20 to 30 cm ranges than either blocks A or B. Hence, it appears that block C did have a cooler burn,

resulting in more new shoots in the previously mentioned categories than blocks A or B. Therefore, if one considers only blocks A and B (representing treatments with intense burns), fewer new shoots were produced than for scraping or mowing, but not less than for herbicide.

All fire treatment plots had fewer resprouts than any other treatment, including the control (Figure 2). This was probably due to fire appearing to be more effective in killing aspen than any other treatment (Table 2). In other treatment sites, even if a tree was heavily impacted by the treatment, it could still produce resprouts. With an average health of 4.93 (*i.e.* 5.0 = dead), fire appeared to be significantly more effective in killing aspen woody stems than the other treatments, thus limiting the production of resprouts (Table 2).

The herbicide treatment also appeared to stimulate the production of new aspen shoots. However, it was less than any other treatment (Figure 1). Standing on the edge of a herbicide treatment plot (Block A), a definitive line could be observed where there were more new shoots in the treatment plot than in the buffer strip.

The number of resprouts in the herbicide treatment plots was clearly greater than the prescribed burning plots, but less than the mowing treatment, and similar to the scrape treatment (Figure 2). The average health of the aspen trees following herbicide treatment was the lowest of all treatments (Table 2). What has yet to be determined is if the difference in health between herbicide and scrape is statistically significant. It will be interesting to determine if these resprouts will still be alive when the August 2001 survey is conducted.

The primary function of scraping was to scrape the bark of the trees, thereby rendering them vulnerable to insects and disease. Scraping resulted in a somewhat similar number of new shoots as the mowing treatment, which was greater than the number of new shoots produced in the control and herbicide sites (Figure 1). The number of resprouts in the scraped plots was similar to the herbicide plots (Figure 2). The average health of scraped trees following treatment was slightly higher than the average for the herbicide treatment (Table 2).

The number of new shoots in the mowing treatment plots was slightly less than the scrape plots, but still significantly greater than for the herbicide plots (Figure 1). The height class distribution was quite similar to that of scrape plots, except for the 20 - 30 cm height class where mowing plots had significantly less new shoots than scrape plots.

Mowing resulted in the growth of a significant number of resprouts (Figure 2). There were many more resprouts found in the 5 - 10 cm height class through to the 30 - 50 cm height class than any other treatment. A large proportion of plants had one or two resprouts each.

In summary, preliminary data suggests that an intense fire using prescribed burning would be the most biologically effective treatment. Following the fire treatments, almost all of the aspen were killed. There were fewer resprouts in the fire sites than in any other treatment site, including the control sites. A biological benefit of prescribed burning is that some nutrients are recycled into the soil. Though there were significantly more new shoots in the burn

treatments than the herbicide treatments, there are some follow-up treatments that could be considered: another burn (as frequent burns reduce aspen suckering), grazing, or perhaps a combination of these two. However, another season of field data needs to be collected, and the data then needs to be further analyzed before final recommendations can be made.

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Table 1: Number of new shoots per height class for prescribed burning.

Number of New Shoots Per Height Class (cm)							
Block	<5	5 - 10	10 - 20	20 - 30	30 - 50	50 - 70	70 - 90
A	0	0	19	92	217	1	0
B	0	0	6	40	127	53	9
C	1	3	238	271	191	17	0

Table 2: Average health of woody aspen stems following treatment. Presented on a scale of 1 to 5; 1 = unaffected by treatment, 5 = dead.

Average Health of Treated Aspen	
Average Health For All Herbicide Blocks	3.5037
Average Health For Scrape Blocks	3.8972
Average Health For All Fire Blocks	4.9320

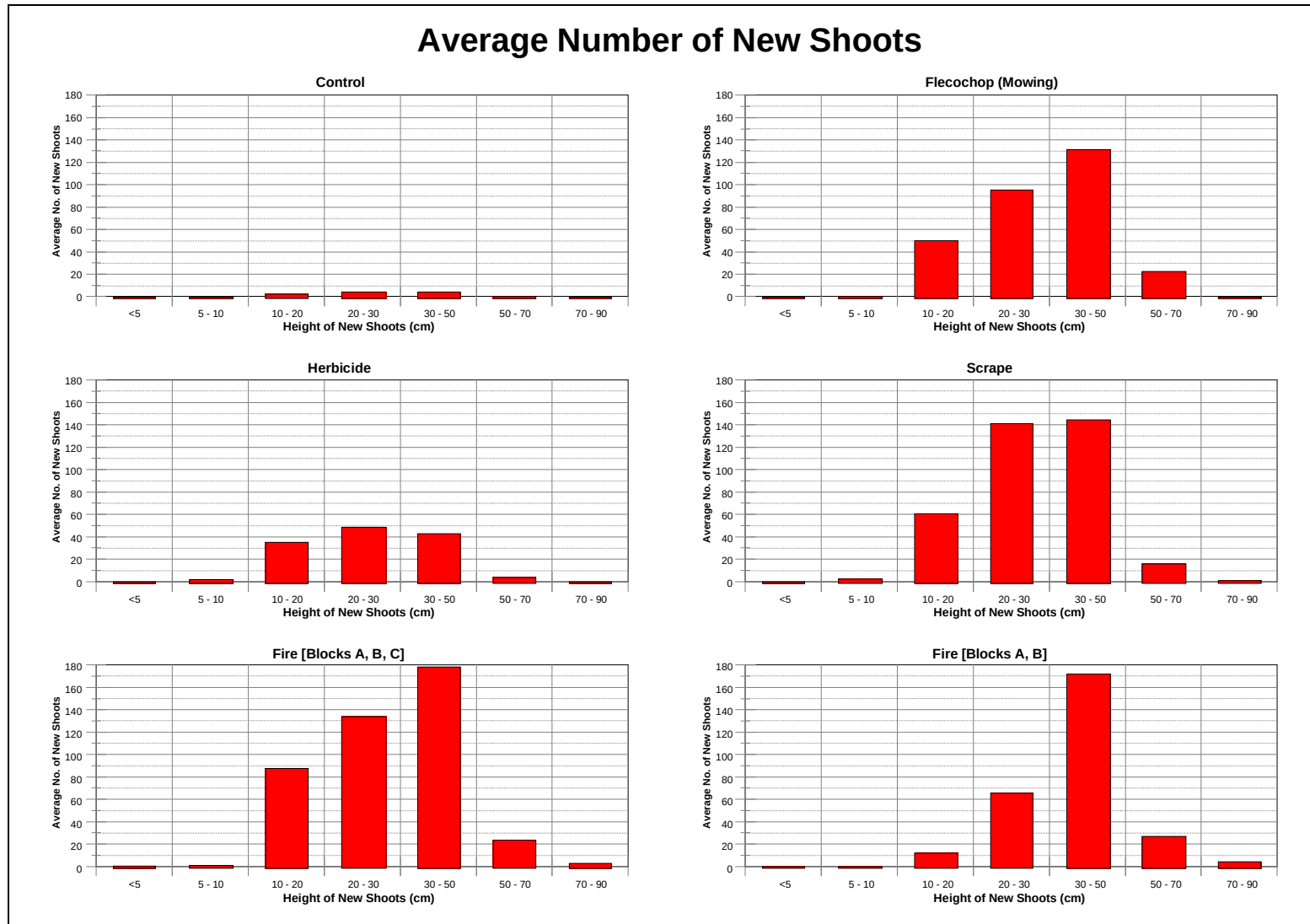


Figure 1: Average number of new shoots following treatment.

Average Number of Resprouts

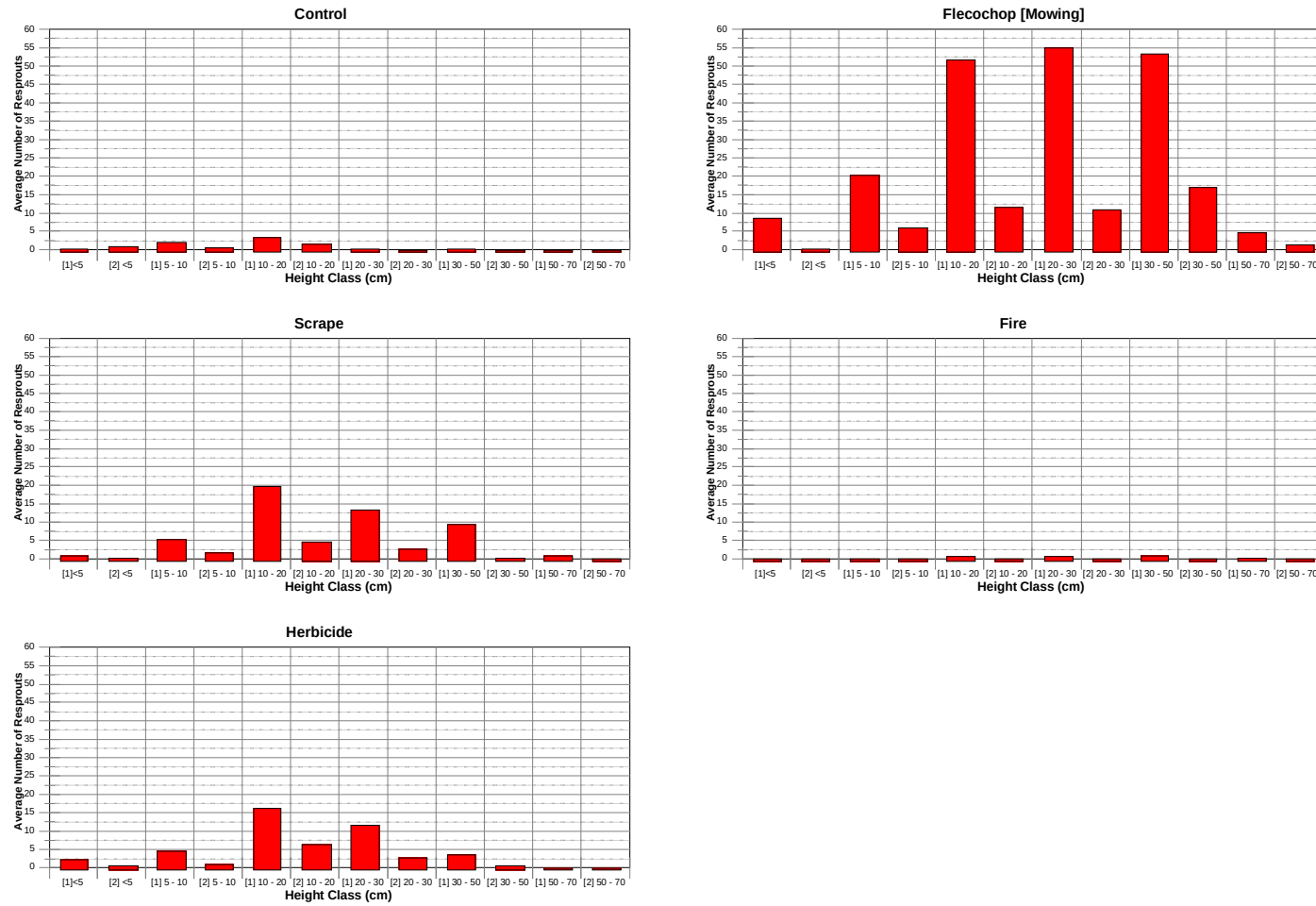


Figure 2: Average number of resprouts for each height class following treatment. The numbers 1 or 2 in parentheses on the x axis represent 1 or 2 resprouts per stem. Since the majority of resprouts were singles or in groups of two, only the first two classes for each height class are shown, for better visual presentation.

PARTNERS IN STEWARDSHIP: THE MANITOBA TALL GRASS PRAIRIE PRESERVE

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Abstract: The Manitoba Tall Grass Prairie Preserve is located in southeastern Manitoba approximately 110 kilometers from Winnipeg, blended into the aspen parkland ecoregion. This area contains Canada's largest intact stand of native tall grass prairie. This tall grass prairie site was unknown to the questing eyes of the prairie naturalists until the late 1980's. Almost immediately after its discovery the Manitoba Naturalists Society formed the Tall Grass Prairie Initiative, hired a prairie ecologist and began the process to determine the extent and quality of the prairie. Eventually other partners were recruited and the Critical Wildlife Habitat Program was formed. The Nature Conservancy of Canada officially joined the partnership as the "securement arm" in 1992. The preserve rapidly grew in size to over 5,000 acres and inventories revealed several endangered orchid species; the western prairie fringed orchid (*Platanthera praeclara*), the small white lady's slipper (*Cypripedium candidum*), Great Plain's lady's tresses (*Spiranthes magnificamporum*) as well as the threatened Dakota skipper (*Hesperia dacotae*). The need for management quickly became a high priority and the roles of the partnership were re-assessed. The Conservancy agreed to fulfill a larger role in managing the preserve and formed a partnership with The Nature Conservancy (U.S.) with management as the primary focus. Effective management is essential for the long-term survival of the preserve. The role of science in the development of management plans is discussed. Securing additional lands and the mechanism for securement is a topic under constant review. The techniques that have been used and those that are planned for the future are also described.

Tall-grass prairie once covered 6,000 square kilometers (1.5 million acres) in Manitoba. Conversion by agriculture and other human developments has all but eliminated this rare natural ecosystem. The very rich soils that underlay this diverse wild grassland lead to its demise. Except for a few small, scattered remnants it was believed to be all gone until the late 1980's. A group of botanists and

prairie enthusiasts from the Manitoba Naturalists Society (MNS) surveyed the southeastern part of the province and located several larger high quality prairie sites. The Tall-grass Prairie Conservation initiative was developed by the MNS and a prairie technician was hired to conduct inventories in the area developing a priority list according to quality. Endangered species

such as the western prairie fringed orchid (*Platanthera praeclara*), the small white lady's slipper (*Cypripedium candidum*), Great Plain's Lady's tresses (*Spiranthes magnificamporum*) as well as the threatened Dakota Skipper (*Hesperia dacotae*) were all found on the prairie sites. The MNS were able to secure several of the higher quality properties that contained several of the endangered species.

Interest continued to grow and a larger partnership was formed within the Critical Wildlife Habitat Program that was administered and housed in the offices of the Manitoba Department of Natural Resources. Members of this partnership included the MNS, Manitoba Department of Natural Resources, and Manitoba Habitat Heritage Corporation. World Wildlife Fund and Wildlife Habitat Canada. This partnership enabled the group to expand its efforts to include more intensive survey, additional securement as well as the development of signage and promotional materials. The establishment of a tall grass prairie preserve had begun.

Inventories had identified several other properties that would be suitable for inclusion into the preserve. Management of the existing holdings soon became a normal part of business. The partnership was enlarged to include the Canadian Wildlife Service and the Nature Conservancy of Canada (NCC). NCC became the securement arm of the partnership and the preserve rapidly grew in size. A local advisory committee (LAC) was established and its membership included local farmers, merchants and other members of the local community. The LAC provided important input to the initiative concerning both management and securement issues. The LAC also began an annual community event on the preserve, now known as the Manitoba

Tall Grass Prairie Preserve 'Prairie Day'. This event is held every 'second' Saturday of August and provides an opportunity for the community and all interested parties to enjoy an interpreted walk on the prairie as well as learn about activities on the preserve in a social atmosphere.

The partnership has evolved over time on the preserve with some changes in responsibilities. All of the original partners are still present of the membership list. Management on the preserve has now become a key element within the mandate of the Manitoba Tall Grass Prairie Preserve partnership. Conducting safe and effective prescribed burns has become one of the principal tools for the enhancement of the existing prairie and for the control of the invasion of both native and exotic species. Other forms of woody species control as well as developing appropriate grazing practices are also important mechanisms needed to insure the survival of these extremely rare native prairie communities.

Partnerships have been established with both the agricultural and academic communities to conduct research and establish evaluation techniques of ongoing and proposed management systems. Graduate students have performed research on the insect communities of the preserve as well as interrelationships between insect and the plant communities. Current and proposed studies include a project concerning pollinators of the western prairie fringed orchid as well as monitoring gas production from grazing livestock.

NCC has agreed to assume a much larger role in the management of the preserve and has also recruited as additional partner. Most recently, The Nature Conservancy (U.S.) has agreed to assist with staff and equipment in the completion of prescribed

burns, one of the most labour intensive activities on the preserve.

In the future it is expected that the partnership will continue to evolve as new challenges are addressed. New discoveries will uncover new species as well as a better understanding of this dynamic and productive ecosystem. The main ingredients that will continue to cement the partnership and lead to its long-term success is the common goal of all the partners. The survival of one of Canada's most endangered ecosystems for future generations.

CONSERVATION AGREEMENTS - A NEW HABITAT TOOL FOR MANITOBA

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Abstract: The Manitoba Government recently passed the Conservation Agreement Act to offer landowners and conservation groups a new way to voluntarily protect plants, animals and their habitats on private land. The primary steps in securing habitat using a conservation agreement are highlighted, including the administrative procedures for placing notice of an agreement (caveat) on the title and for issuing a tax receipt in cases where the conservation interest is donated. Among the habitats that may be secured by conservation agreements are: grasslands, wetlands, woodlands and riparian zones. The main attributes of a conservation agreement are:

1. the land stays in private ownership,
2. landowners can set conditions for future use of their land and,
3. a notice (caveat) is recorded on the title to alert all future owners of the conservation agreement therefore natural values remain protected even if the land changes hands.

Conservation agreements should be looked upon as a long-term habitat conservation option. Landowners now have a tool to sustain our rich natural heritage beyond their term of ownership.

SASKATCHEWAN BURROWING OWL INTERPRETIVE CENTRE; RAISING AWARENESS ON THE PRAIRIES

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Abstract: The Saskatchewan Burrowing Owl Interpretive Centre is a non-profit organization, based out of the Moose Jaw Exhibition, with the foci of Education, Eco-Tourism, Conservation and Stewardship. Through the delivery of Owls On Tour, a unique and highly interactive outreach program, nearly 9,000 people in the year 2000 were made aware of the need for conservation of short grass native prairie. The history and layout of the Centre as well as an overview of Owls On Tour is discussed.

HISTORY

The Saskatchewan Burrowing Owl Interpretive Centre (SBOIC) was opened in 1996 through a partnership between the Moose Jaw Exhibition Company Ltd., Saskatchewan Environment and Resource Management, and Nature Saskatchewan. It was determined that the best location for the SBOIC was a half of a Quonset and an adjacent acre lot adjacent on the Moose Jaw Exhibition Grounds. This site was selected so that summer visitors to the SBOIC would have the opportunity to view wild owls that inhabited the infield of the Exhibition's racetrack.

The goal of the founding partners was to provide a seasonal eco-tourism opportunity that would increase awareness of the decline of the burrowing owl population as well as to promote the conservation of the habitat the owl depends on, native short grass prairie. The period from 1996 to 1998 saw an increase in numbers of visitors to the SBOIC as well as the number of classes that toured the Centre during the late spring and early fall.

In 1999 and 2000 advancements were made to expand by providing year round programming for visitors to the SBOIC and expand our environmental outreach program dubbed Owls On Tour. It was during this time that the newly hired full time director oversaw the following enhancements: the SBOIC was winterized, facilities were built to house 12 non-releasable owls, addition of a second imprinted owl used in programming, addition of an injured ferruginous hawk, the acre of land the SBOIC surrounding the SBOIC was reclaimed to native prairie and through a partnership with Saskatchewan Wetland Conservation Corporation (SWCC) a new pathway through the prairie was installed.

LAYOUT

The SBOIC is _ a Quonset on an acre of recently restored native prairie. Attached to the SBOIC is a summer facility that houses our 12 non-releasable owls. This cage system (96' x 12' x 30') was constructed through partnership with the Western Economic Diversification Fund as well as over 1,000 volunteer hours.

Inside the SBOIC's Quonset are displays highlighting research, natural history, range and conservation efforts. As well there is a giant burrow that provides an opportunity for children of all ages to explore what it would be like to live underground.

PROGRAM

When a school or other youth group receives a program from the staff of the SBOIC, either in-house or during Owls On Tour, the children learn through participation. During the hour program children sing songs, play

games, participate in skits and discuss the natural history and the conservation needs of burrowing owls. At the conclusion of the presentation a live imprinted burrowing owl is introduced to the children and the students have the opportunity to pet the owl.

We also visit natural history societies, senior citizen homes and other guest speaking opportunities. The presentation we offer for an adult audience is one of slides, stories and the opportunity to meet Luna or Scamper our imprinted owls.

EDUCATION & ECO-TOURISM

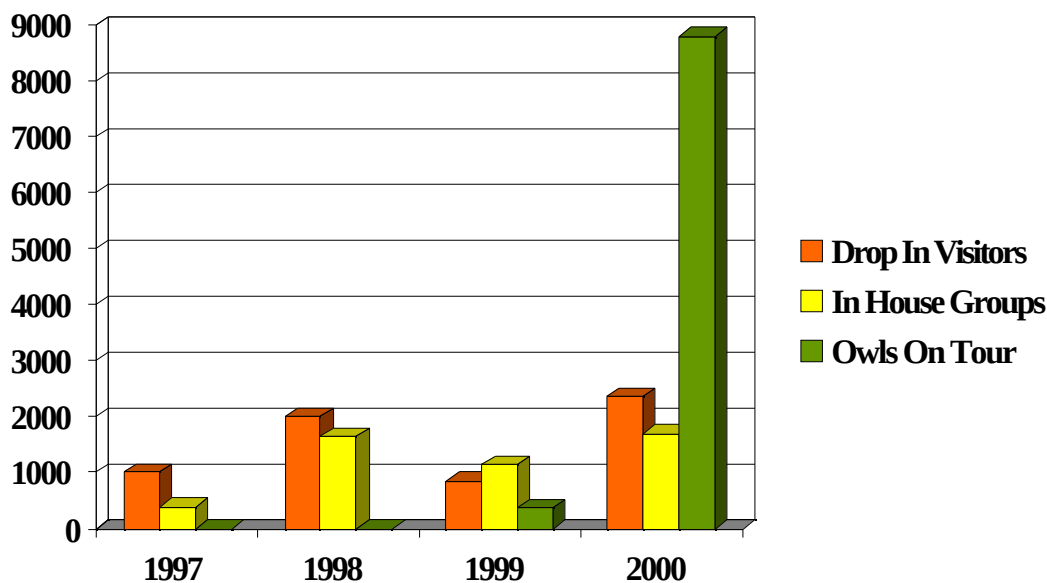


Fig. 1 In the early years of the SBOIC most of the audience for the conservation message came from drop in visitors, tourists to the Centre as well as local school groups who visited the Centre. Recently, we have focused on providing programming outside of the SBOIC during the non-peak tourist season.

When speaking to groups of children and adult alike, it has been a shock to find out how few people know what short grass native prairie is or that it is a vital component to the ecosystem, which supports the wildlife of this province, including the

burrowing owl. Throughout the history of the SBOIC drop in visitors to the SBOIC learn about the owls and native prairie, however most of the visitors to the SBOIC are out of province. It became very important to us to become more involved in

raising awareness of conservation issues with the people of this province. To do this Owls On Tour was created.

OWLS ON TOUR

In 1999 the SBOIC was invited by Grasslands National Park (GNP) to become part of a week of conservation outreach, The Travelling Road Show. The Road Show brought conservation groups (GNP, Prairie Conservation Action Plan, SWCC, SBOIC) together to deliver a fun morning of activities to schools in southwest Saskatchewan. The SBOIC provided a staff member to offer our program to all of the schools visited. At every school the message was the same... teachers expressed how happy they were to receive in-school programming at an affordable price, as many schools cannot afford out of town trips to visit places like GNP and SBOIC. After returning from the Road Show the SBOIC began to investigate how to take their message on the road.

To ensure that Owls On Tour was affordable to the schools funding was obtained from SaskEnergy, Wildlife Preservation Trust Canada, and Village Ford Lincoln in Moose Jaw provided a vehicle. After the finances were secured an interview on CBC radio in August resulted in a flood of calls and more schools contacted us than we could visit. Owls On Tour was on the road for most of two months in 2000. Communities from Shellbrook to Estevan and Monmartre to Marengo participated in the program.

In the early part of 2001 the SBOIC, along with SWCC, GNP, Ducks Unlimited and Nature Conservancy of Canada, was part of the newly renovated Traveling Road Show that was organized through the Prairie Conservation Action Plan.

Through the support of Village Ford Lincoln, Wildlife Preservation Trust, SaskEnergy and Canadian Wildlife Service: through their Habitat Stewardship Fund Owls On Tour is being expanded and will be offered throughout 2001.

FOR MORE INFORMATION

To obtain a copy of the songs, skits and stories we use during our programs OR to find out more information about the SBOIC please use the following contact information.

Saskatchewan Burrowing Owl Interpretive Centre
250 Thatcher Drive East
Moose Jaw, SK S6J 1L7
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phone: 306-692-8710
fax: 306-692-2762

THANKS

Our thanks to our associates and sponsors who aide us as we provide a unique and memorable conservation message to those visiting the SBOIC as well as those we meet during Owls On Tour: Canadian Council for Human Resources in the Environment Industry; Canadian Wildlife Service; Chaplin Nature Centre; City of Moose Jaw; Human Resource Development Canada; Moose Jaw Exhibition Company; Nature Conservancy of Canada; Nature Moose Jaw; Nature Saskatchewan, Operation Grassland Community; Prairie Conservation Action Plan; Regina Natural History Society; Royal Saskatchewan Museum; Saskatchewan Environment and Resource Management; Saskatchewan Wetland Conservation Corporation; Saskatchewan Wildlife Association; SaskEnergy; Shell Canada; South Saskatchewan Wildlife Federation; The Owl Foundation; University of Regina;

University of Saskatchewan; Village Ford
Lincoln; Wildlife Habitat Canada; Wildlife
Preservation Trust Canada.

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Company, Prairie Conservation Action
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Corporation and Wildlife Preservation Trust
Canada.*

THE LITTLE SASKATCHEWAN RIVER: A WATERSHED APPROACH TO DEAL WITH WATER QUALITY AND FISH HABITAT ISSUES

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Abstract: The Little Saskatchewan River is located in southwestern Manitoba. The headwaters originate in Riding Mountain National Park and the river flows southward approximately 140 kilometres before joining the Assiniboine River five kilometres west of Brandon. From 1992 to 1998, Manitoba Fisheries Branch coordinated and funded 20 enhancement projects along the river. Various watershed stakeholder associations in cooperation with landowners spearheaded the project work. Project objectives have included:

- Reducing nutrient and sediment loading into the river along stream bank areas impacted by livestock.
- Showcasing a variety of mitigation techniques that protect water quality and valuable fish and wildlife habitat.
- Installation of fishways at barriers to fish movement.

In 1996, the Little Saskatchewan River Stakeholder Committee was formed. The committee included representatives of fish and game associations, lake enhancement associations, landowners, and municipalities within the watershed as well as governmental agencies. A watershed plan was introduced and initiated.

PROGRESS AND PROSPECTS FOR PRAIRIE CONSERVATION IN ALBERTA

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Abstract: Alberta is embarking on a third iteration of the enduring Prairie Conservation Action Plan (PCAP). The latest PCAP results from a tweaking of its predecessor, rather than a wholesale reworking. Landscape integrity is being affected by urban expansion, intensive agriculture and a burgeoning resource industry sector. Strategic priorities of the Prairie Conservation Forum over the next five years include: documenting and quantifying changes taking place; better understanding the implications of change over time; and promoting a better understanding of the implications of landscape integrity inputs amongst the public and decision-makers. Key changes in the emphasis of the PCAP, key accomplishments during the 1996-2000 plan, and key current initiatives will be briefly reviewed.

INTRODUCTION

An update on the status of the Prairie Conservation Action Plan (PCAP) in Alberta has been provided at every conference since Regina (1989). At the last conference in Saskatoon (1988) a report was given on the 'new' Alberta PCAP, 1996-2000 and on various activities of the Prairie Conservation Forum (PCF). 'New' of course, doesn't age well and that document has now been retired and is in the process of being superseded. This update highlights major changes of emphasis in the latest PCAP, notable PCF happenings, key current initiatives and concludes with some observations regarding future prospects and challenges.

ALBERTA PCAP, 2001-2005

Welcome to the next, next, generation; yes, we are on our third generation PCAP in Alberta!

The 1996-2000 PCAP was crafted as a three-tier document with four broad goals addressing information and research, government policy, landscape management and public awareness. The goals were supported by subsumed objectives and nested under these were specific action recommendations.

In reviewing this framework and areas where progress had been made the PCF felt that the basic framework of the plan was sound. Numerous actions have been achieved, many were ongoing, some were stalled and new requirements have arisen. At the objective level some tweaking was needed, but all members felt the broad goals remained relevant. It was agreed that at the 10-year mark a 'root and branch' revision of the PCAP should be made, but that more of an administrative update was required after 5 years.

A PCF Work Group was struck to oversee the process of revision with smaller teams to address revisions to each goal. A first draft

was reviewed by the PCF in May 2000 and a second in September 2000. Following further revision formal feedback was sought from all PCF member organizations in the fall. A final version was reviewed and approved at the January 2001 meeting. In the last couple of weeks a Foreword has been provided by the Minister of Alberta Environment and efforts are currently underway to secure corporate sponsorship and proceed with printing.

- Major changes to the new PCAP include a new emphasis on: Addressing strategic issues especially urban expansion and acreage development, irrigation expansion and agricultural intensification, commodity extraction and introduced species.
- Completing baseline native vegetation inventory work in the aspen parkland and conducting a change analysis of native vegetation in the Grassland Natural Region.
- Development of landscape level cumulative effects tools, a new range health methodology, a “new generation” of regional strategies in integrated resource management, emphasis on deeded rangelands and a stronger reclamation/minimal footprint emphasis for industrial impacts.
- Targeting decision-makers at the municipal level as a priority for extension/awareness efforts.

PRAIRIE CONSERVATION FORUM ACTIVITIES

The PCF is now in its 13th year of existence. The committee has met three times annually throughout that period in rotating centres in

prairie and parkland Alberta. The forum currently has four dozen members representing a very wide spectrum of government and non-government, agricultural, environmental, industrial and academic organizations.

The Forum strives to keep administrative complexities to a minimum, focuses largely on information exchange, networking and relationship building, incorporates a strong field/applied component in two of its three annual meetings, and recognizes and respects differences in the wide spectrum of interests and values comprising the membership. The PCAP defines the focus and the boundaries of the PCF’s interest and effort is focused on initiatives that require the collaboration of multiple parties or actions that ‘fall between the cracks’ of work already being done. PCAP goals also exert significant influence on the priorities and work plans of the member organizations.

Since the last Prairie Conservation and Endangered Species Conference the PCF has convened in Brooks, Claresholm, Calgary, Elkwater, Lacombe, Lethbridge, Warner, Wainwright and Airdrie. Members have spent time on the ground at the Antelope Creek Ranch, at the Granum burn site in the Porcupine Hills, reviewing fire, encroachment and riparian research projects in the Cypress Hills, observing dinosaur egg excavation, a bison kill site and grazing reserve management on the Milk River Ridge, and assessing management strategies on the Wainwright Dunes Ecological Reserve and public land acquisition in the Battle River area.

A ‘Straight Talk’ feature has been introduced to PCF meetings allowing for candid discussion of topical issues following an informed presentation. Topics addressed

to date include control of predators and nuisance wildlife, management practices on a ranch on the Milk River, and conservation challenges in the aspen parkland.

The Forum has been quite active on the communications front, developing a writers' kit for a workshop in Waterton Park, printing pamphlets on the Forum and southern Alberta's Cottonwood Forests and developing background papers to help focus extension messaging on what is prairie, the value of prairie, and changes prairie is experiencing. A PCF display has also been produced, together with a grasslands poster.

A provocative paper challenging the way our society perceives the prairie and contrasting European and native peoples' world views is currently being printed as the third paper in the Forum's Occasional Papers series.

PCF PRIORITY INITIATIVES

Within the past year, the PCF has focused significant resources in four priority areas:

1. PCF web site:

www.albertapcf.ab.ca has been significantly reworked and expanded. There are an increasing number of high quality web based information sources pertaining to prairie conservation and the PCF wants to establish a presence and reputation for providing credible information in an Alberta context. The site allows surfers to pull off information about the Forum, our terms of reference, current initiatives and membership, the PCAP and other publications, including annual reports and the Occasional Papers. Additionally,

the site provides a guide to Environmentally Significant Areas reports in the Grassland and Parkland Natural Regions and allows querying the status of native vegetation in every quarter section of the entire one thousand township Grassland Natural Region. A start has also been made in building in various educational and awareness resources.

2. Prairie Conservation Course:

The course had its third offering in the Fall 2000 semester and continues to be well received. It has been upgraded from its 'occasional offering' status and will now appear in the university calendar. The course follows the broad information/policy/management/education themes of the PCAP itself, exposing students to information about prairie ecosystem management, the biotic and cultural environment, information sources, the role of governments, and management challenges associated with urban and industrial, rangeland, cropland and protected areas management. Full details are posted on the PCF website.

3. Provincial Grass:

Inspired by Saskatchewan's lead with Needle and Thread the PCF has made good progress toward identifying a provincial grass emblem for Alberta. A work group was struck, grants have been received, political support has been expressed, finalists identified, a brochure developed and balloting is

underway. Full details are on the PCF website. The finalists are blue gamma grass, green needle grass, june grass, rough fescue grass and western wheat grass. The grass species receiving the largest number of votes will be announced in May 2001 and steps will then be taken to have the candidate provincial grass introduced in the Alberta Legislature as a potential new emblem.

4. Cumulative Effects work:

In order to get a handle on where growth in multiple sectors is taking us and to prepare the ground for the PCF's strategic priorities of the next five years, a large steering and technical committee has been working to test the utility of a cumulative effects model, ALCES (A Landscape Cumulative Effects Simulator) in southern Alberta. Work is ongoing, but the model has been partially paramatized for two areas – the Grassland Natural Region and the Oldman River Basin and introductory PowerPoint presentations have been produced for both areas. Web-based presentations and applications are under development.

Key strategic priorities of the PCAP and PCF over the next five years include documenting and quantifying changes taking place on the prairie landscape, achieving a better understanding of the implications of change over time and promoting a better understanding of the implications of impacts on landscape integrity amongst decision-makers and the public. It is anticipated that ALCES will be a key tool in both the analysis and educational components of this

task and a 10-year change analysis of the Native Prairie Vegetation Baseline Inventory will provide hard data on what sectors are currently impacting remaining native prairie.

RECENT ACTIVITY HIGHLIGHTS

A good number of progressive prairie conservation efforts are underway in Alberta which PCF member organizations are leading or are involved in together. Following are some representative examples.

Minimizing the impact of oil and gas activity on native prairie: Five PCF member provincial agencies are collaborating to update an existing information letter providing direction to industry on how to minimize their 'footprint' on the landscape. The revision is substantive and will significantly 'raise the bar' in terms of performance expectations. Integrated direction will be provided on environmental planning, construction and operations for the seismic, drilling and production, pipelining and reclamation phases, providing guidance on site and route selection, terrain and soils, vegetation and wildlife, access management, scheduling, drainage crossings, handling materials and drilling fluids etc.

A companion extension document, modelled loosely on the successful 'Cows and Fish' Awareness document is also being produced. This will provide tools, tips and 'best management' advice to industry, regulators and land managers and landowners. This project is nearing completion.

Prairie Ecology Research Committee: One PCF work group is seeking to encourage research that leads to a better

understanding of prairie ecology and the improved management of resources, habitats and species occurring on the prairie landscape. The intent is to add a page to the PCF website that would include:

- A bibliographic page holding a reference database with uploading and downloading capacity;
- A page with research gaps in prairie ecology;
- A page for active research with capacity for uploading and downloading of project information; and
- The site would include links to other related prairie ecology websites and information databases as an added service to its users.

Alberta Fish and Game Association:

Operation Grassland Community has been active with landowner recruitment, public awareness, habitat enhancement and cooperative initiatives. In 2001/02, Operation Grassland Community will launch a new Conservation Toolbox to its program participants. This toolbox reflects new possibilities for private land stewardship, and will provide OGC members with much needed introductory information on important habitat conservation approaches, such as: conservation on-farm planning; conservation easements; landowner rights and responsibilities regarding oil and gas development and protection of endangered species and prairie habitat; best management practices for Burrowing Owl habitat. This information will be delivered to OGC members through written materials, on-site visits, and locally held workshops/community meetings. OGC will also be working directly with individual landowners to secure wildlife habitat through membership renewals, signing new members, preparing and assisting in the implementation of conservation on-farm

plans, and developing and signing conservation agreements.

Department of National Defense: CFB Suffield is hiring a Range Biologist and an oil and gas technician to more effectively address environmental and conservation issues and research and to effectively respond to increased levels of oil and gas activity on the base. A Kangaroo rat study is being conducted on the base.

Alberta Conservation Association: The ACA's Short-Tailed Grouse Habitat Program has approximately 300,000 acres under agreements. Three thousand acres of cropland are also being converted into tame pasture as a result of the program.

Ducks Unlimited: New records were set on the numbers of waterfowl migrating south in the fall of 2000 although the northern pintail population continues to decline. DU is promoting annual cropping programs such as fall seeding to winter wheat that are friendly to waterfowl.

FUTURE PROSPECTS AND CHALLENGES

As usual, there are both negative and positive omens and potents. On the negative side, the comforting thought that "maybe things are stabilizing and if only we can survive the ravages of the twentieth century, the twenty first will be a kinder, gentler, more enlightened place" was clearly wishful, foolish thinking. An irrigation district plans to put up to 12 sections of native prairie under the plow and irrigation to grown potatoes for one of southern Alberta's new 'secondary value-added processing' potatoe plants. A coal company plans to strip-mine another half township of native grass to fuel a coal-fired thermal generating station to help meet the current

energy shortfall in Alberta. Country residential properties are growing at 5% per annum as the urban affluent seek bucolic lifestyles. Currently the population of the Grasslands Natural Region is growing at a rate of 3% to 4% per annum. At these rates, the population of the region will grow from 1.6 million souls to 25 million in between 65(4%) and 90(3%) years. While Manitoba nurtures acres of native prairie, we're obliterating townships and sustaining the burgeoning growth of the Alberta Advantage will require unfettered access to depleting reserves of oil and gas on the prairie and in the foothills as well as the first bites into the phenomenal coal beds which underlie the prairie glacial till.

On the positive side of the ledger, millenniums are a fine time to question basic assumptions. The current energy crisis, farm crisis, pitched battles over ILOs, health concerns over sour gas and worries over climate change and environmental quality are creating a broad and growing willingness across all sectors of society to question what really matters. People are more willing to look at the interest of the whole – not just the parts, and to be open to non-ideological ways of exploring how true sustainability might be achieved. The level of commitment by those working in the prairie conservation field is strong, the base is broad, our tools and information are getting better and the number of people being influenced is growing. There are several new non game biologists working in the Grassland and Parkland as a result of program enhancements and a political commitment to address endangered species issues effectively.

CUMULATIVE EFFECTS IN THE GRASSLANDS NATURAL REGION OF ALBERTA - SUMMARY OVERVIEW

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Abstract: Most cumulative effects work has focused on specific projects subject to Environmental Assessment requirements. Yet cumulative effects tools can be invaluable in identifying strategic-level environmental and industrial problems at a landscape level. The prairie biome has been extensively reshaped by human land use practices. Human population, settlement and infrastructure, recreational use, the agricultural sector and the oil and gas sector are all growing. All have consumptive requirements on a finite land base and are transforming the landscape.

PURPOSE

The purpose of the initiative was to test the utility of a cumulative effects model, ALCES (A Landscape Cumulative Effects Simulator) in a complex landscape that has experienced significant transformation. The model has been developed by Dr. Brad Stelfox of Forem Technologies (www.foremtech.com). Previously this model had been used on a pilot basis in the ALPAC FMA area. There was a desire to

test the robustness of ALCES in a wide range of Alberta landscapes. There are also a host of issues concerning environmental quality and human pressures on a finite resource base in southern Alberta and various planning and partnership initiatives underway or planned. Governments are under increasing pressure to address cumulative effects issues effectively, and ALCES appeared to hold potential as ‘another tool in the tool box’ that may have educational, strategic forecasting, planning and applied management applications.

‘ALCES is a fast user-friendly landscape simulator that enables resource managers, society, and the scientific community to explore and quantify dynamic landscapes subjected to single or multiple human land use practices and various natural disturbance regimes (such as fire). ALCES assists resource managers in identifying strategic-level environmental and industrial problems associated with landscape sustainability and in discovering mitigation strategies for issues related to flows of natural resources. ALCES can be run for relatively small landscapes (for example, a quarter-section) or for large regional landscapes of millions of hectares’ (Stelfox unpubl.).

Although cumulative effects work has largely focused on regulatory (project specific Environmental Assessments), it is inherently suited to deployment on a landscape basis. The innovative and attractive attributes of ALCES are:

- that it focuses attention strategically, i.e., on the system as a whole;
- that it deals with the interactions of the full suite of human activities/demands on both landscape and each other;
- that it deals with the temporal dimensions; and
- that assumptions regarding growth trajectories for various resources uses can be changed, allowing assessment of different future consequences.

METHODOLOGY

A large Steering and Technical Committee was struck to steer the process, provide technical input, test assumptions and ensure a balanced product. The committee included government and public discipline experts with research or management expertise in a broad range of sectors including: range science, native plant communities, forage production models and grazing dynamics, landscape ecology, plant ecology, cumulative effects management, environmental impact assessment, carrying capacities, GIS/aerial photography/remote sensing, wildlife biology, fisheries biology, forest management, water allocation modeling and environmental analysis, riparian ecology, environmental monitoring, land management, pedology, agronomy, irrigated and dryland agriculture, soil and water quality, plant, insect and vegetation ecology, systems ecology and spatial analysis, water quality biology, forest ecology, conservation biology, endangered

and rare species and herbivore/fire relationships.

The Steering and Technical Committee provided direction, critical feedback and advice to a primary consultant (Brad Stelfox) responsible for programming ALCES and presentation development. Together, the Steering and Technical Committee and consultants held six meetings over the period December 1999 to December 2000 to:

- Understand the model;
- Identify key issues;
- Collect data and test assumptions;
- Program the model;
- Review, critique and revise output;
- Identify applications;
- Develop presentations; and
- Review, critique and revise presentations.

APPLICATIONS

ALCES can be used to better understand what ‘drives’ a system and where attention, energy, resources, programs and policies might be directed. It can be used to help create a reasoned dialogue at agency, community, academic, and political levels about what we want the future to be and the landscape to look like (the future is not what it used to be—it will change in response to today’s decisions). It encourages a longer term approach to planning and decision-making which considers environmental sustainability.

Prairie Conservation Action Plan (PCAP)

The new Alberta PCAP: 2001 – 2005, will be released in 2001. Key strategic priorities of the plan and the Prairie Conservation Forum over the next five years include documenting and quantifying changes taking place, better understanding the implications of change over time, and promoting a better understanding of the implications of landscape integrity impacts amongst the public and decision-makers. ALCES goes a long way to addressing the first two tasks while the associated presentation provides a means of pursuing the final task. A web-based version of the Cumulative Effects presentation given at Winnipeg in February 2001 should be posted on the Prairie Conservation Forum website www.albertapcf.ab.ca) by mid-summer, 2001.

Oldman Initiative

Increasing public concern over the effects of intensification of human activity on environmental quality prompted the launching of the Oldman Initiative in 1998 which focuses on water quality. Data collected through this project has been incorporated into the ALCES model. Public interest is also high in other areas such as air quality and human health. Stakeholders involved in the Oldman Initiative have expressed great interest in ALCES.

Castle River Integrated Resource Plan

Using regional resources, ALCES will also be used to model the Castle River IRP area. Various planning initiatives are underway in this area in response to recommendations arising from a provincial protected areas project. Public and media interest in the Castle continues to be high and an ongoing environmental campaign promoting stricter protection and calling for 'zero tolerance' of new activities is placing pressure on the government to demonstrate environmental

quality is being preserved. Additionally, two EUB Decision Reports in the spring of 2000 assert that cumulative effects in the Castle are 'at or beyond' thresholds.

Developing a capability to address cumulative effects modeling together with associated initiatives (ecosystem monitoring, revising the IRP and promoting awareness) are key steps the department is taking to demonstrate commitment to environmental stewardship.

Regional Strategies

Following the Northern East Slopes Sustainable Development Strategy pilot and the development of a provincial framework for Regional Strategies, there is an expectation that the 'next generation' of regional IRM plans will shortly be initiated. The current IRPs under the Eastern Slopes Policy are up to 15 years old and the Regional IRP developed in the early 1990s did not proceed to approval. There is a pressing and growing need to deal with regional IRM issues strategically.

The new Regional Strategies will address all resources and values, sustainability issues, adopt an ecosystem management approach, take a long time perspective and incorporate good science and data. Emphasis will be placed on forecasting future resource demands and uses and predicting trends and implications. The Prairie Cumulative Effects Initiative provides a prerequisite foundation on which to build a successful planning approach. The PowerPoint presentation will be invaluable in educating participating stakeholder about cumulative effects and engendering discussion and debate about cumulative effects issues. The ALCES model will provide a custom made tool to assess different strategies, options and implications in the planning process itself.

THE MANITOBA VOLUNTEER-BASED DRAGONFLY SURVEY

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Abstract: Dragonflies have been used as indicator species for assessing habitat and water quality in a variety of wetlands, riparian forests, and lakeshore habitats around the world. Scientists in Europe, Japan and the U.S. have had good success in establishing citizen monitoring networks to collect data for regional or national dragonfly survey and environmental monitoring projects. Teachers, school groups, nature societies, and other interested citizens groups or individual volunteers have been recruited for these projects. In 1999, Manitoba Conservation initiated a Volunteer-based Dragonfly Survey. Monitoring guides are made available to recruits so that data is recorded and specimens are collected according to survey standards. Data and specimens collected over 5 years will be incorporated into a provincial dragonfly atlas and field guide, as well as contributing to the Manitoba Conservation Data Centre and international databases. The results will also contribute information to the database and mapping project of the Dragonfly Society of the Americas and the Odonata information network of the Worldwide Dragonfly Association. A project update will be presented, including the discovery of dragonfly species new to Manitoba.

1688 ENCORE?

THE PROPERTY LOBBY'S VICTORY IN THE TRANSITION FROM BILL C-65 TO BILL C-33

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Abstract: This paper documents the major changes that occurred, in the proposed regulatory schemes, between the Bill C-65 and Bill C-33. It then argues that, while these changes are decidedly in favor of property interests, there is good reason from economic theory to expect that the regulatory scheme adopted by Bill C-33 is more likely to effectively protect endangered species than the regulatory scheme under Bill C-65. That is, Bill C-33 provides a system of incentives and penalties that is more likely to engender land owner compliance than the system of incentives and penalties that Bill C-65 would have put in place had it become law.

INTRODUCTION

When the **Canada Endangered Species Protection Act** (Bill C-65, 2nd Session, 35th Parliament, 45 Elizabeth II, 1996-97) (hereinafter Bill C-65) died on the order paper with the calling of the 1997 Canadian Federal General Election¹, the Government of Canada undertook a consultation process, seeking input on endangered species

¹ Bill C-65 had not passed Second Reading in the House of Commons at the time the 1997 General Election was called. By the rules of Parliament a Bill becomes law when it has passed Third Reading in both the House of Commons and the Senate, in the same form, and has been endorsed by the Monarch. If between the time a Bill is introduced and it becomes law Parliament is prorogued, either by an election call or a Speech from the Throne, it is said to have died on the order paper. This means that, as far as the legislative process is concerned, the Bill has to start all over again from introduction in the next Parliament, in the case of an election, to become law. That is, once a Bill dies on the order paper, as far as any subsequent legislative actions are concerned, it is like it had never seen any of the process before.

protection from a wide variety of stake holder groups, that ultimately ended with the introduction of **The Species at Risk Act**² (Bill C-33, Second Session, Thirty-sixth Parliament, 48-49 Elizabeth II, 1999-2000)(hereinafter Bill C-33). During this process there appeared to arise an informal coalition of various industries involved in the extraction of both renewable and nonrenewable natural resources, whose participants held interests in real property. These property interests scored a huge victory, over the manner that the endangered species will be protected, in Canada, with the transition from the way that Bill C-65 would have affected endangered species protection to the regulation property owners will face should Bill C-33 be reintroduced

² **The Species at Risk Act** ultimately died on the order paper with the calling of the 2000 Canadian Federal General Election. Thus, Bill C-33, like Bill C-65 before it, failed to become law.

and enacted, as it existed when the 2000 Election was called.

Following an examination of the economic rational for government to regulate to protect endangered species this paper will set out the major changes between Bill C-65 and Bill C-33. It will then argue that, in the main, these changes represent a victory for the property interests. The paper will then proceed to argue that the regulatory scheme proposed by Bill C-33 can be expected to provide better endangered species protection than the regulatory scheme proposed by Bill C-65. Finally, it will be argued that this improved protection is the result of the changes in favor of the property interests and the decrease in the private incentives to disobey the law associated with the changes.

THE ECONOMIC RATIONAL FOR REGULATING³

That the endangered species crisis is largely a product of habitat loss is uncontroversial. The **Globe and Mail** in its February 24, 1999 edition avers that, in Canada, 80% of species at risk are so because of habitat loss. It is self-evident that this habitat loss is a result of the species at risk being unable to successfully compete with humanity for the land that they require. Thus, implementing a successful endangered species protection policy will require that land be utilized in a manner consistent with the policy.⁴ This

³ Most of what follows in this section is a Pigouvian analysis of market failure. An interested reader may wish to read Pigou and may also wish to compare and contrast Pigou's conclusions and recommendations with those of Coase.

⁴ Habitat loss is; of course, not limited to land based species. Both Bill C-65 and Bill C-33 recognize this. However, as much of the controversy surrounding both Bills has to do with the effects of the Bills on the holders of private property and as

will require, in a private property regime like Canada, dealing with private landowners.

Given that the endangered species problem exists, it is apparent that the current institutional structure aimed at regulating land uses, particularly in rural Canada, has not proven to be consistent with maintaining biodiversity. For example the fact that in Saskatchewan it is illegal to charge hunters a fee to enter private land to hunt acts as a disincentive to the provision of game habitat on private land.⁵ This suggests that the price signals the market is sending owners of private property lead property owners to under value habitat and consequently biodiversity. Yet, the **Canadian Biodiversity Strategy** observes the following:

Many Canadians believe that each species has its own intrinsic value, regardless of its value to humanity, and that human society must be built on respect for the life around us. They believe that we should conserve biodiversity for its own sake, regardless of its economic or other value to humans.

Failing to conserve biodiversity puts future options, flexibility and

riparian rights are virtually non-existent on the Canadian portion of the North American Plain I have restricted this work to considering land only. A reader interested in these issues as they relate to water and its management, particularly in private hands in the United States, might wish to consider the work of Anderson and Leal.

⁵ It does bear notice that the recent elimination of grain and oilseed production subsidies has gone some way to eliminating the incentives for further habitat elimination. However, their presence in the past was an undeniable incentive to break land for agricultural purposes that by a best use policy should have remained unbroken, Palliser's triangle for example.

economic opportunities at risk and passes enormous costs onto future generations. Conserving biodiversity is an investment in the future and makes good business sense.(p.14)

Should a society have a good or service it values that is being undervalued or under provided by the market then that society meets the received economic theory justification for government intervention in the market. This justification is market failure. Does the private market for habitat fail? The **Canadian Biodiversity Strategy** clearly suggests that biodiversity is a good of value. Endangered species are commonly used as indicators of biodiversity. As we are in the presence of a loss of habitat driven endangered species crisis, it seems clear that the existing market for habitat, and thus biodiversity, has failed. If the market were supplying optimal amounts of biodiversity, there would not be a loss of habitat driven endangered species crisis.

Graphically this can be represented in figure 1. Where the P axis is the price of habitat and the Q axis is the quantity of habitat. S is the private supply curve for habitat.⁶ The private supply curve is the locus of points where private individuals are prepared to supply the greatest quantity, q, of habitat that they are prepared to supply at the price, p. That is, for any given price, p, the maximum amount of habitat that private individuals will supply is the quantity, q, read off the supply curve. D is the private demand curve for habitat. The private demand curve

⁶ The supply curve intercepts the quantity axis to the right of the origin, because there is some land that has no economically viable use other than habitat. As technology continues to change so will the intercept of the supply curve and either the quantity or the price axis.

is the locus of points that represent the minimum quantity of habitat, q, that private individuals will demand at a given price, p. That is, the most that private individuals will pay for a given quantity of habitat, q, is the price, p, read off the demand curve. The private market is said to be in equilibrium when the quantity demanded is equal to the quantity supplied at the same price. That is the intersection of the supply and demand curves for habitat, where at the same price suppliers are supplying as much as they are willing to while at the same time demanders are receiving the least amount they will take. In figure 1 the market equilibrium would be to supply habitat in the amount q_e at the price p_e . In the absence of market failure, the allocation of habitat at the equilibrium, q_e and p_e , can be shown to be optimal.⁷ If, however, you live in a world, as we apparently do, where the optimal amount of habitat is q^* there is a clear market failure and government intervention is justified by received economic theory.

⁷ The interested reader can see Varian for example.

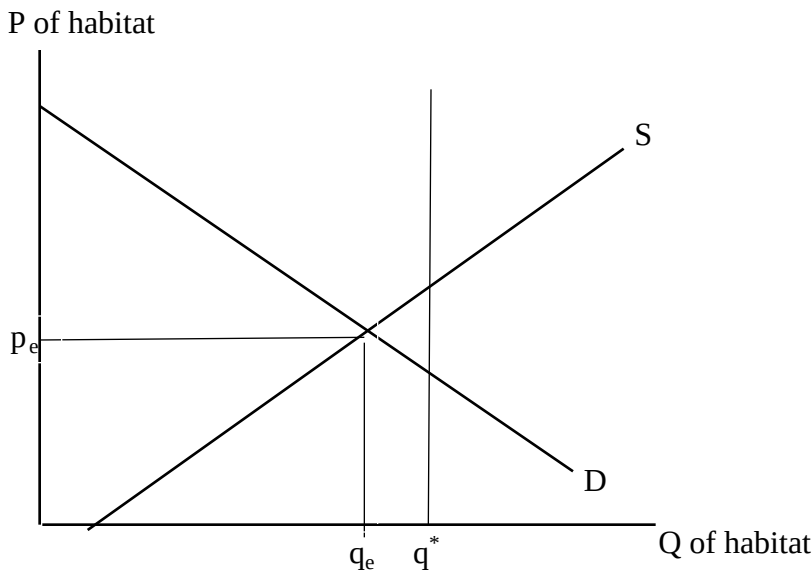


Fig. 1: The private demand and supply of habitat

Given that there is a market failure before government intervenes it is necessary to ascertain the cause of the market failure. The cause of the market failure needs to be ascertained in order to insure that the corrective policy adopted does not exacerbate the problem. In the instant case the problem is caused by the public good nature of biodiversity generally, and endangered species habitat specifically.

The public goods problem has its roots in the inability of the provider of the good to extract all the benefits available from the supply of the good. By received economic theory an economic agent will only make an investment if the expected stream of benefits that the investor can extract from that investment is equal to or greater than the costs associated with the investment. The costs in such a comparison, again by received theory, must include the opportunity costs of the investment. That is, those benefits that could accrue to the agent through an alternate use of the investment, in the case of

habitat the foregone benefit of some other use of the land. The economic agents that

provide endangered species habitat, landowners, cannot extract the complete benefit generated by the land as habitat. This is because no legal means exists for the landowner to extract the benefits that other people receive from the habitat. In fact, the only benefit that landowners can extract is their own personal benefit. Thus, when landowners compare the benefits available to them of the land as habitat to the costs associated with the land as habitat, they will value only the benefits that they can extract, and accordingly will under invest in habitat. This is because as soon as some other use, say growing grain, produces benefits to the landowner that are greater than the benefits that the landowner receives from the land as habitat that other use will be chosen. This is true even if the total benefit to the society of the land as habitat exceeds the total benefit to society from the other use, and is the root of the public goods problem.

The public goods problem is modeled graphically in figure 2. In figure 2 MPB is the marginal private benefit of habitat, while MSB is the marginal social benefit of habitat. Marginal private benefit is the benefit gained by private individuals from the last unit of habitat created and in a perfectly competitive world is the same as the demand curve in figure 1. Marginal social benefit is then, of

course, the benefit that society gains from the last unit of habitat created. The fact that these two curves are separate is why the market failure occurs. Q, P and S are, as in figure 1, the quantity, the price⁸ and the supply of habitat.

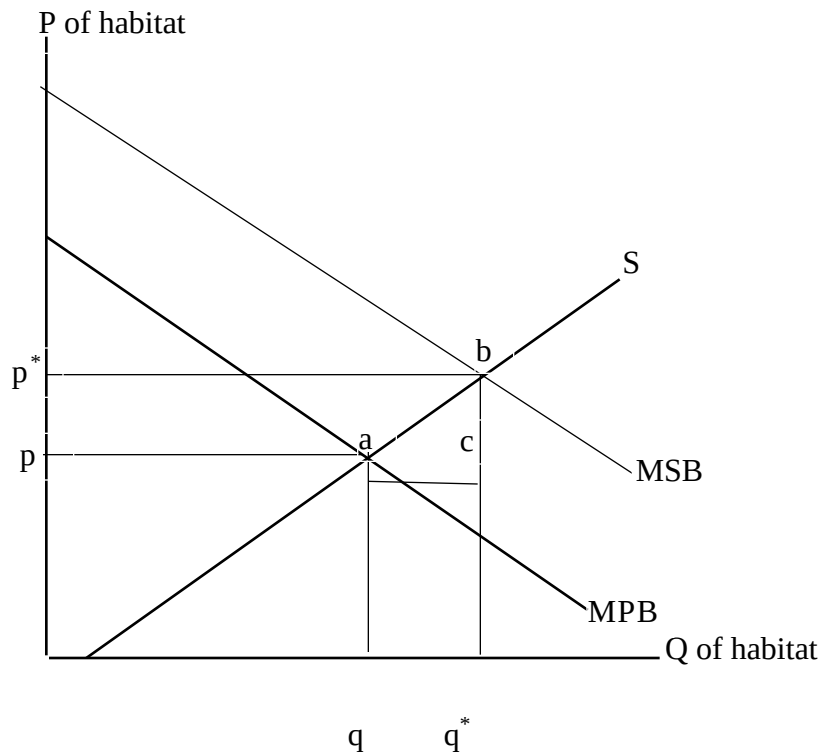


Fig. 2 Market for habitat with the public goods problem

⁸ The price of supplying habitat need not be a direct cash outlay on the part of property owners. In fact, the cost of habitat is likely to be the opportunity cost of foregoing some other use for the land.

By the same reasoning that the intersection of the supply and demand curves in figure 1 represent an equilibrium in the private market, the intersection of the MPB and the supply curve, at p and q represents the identical private equilibrium in figure 2. However, by allowing the private suppliers to extract the social benefit rather than merely the private benefit, figure 2 shows that the optimal quantity of habitat, q^* , is available at the price, p^* , where the MSB curve intersects the supply curve. That is, at the point where for the same price, the maximum amount of habitat that suppliers are prepared to supply is just equal to the minimum amount of the benefits of habitat that society is prepared to accept at the price. The move from point a to point b requires the elimination of the gap between the two benefits curves, the solution to the public goods problem. The gap exists between the two benefits curves, in figure 2, because the landowners can and will choose uses for the property other than habitat, when they only receive p of benefit rather than p^* of benefit. In instances like this, the policy government wants to adopt is one that will eliminate the gap between the MPB and the MSB curve. One way the gap can be eliminated is by the transfer from the rest of society to landowners of an amount equal to the area in the rectangle pp^*bc . That is, one policy that will solve the problem is to have an additional amount pp^*bc invested in habitat by the state. This is the classic Pigovian subsidy. If a change in landowner preferences, that is, if what they perceive as beneficial and how they value it occurs that results in an upward shift of the MPB curve to the point that it overlays the MSB curve, then the problem eliminates itself. This notion underlies the idea that education will

assist in alleviating the endangered species problem.

THE CHANGES FROM BILL C-65 TO BILL C-33

Both Bills share an identical preamble. Bill C-65 uses a species listing procedure. A species is determined to be at risk of extinction or extirpation by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and it is listed. Once a species is listed it enjoys all of the protections contained in the Bill. Bill C-33 maintains the listing procedure of Bill C-65, save that the final listing determination is taken out of COSEWIC's hands and given to the Federal Cabinet. The section reads:

27. (1) The Governor in Council may, on the recommendation of the Minister, by regulation, establish the List of Wildlife Species at Risk and amend the List by adding a wildlife species to the List, by reclassifying a listed wildlife species or by removing a listed wildlife species from the List.
- (2) Before making a recommendation in respect of a wildlife species or a species at risk, the Minister must
 - (a) take into account the assessment of COSEWIC in respect of the species;
 - (b) consult the competent minister or ministers; and
 - (c) if the species is found in an area in respect of which a wildlife management board is authorized by a land claims agreement to perform functions in respect of a wildlife species, consult the wildlife management board.

This will, of course, raise the potential for the politicization of what was a purely scientific exercise under Bill C-65.

The application section of Bill C-65 reads:

3. (1) Subject to subsections (2) and (3), this Act applies in respect of wildlife species and their habitats, including

(a) aquatic species and their habitats; and

(b) species of migratory birds and their habitats that are protected by the Migratory Birds Convention Act, 1994.

(2) Sections 30 to 32, regulations under section 42 and emergency orders apply in a province, other than the Yukon Territory or the Northwest Territories, in respect of wildlife species and their habitats, other than those mentioned in paragraphs (1)(a) and (b), only in so far as individuals of those species and their habitats are found on federal land.

(3) The Governor in Council, on the recommendation of the Minister, may make an order providing that a provision of this Act does not apply in respect of a wildlife species, other than one mentioned in paragraph (1)(a) or (b), in so far as individuals of that species are found in the Yukon Territory or the Northwest Territories, but outside federal land under the authority of the Minister of Canadian Heritage. Despite the order, the provision continues to apply to Her Majesty in right of Canada.

Bill C-33 has nothing in it that purports to limit the Bill's ability affect private property, except where critical habitat is concerned. However, Bill C-65 expands its apparent curtailment of protection to federally regulated property by section 33, which reads:

33. The Minister may make regulations prohibiting any person from

(a) wilfully killing, harming, harassing, capturing or taking an individual of a wildlife animal species, other than one mentioned in paragraph 3(1)(a) or (b), if COSEWIC

(i) has determined that the species migrates across an international boundary of Canada or has a range extending across such a boundary, and
(ii) has designated the species as an endangered or threatened species; or

(b) knowingly engaging in activities that damage or destroy the residence of the individual.

Before making the regulations, the Minister must consult the provincial minister of each province in which the regulations will apply.

Bill C-33 and Bill C-65 share the same definition of residence. The definition reads:

“residence” means a specific dwelling-place, such as a den, nest or other similar area, place or structure, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles,

including breeding, rearing or hibernating.

This definition, had either Bill become law, would have rendered the size of the residences front and back yards a question for judicial determination. This determination would have been required under Bill C-33 because its section 33 sets out the following prohibition:

33. No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.

The next major difference is that Bill C-33 contemplates the compensation of private landowners for any effects of protecting critical habitat. It bears notice that habitat only becomes critical when it is deemed so by a recovery strategy or action plan, and can only effect private property directly following a fairly arduous administrative procedure. Section 64 reads:

64. (1) The Minister may, in accordance with the regulations, pay compensation to any person for losses suffered as a result of any extraordinary impact of the application of section 58, 60 or 61 or an emergency order in respect of habitat identified in the emergency order that is necessary for the survival or recovery of a wildlife species.

(2) The Governor in Council may make regulations that the Governor in Council considers necessary for carrying out the purposes and provisions of subsection (1), including regulations prescribing

- a) the procedures to be followed in claiming compensation;
- b) the methods to be used in determining the eligibility of a person for compensation, the amount of loss suffered by a person and the amount of compensation to be paid in respect of any loss;
- (c) the terms and conditions for the payment of compensation

This is something that C-65 failed to explicitly do.

Bill C-33 also requires consultations with landowners and all other interested parties through the recovery planning process. This is again a departure from Bill C-65. This change is essentially one of tone. Consultation under Bill C-33 is mandatory and the requirement is often repeated. When reading Bill C-33 the reader is left with the impression that there is very little that the Government can do without extensive consultation with anyone who may be affected. Bill C-65 while hardly exclusionary, lacks the focus on consultation found in Bill C-33.

The last major departure from Bill C-65 found in Bill C-33 is also to landowners' apparent advantage. Bill C-33 does not contain the public interest litigation procedures that would have been available had Bill C-65 become law. Thus, landowners

are not likely to find themselves in the center of lawsuits over endangered species.

THE WINNER IS?

In balance landowners appear to be the principle beneficiaries of the changes between Bill C-65 and Bill C-33. The elimination of special standing rules to launch public interest litigation is a clear victory for property interests. The same is true with the added emphasis on consultation and the politicization of the system inherent in Bill C-33 compared to Bill C-65.

The politicization of the system allows property interests the ability to lobby against the inclusion on the list of any species they feel will be detrimental to their interests. The same is true of the emphasis on consultation, particularly in the recovery planning process. If they lose on the listing lobby, the consultation process allows them to lobby with respect to the extent to which their interests may be affected and on the question of compensation.

Compensation is another clear victory for the property interests. While Bill C-65 did not expressly forbid compensating private property holders affected by the operation of the Bill, neither did it express contemplate it. Compensation is permissive under Bill C-33, however, given the exalted position property holds in our society, a man's home is after all his castle, it seems highly unlikely that the courts would allow an individual to have to suffer any grievous harm to his property interests to protect an endangered species.⁹

⁹ To those who would argue that this amounts to paying people to obey the law you are absolutely correct. However, while we do not pay people

Finally, there is the question of the protection of the residence. It appears, at first blush, to be far broader under Bill C-33 than under Bill C-65. This breadth is largely illusory. The exception for trans-boundary species is going to catch most of the property owners in Southern Canada; where most of the private property in the country is admittedly held, thus rendering the two Bills essentially identical, from the property owners position. The courts, had either Bill become law, would have had to decide whether or not to protect more than the hole in the ground or nest in the tree. That is, they would have had to decide if they are going to grant the individual of the protected species a front yard and a back yard. Should the courts have rendered such a decision, their reasoning would have by necessity required that they concluded that in the overall scheme of the legislation it was Parliament's intent to see the continued survival of the endangered species, or else they would grant protection based on the clear wording of the statute. Such a decision requires an acknowledgment by the courts that the individuals of the species at risk require the front and back yard for their survival. This in turn seems to clearly fall within the definition of critical habitat within

directly, in cash, not to murder others or to steal from others, and in fact punish thieves and murders to deter others, there appears to be a quid pro quo. The bargain being that by my refraining from such activity the state will reward me by using its monopoly on coercion to compel others to act in a similar manner. In the instant case it is the state that is interfering with the individual's property, and unlike taxes, which are fairly universal, the property interests might well wonder why they should bear the costs for the benefit of the entire society. That the property interests managed to get compensation included in Bill C-33 suggests, if nothing else, that they are better rent seekers than those who opposed compensation.

Bill C-33, which entitles the landowners to advance a claim for compensation. It seems clear that once again the property interests come out the winner in the changes between the two Bills.

HOW FAIRS HABITAT?

The true test of the wisdom of the policies adopted by Bill C-65 and Bill C-33 is the extent to which one can expect either to protect habitat on privately held land. It will be argued here that primarily because of Bill C-33's adoption of compensation and its emphasis on consultation that it could be expected to be more effective.

Regulation is only effective if those whom the regulation is aimed at are going to obey it. Following Becker an economic agent's decision to comply with any particular prohibitive policy can be viewed as a problem of expected utility comparison. Utility being the benefits, including both the financial gains and any other benefits be they emotional or social that the decision maker receives from the decision. The decision-maker calculates the expected utility gain or loss from either complying or cheating. The decision-maker will conduct an examination of the change in utility from noncompliance, by taking the utility gain from noncompliance less any costs associated with noncompliance. Thus, for example, if the government were to adopt a policy that purports to force land owners to bear the investment $pp^{*}bc$ in figure 2, the rational land owner will only comply if the expected costs both financial and social of noncompliance, discounted by the probability of detection and conviction are equal to or greater than the area $pp^{*}bc$ in figure 2.

So what are landowners perceptions of all of these costs? Furtan, Gray, Buckingham and Dierker found that there was reason to suspect that Bill C-65 would be more honored in the breach than in the observance, due in part to its failure to expressly contemplate compensation. Similarly, Environics Research Group found evidence that suggested that "landowners would respond to monetary incentives to encourage them to plant trees".(Environics p.31) Finally one need consider the enforcement problems with the United States' **Endangered Species Act**, reported by authors like Mann and Plummer to conclude that a policy that ignores compensation for private property holders is likely to encounter substantial enforcement problems.

The problem could, in fact, be exacerbated by the failure to expressly contemplate compensation. Should private property holders fear that if any habitat is present on their property that they may be forced to bear the investment $pp^{*}bc$ in figure 2, they may act to avoid these potential costs by the simple expedient of eliminating all potential endangered species habitat. Mann and Plummer document at least one such, admittedly extreme, case in the United States. They report the instance of Pardee Construction as follows:

As a result they had a great incentive to ensure that official endangered species never appeared on their property. The implications of this were demonstrated in an extreme form by the case of the San Diego mesa mint, which the Fish and Wildlife Service proposed listing in October 1978. One of the plant's three populations inhabited a 279-

acre tract on which Pardee Construction of San Diego intended to erect a 1,429-unit subdivision. Pardee had asked the Veterans Administration to provide a loan guarantee. A few days before the mesa mint was added to the list, the VA informed the developer that the plant lived on the site; Pardee promptly bulldozed the population while it was still unprotected. After a few angry letters, the company got a VA loan guarantee-no endangered species existed on the property to disrupt construction. (Mann and Plummer p. 187)

By adopting a policy that contemplates compensation it seems relatively clear that Bill C-33 could be expected to better protect habitat, on private property, than Bill C-65 would have.

Environics also noted: “Moreover although the research reveal that there may be some barriers to overcome, policy makers and communicators will be rewarded in their efforts to increase stewardship practices among Canadian landowners, as long as appropriate initiatives are launched and as long as trusted channels of communication are employed.”(Environics p.36) Thus, the additional emphasis that Bill C-33 places on consultation over Bill C-65 should be expected to aid in the building of trust.

Furthermore, if a level of trust can be established, the consultation process, over a long enough period of time, may be able to take on an educational component which may result in a change in the utility functions of land owners, moving their perceptions of the returns from habitat (the MPB curve in

figure 2) closer to the overall social perceptions (the MSB curve in figure 2). The closer these two curves move to each other the less compensation it will be necessary to pay.¹⁰

CONCLUSIONS

As the property interests’ victory in the Glorious Revolution led to the creation of the modern western liberal democracies, with their market economies and the accompanying rise in wealth and universal standard of living within those democracies, it may well be that the property interests’ victory may have lead to an improvement in the states ability to protect endangered species habitat. In the transition from Bill C-65 to Bill C-33 it is clear that property interests carried the day. They were clearly the most successful of the stake holder groups at advancing their position to government. However, it appears equally clear that even though Bill C-33 went farther in advancing the interests of property owners than Bill C-65, that Bill C-33 could have been expected to have more successfully protected endangered species habitat on private land had it become law than Bill C-65 could have been expected to have done had it become law.

¹⁰ This line of reasoning abstracts from rent seeking behaviour. Property owners are going to have an incentive to under represent the benefit that they receive from endangered species habitat, in the hope of receiving a larger compensation package. This effect could conceivably be exacerbated if original compensation packages are set too high. However, an ongoing consultation process will allow the players in the compensation game to become more familiar with each other. This familiarity and some hard bargaining on the part of the governmental agency charged with administering a compensation program could go a long way to lessening the property owners’ ability to rent seek.

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STATUS OF THE NORTHERN LEOPARD FROG IN SASKATCHEWAN

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Abstract: Current monitoring of amphibians in Saskatchewan provides limited information to describe recent recovery of populations of the northern leopard frog after significant declines first detected in the late 1970's. Atlas records indicated increasing numbers of reports but this may reflect, in part, increasing interest and solicitation of reports. The northern leopard frog appears to persist in permanent wetlands along major drainages in southern Saskatchewan. Inspection of sites with historical reports, and establishment of monitoring sites specifically for this species, are required.

RECENT STATUS ASSIGNMENTS FOR AMPHIBIANS AND REPTILES OF PRAIRIE CANADA

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Abstract: A new national assessment of the status of wildlife in Canada is nearing completion. In prairie Canada there are very few species considered to be at risk, or to may be at risk, but many are considered to be sensitive and others cannot be assessed with current information. Comparisons of species rankings among the three prairie provinces are provided. Landscapes with groups of species which may require different stewardship efforts are considered.

SASKATCHEWAN AMPHIBIAN MONITORING PROJECT

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Abstract: The Saskatchewan Amphibian Monitoring Project (SAMP) was initiated in 1993 as part of a national monitoring network. Volunteers conduct survey routes which mainly follow Wisconsin and Ontario survey route protocols, and a few volunteers monitor single ponds near their homes on a more regular basis. Volunteers have been mainly from local natural history groups but declining number, and aging, of naturalists limits expansion of surveys. Training and lower response rates of rural residents are problems which can, and will, be addressed to expand the survey coverage. These surveys are appropriate for the wood frog, boreal chorus frog and Canadian toad. The limited distribution of the great plains toad, the localized breeding of the northern leopard frog, and the intermittent breeding of the plains spadefoot toad, result in a need for special surveys to monitor these species. Trend information is provided for selected species and areas.

FACTORS INFLUENCING GRASSLAND SONGBIRD POPULATIONS IN PRAIRIE CANADA

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Abstract: Analyses of data from the North American Breeding Bird Survey indicate that grassland bird populations are experiencing the steepest and most consistent declines of any avian group. Widespread loss and degradation of prairie habitat have often been cited as the primary factors responsible for these declines. Unfortunately, few studies of grassland birds have been conducted in Prairie Canada despite the fact that 70% of grassland birds are declining in Canada and that several endemic grassland bird species reach their greatest abundance in this region. Here I summarize recent research in an attempt to identify factors that may contribute to the decline of grassland birds in Canada.

Results from grassland bird surveys indicate cropland habitat is least attractive for all species with the exception of the Horned Lark. Several species are often associated with hayland and seeded pastures (e.g. Baird's Sparrow), while other species are mostly restricted to native pasture (e.g. Sprague's Pipit). These results suggest that 1) the conversion of native prairie to cropland has likely played a major role in the decline of grassland birds and, 2) while forage crops provide habitat for some generalist species, they do not provide habitat for grassland specialists.

Over-grazing is often cited as having a deleterious effect on grassland birds because of drastic changes in vegetation structure, although some species are associated with heavily grazed habitats. Indeed, some species are least abundant in heavily grazed pastures and residual vegetation has been found to be the most important parameter in nest-site selection models. However, the overall impact that grazing has on grassland bird populations in Canada is unknown and may be relatively minor.

Breeding habitat may also be degraded through the process of fragmentation. The increased edge habitat resulting from habitat fragmentation may cause the loss of species that require interior habitats and increase the abundance of edge species, including predators and brood parasitic Brown-headed Cowbirds. Indeed, my research indicates that grassland specialists are more likely to occur on large pastures and cowbird parasitism is inversely related to patch size. However, nest success and productivity of grassland birds was as high or higher in small native pastures (≤ 65 ha) than in large pastures (> 256 ha). The results of these studies support the contention that the destruction and fragmentation of native grasslands has contributed to the decline of some grassland bird species. Thus conservation of native range should be the one of Canada's highest conservation priorities for sustaining endemic grassland bird populations.

STATUS REPORT ON THE CANADIAN LANDBIRD MONITORING STRATEGY

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Abstract: The Canadian Landbird Monitoring Strategy (CLMS) was instigated in 1992 by the Canadian Wildlife Service and after a 1998 review and the involvement of additional agencies and organizations became a program of Partners in Flight - Canada. The CLMS is a series of volunteer-based surveys that collect information on population trends, distribution, productivity, mortality and habitat use. The goal is to collect information on population change, and use this to identify species or groups of species needing study or conservation action. Information collected should be accurate, current and readily available. The CLMS changes monitoring from a passive process of recording change to a proactive element of conservation. The volunteer surveys are run by a variety of agencies and non-government agencies. Much progress has been made in increasing participation and expanding coverage of surveys, training of volunteers, computerization of old data sets and the development of new surveys to address geographic or species coverage gaps. The prairies have been in the forefront of much of this progress. After 8 years we have been able to assign action priority status for species in Canada and are close to reaching the point of being able to attempt our first analyses integrating the results of multiple surveys and other research. Examples of integrated analyses and how they can direct further monitoring, research and conservation will be provided. We'll compare trends from multiple surveys for the same species and show examples of innovative research related to monitoring. We will identify remaining coverage gaps and describe some of the priority actions in the continuing development of the CLMS.

THE MANITOBA HABITAT HERITAGE CORPORATION'S GREEN BANKS PROGRAM

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Abstract: The Manitoba Habitat Heritage Corporation developed and implemented a riparian habitat management program focused on co-operative projects with cattle producers. Since 1994 MHHC has signed 105 landowner project agreements enhancing 122 miles of shoreline, 3,296 riparian habitat acres and 20,367 adjoining pasture acres for wildlife. Sustainability of those riparian management changes depend on the acceptance and continuing operation by landowners. To monitor impacts of the Green Banks Program on landowners, MHHC has initiated a series of project reviews and landowner surveys. Those evaluations are summarized and discussed.

ENVIRONMENTAL TAX CREDITS FOR SUSTAINABLE LAND MANAGEMENT: PILOT RESULTS AND OPPORTUNITIES FOR EXPANSION

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Abstract: Ducks Unlimited Canada, Prairie Farm Rehabilitation Administration (PFRA), Manitoba Conservation and Northwest Soil Management Association are participating in a 3 year pilot program that offers a \$1 per acre tax credit to landowners undertaking conservation practices in the RM's of Strathcona and Mountain North.

This innovative program is the first of its kind in Manitoba and recognizes landowners at a landscape level who are actively practicing good stewardship or who adopt conservation techniques. Results from the first two years of the pilot indicated approximately 30% of the land base of each RM was annually protected through the program. Program evaluation via a landowner mail-out survey found 86% of participants agreed the program was worthwhile and 88% agreed the property tax system was effective compensation for conservation practices.

The program's key to efficient delivery lies in the motivational influence associated with taxes. By impacting a large number of landowners, the program operates at a landscape level that translates into benefits for society as a whole.

This concept of using nominal tax incentives presents significant opportunity to serve as a framework for expanded conservation programming initiatives.

ECOLOGICAL GOODS AND SERVICES

Canadian society has established a pricing mechanism to compensate farmers for the agricultural products that they produce. Annual and perennial crops, livestock and livestock products can all be sold in the market place. However, the present market system does not account for the full value of

our endowments of natural capital. Multifunctionality is a term that describes the condition whereby an economic sector (such as agriculture) performs multiple functions that contribute to society's welfare. Beyond its primary function of producing food and fiber, agriculture contributes to the achievement of a number of other important societal goals through the provision of ecological goods and services.

Examples of ecological goods and services include: the preservation, management and enhancement of the rural landscape and the protection of the environment (wildlife habitat, aquifer recharge, flood and erosion control, riparian buffer zones, biodiversity, and the preservation of soil and water quality). These goods and services have non-market values, that is, they are not traded in the marketplace and therefore, tangible information about their benefits and contribution to society's well-being is poorly understood. In many cases the provision of these public services contributes to or is perceived as providing disbenefits in terms of operational inefficiency, reduced production, etc. We thus have a paradoxical market structure where largely public benefits are accrued at largely private expense.

Policy and market signals guide agricultural producers toward economically motivated decisions. In the case of ecological goods and services, these signals become distorted and ineffectual because policies have not been not designed to address these kinds of goods and services.

Currently, the policy framework in Manitoba does account for the value of ecological goods and services, nor compensate landowners for their provision. As a result of their apparent zero or negative market value, the producer often associates conservation lands with a loss of revenue.

Society benefits directly from the sustained maintenance of the land and water resource base and continued ecological diversity provided by a mosaic of natural landscapes. Therefore, the burden of ensuring long-term agricultural and environmental sustainability should not rest solely with the landowner. Through the provision of ecological goods and services, these landowners have benefited not only the environment, but

society as well. Agriculture maintains a built-in cultural heritage in the countryside. Environmental tax credits, which provide compensation and recognition to landowners who carry out conservation practices could constitute a start to correcting the distorted market structure associated with ecological services.

PROPERTY TAX STRUCTURE AND TAX CREDIT CONCEPT

Significant positive changes to the landscape are unlikely to occur until stewardship goals are embedded into mainstream policy and programs. Ensuring the multifunctional role of agriculture requires policies that encompass the interdependency of the environment with agriculture.

Among the important policy tools that could influence land use is the municipal property tax system. The tax system in prairie Canada is administered under provincial legislation by the municipal level of government. It is based on an assessment of the market value of land under private ownership, which is determined by provincial assessors according to the principles and processes established by provincial municipal assessment legislation. Individual municipal governments then apply a specific rate of tax in the form of a percentage of the assessed value (referred to as the mill rate), which is calculated based on the projected municipal budget for that year. Revenue from property taxes levied and collected is then applied toward municipal purposes.

Land use decisions are influenced by numerous factors, one of which is taxes. Our present property tax structure does not readily provide a breakdown of the different taxes on different land uses. Many landowners do not know what their taxes are on a per acres basis (Table 1). When people

get the tax notice for their property, the natural reaction is to distribute the billing evenly across all acres on their property. Unfortunately, this attributes an artificially high tax load on conservation lands which very likely has an influence on land use decisions.

Reforms to the municipal tax system could provide economic incentives to private landowners in return for carrying out

conservation farming practices. The property tax structure is attractive in that it could provide a 'broad brush' approach capable of affecting a large landscape while incurring relatively low costs of administration. The value of such a concept will be manifested in its encouragement and recognition of conservation-minded landowners and in the publicity it generates for the preservation of conservation lands.

Table 1. Property Taxes Paid Per Acre For Various Land Uses

RM of TURTLE MOUNTAIN

LAND USE	ASSESSMENT PER ACRE	PORTION %	MILL RATE (23.11+30.42)	TAXES PAID PER ACRE
Creeks	30	30	53.53	\$0.48
Draws	30	30	53.53	\$0.48
Ravines	30	30	53.53	\$0.48
Wetlands	30	30	53.53	\$0.48
*WSB	60	30	53.53	\$0.96
Bush	90	30	53.53	\$1.45
Bush/Pasture	120	30	53.53	\$1.93
Pasture	140	30	53.53	\$2.25
Arable	230-350	30	53.53	\$3.69-\$5.62

* WSB (waste/slough/bush)

General Municipal Rate = 23.11

School [Turtle Mountain] = 30.42

To calculate taxes per acre, use the following formula:

$$\frac{\text{Assessment (Portion \%)(Applicable Mill Rate)}}{1000} = \text{TAXES PAID.}$$

Portion % is calculated as a decimal, i.e., .3

OBJECTIVES OF THE ENVIRONMENTAL TAX CREDIT PROGRAM

The intent of the Environmental Tax Credit Program is to evaluate the effectiveness of a \$1/acre property tax credit offered to all landowners in two rural municipalities in Manitoba (Strathcona and Mountain North). The first two years of a proposed three-year pilot project have successfully been completed in 1999 and 2000.

The pilot project will evaluate an innovative method of delivery for conservation/environmental programming which is the first of its kind in Manitoba. Historically, funding from conservation programs has generally been paid directly to the landowner upon completion of a pre-approved conservation project. Although this method of programming can be effective, it generally offered a relatively large amount of funding per project and consequently was limited in the number of projects which could be funded. This made the programs restrictive in their capability to reach a wide range of landowners and to impact at a landscape level. Also, traditional conservation programs were often structured in a way to restore natural functions that were lost as opposed to conserving existing natural systems. In some cases, net incremental gains were not made as existing natural systems were often lost at a faster rate than they were restored. The Environmental Tax Credit Program has been designed to address these issues.

The objectives of the Environmental Tax Credit pilot are as follows:

a) To strengthen landowner's awareness of the value of ecological goods and services and reward landowners for the service they provide to society.

- b) To evaluate an alternative method of conservation/environmental delivery. The use of the property tax system may have potential for other types of projects in the future. Also, if the program is deemed successful, it could have the potential to influence property tax policy reform that will help protect the land and water resource over the long-term.
- c) To attempt to discern any economic benefit that the two municipal governments might capture over the three-year pilot project. Reduced expenditures may occur in the following areas: silt removal from waterways, flood control, erosion repairs, culvert and crossing repairs, and also the loss of tax revenues from badly eroded land.
- d) To provide an economic incentive to landowners in the target areas to maintain and preserve existing habitat and therefore lessen the cost of restoration in the future.
- e) To benefit the environment and productive use of the land through improved soil and water management.
- f) To determine the impact that \$1 per acre tax credit has on landowner's attitudes and behavior regarding conservation practices.
- g) To raise the awareness and determine impact of information regarding the differential tax loads on various land uses.

This pilot program is jointly offered by the Northwest Soil Management Association, Prairie Farm Rehabilitation Administration through the National Soil and Water Conservation Program, Ducks Unlimited Canada, Manitoba Conservation's Sustainable Innovation Fund, and the Rural Municipalities of Mountain North and Strathcona. By implementing a tax credit program, land management practices that preserve or restore desirable elements of the environment can be recognized by society

and made more culturally and economically acceptable.

IMPLEMENTATION

This program provides funding to the rural municipalities, who then offer the credit on municipal land taxes to all landowners who apply for one or more particular conservation practices. Eligible land uses, or land management practices include tame forage, native grassland, wetlands, riparian buffer zones, and a minimum of 40% residue cover on cropland available in the spring.

Landowners apply at the appropriate municipal office by March 31 of each year for lands that are eligible for the spring of that same year. Each year a satellite image of each rural municipality is acquired and the appropriate ground truthing is performed to confirm the eligibility of each application. The imagery is taken between May 15 and June 15 each year, depending on the progress of seeding. Landowners receive the credit on eligible land when they pay their land taxes in October.

Results from 1999 and 2000 Field Seasons

The total applicants for both municipalities in 1999 was 233, which represents approximately 33% of all landowners in the two municipalities (Table 2). The program protected 6,538 acres of wetlands, 15,116 acres of land under conservation tillage, and 39,334 acres of tame forage, native prairie and riparian zones. The total number of acres enrolled in the program for 1999 in

both municipalities was almost 61,000 acres, which represents approximately 28% of the total privately owned land base. The number of acres enrolled in the program surpassed the anticipated 25% sign-up rate for the 1999 field season, which was approximately 55,000 acres. Furthermore, the average tax credit per landowner was \$261.80 though, the tax credit payments ranged anywhere from \$1 to \$1628.

General trends from 1999 to 2000 (Table 3) show an increase of 10% in the number of acres enrolled in the program. The total number of acres enrolled in the program for both municipalities in 2000 was 67,000 acres, which represents approximately 31% of the total privately owned land base. The number of participants remained much the same from 1999 to 2000, however there was an increase in the number of acres enrolled in the program, with the largest increase of 33% in the conservation tillage category.

Overall, there has been very positive reaction and strong support for the Environmental Tax Credit program. Program evaluation via a landowner mail out survey found 86% of participants agreed the program was worthwhile and 88% agreed the property tax system was effective compensation for conservation practices. The program's key to efficient delivery lies in the motivational impetus associated with taxes. Landowners also appreciated the reward for maintaining as well as adopting good stewardship practices that are environmentally sustainable.

Table 2. Environmental Tax Credit Program – 1999 Results								
	Wetland	Cropland	Forage/ Riparian /	Total	% of RM Protected	Clients	Ave. / Client	Quarter Sections
	(acres)	(acres)	Native (ac)	(ac)		(#)	(ac)	(#)
Strathcona								
applied	5,356	16,631	24,646	46,633		140	333.1	420
eligible	4,205	11,363	22,702	38,270	32.2	138	277.3	417
Mountain N								
applied	2,840	8,775	18,221	29,836		95	314.1	274
eligible	2,333	3,753	16,632	22,718	22.4	95	239.1	269
Totals								
applied	8,196	25,406	42,867	76,469		235	325.4	694
eligible	6,538	15,116	39,334	60,988	27.7	233	261.8	686

Table 3. Environmental Tax Credit Program – 2000 Results								
	Wetland	Cropland	Forage/ Riparian /	Total	% of RM Protect ed	Clients	Ave. / Client	Quart er Sectio ns
	(acres)	(acres)	Native (ac)	(ac)		(#)	(ac)	(#)
Strathcona								
applied	5,074	20,869	27,223	53,166		146	364.2	439
eligible	5,011	12,543	24,808	42,362	35.6	146	290.2	437
Mountain N								
applied	2,176	10,976	18,255	31,407		85	369.5	269
eligible	1,973	7,479	15,391	24,843	24.5	85	292.3	264
Totals								
applied	7,250	31,845	45,478	84,573		231	366.1	708
eligible	6,984	20,022	40,199	67,205	30.5	231	290.9	701

TAX CREDITS IN OTHER JURISDICTIONS

The concept of using nominal tax incentives presents significant opportunity to serve as the framework for expanded conservation programming initiatives. Although tax credits have been instituted in several U.S. states (and revoked in some cases), they have only been introduced in Canada in a limited manner within the province of Ontario, which provides an exemption for wetlands and native lands. A few municipalities in prairie Canada have also introduced municipal tax credits for conservation land uses on a pilot basis. The majority of pilot tax incentive programs have been discontinued after their initial implementation. Many of the programs were not well publicized and promoted and therefore, participation levels were modest and garnered little political support. A lack of formal evaluations and ability to

demonstrate the program benefits make these programs vulnerable to budget cutting. The absence of a scientific way of accounting for the biological, economic, and social benefits of such programs and the lack of any long-term financing commitments from senior governments has prevented the continuance of these programs beyond their initial phase.

BROADENED FUNDING SUPPORT

Environmental Tax Credits could help to promote the role of agriculture in maintaining essential ecological processes and functions. Tax credits could also help sustain the broad social values contributed to Canadian society by a sustainable agricultural community. In order to secure the provisions of ecological goods and services, public intervention is necessary. While individual farmer involvement is

essential; government, conservation, business, industry and local community organizations are important partners in policy development, information exchange and activity coordination. True integration of conservation objectives into any institutional structure such as the municipal property tax system, will require financial and moral support from an array of sources. Because land and water resources provide a myriad of public goods and services, there exists a vested interest on the part of governments to ensure the sustainability of these resources and to maintain their quality and productivity for future generations. Government must be involved to ensure a coordinated funding commitment is developed to foster favorable public attitudes and policy signals toward initiatives that encourage farmers to adopt conservation techniques. Equally important to the success of a tax credit program will be the support of the urban public who must be assured that there are tangible environmental benefits that can be attributed to soil and water conservation practices or the maintenance of biodiversity on the rural landscape. A positive public perception of the tax credit approach will translate into positive political support for allotment of public funds.

CONSULTATION AND BUILDING OF PARTNERSHIPS

The participating partners recently held a workshop in Russell, Manitoba to discuss the relevance and benefits of this approach. Workshop participants indicated strong interest with some committing to explore the potential of expanding the concept of Environmental Tax Credits to promote sustainable land management.

Interagency discussion is required to: test the concept of an expanded tax credit program, develop administrative options, refine program design, identify stakeholders, and generate support. The tax credit approach lends itself well to partnerships among industry, governments, communities, conservation agencies, and agricultural interest groups. Furthermore, partnerships help develop effective solutions to rural issues that cut across sectors and jurisdictions. Partnerships will facilitate delivery of program activities and help avoid the risk of duplication. Our next steps involve: presenting various agencies with the concept behind the tax credit approach, determine how tax credits may benefit the respective agencies and society as a whole, and discuss the role that each agency can play.

Early support and participation by key interested groups can help to ensure the success of the initiative. If your organization is interested in participating or if you would like more information, feel free to contact:

Ducks Unlimited Canada:
1-204-467-3275
or PRFA: 1-204-983-2243
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THE IMPACTS OF CLIMATE CHANGE ON THE PRAIRIES

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Abstract: As global climate change progresses over the next few decades, and beyond, the prairie climate could, and undoubtedly will, itself change in noticeable, important, and even profound ways. The climate is certainly expected to become warmer, especially in the colder months of the year, but it will change in other ways as well. For example, we could see significant changes to: the number, timing, and intensity of precipitation events; the frequency, timing, persistence, intensity and prevailing tracks of synoptic-scale pressure patterns; the frequency, timing and duration of extreme heat waves, cold waves, droughts, and floods; the length and timing of the frost-free period; and the duration and pattern of snow cover. Indeed, we must not expect that a system as complex and inter-connected as the North American climate system will respond simplistically to global-scale climate change. Of course, these changes, however they eventually manifest themselves, have major implications to the organisms, biomes, and landscapes of the prairie region, and probably in some unanticipated and undesirable ways.

Danny Blair was born in Regina, Saskatchewan. He obtained a Geography B.Sc. from the University of Regina in 1981 and a Geography M.Sc. in 1983, for which he produced a thesis titled “The Thunderstorm Hazard in Saskatchewan”. In 1989 he received a Geography Ph.D. from the University of Manitoba; his dissertation was on The Synoptic Climatology of the Red River Region. In 1987 he became a Lecturer in the Department of Geography at the University of Winnipeg, where he is now an Associate Professor and the Department Chair. His current portfolio of courses includes *Introductory Atmospheric Science, Weather & Climate, Climate Change & Variability, Natural Hazards, Topics in Climatology*. His current research interests include prairie climate change and variability, teleconnections and long-range climate forecasting, the synoptic climatology of the Peace-Athabasca region, the prairie hail hazard, map classification, climate reconstructions using stable isotopes, and the climatology of Red River floods.

MORTALITY OF WHOOPING CRANE COLTS IN WOOD BUFFALO NATIONAL PARK, CANADA

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Abstract: Intensive aerial monitoring, ground observations and radiotelemetry were used to monitor eight (1997), six (1998), and eight (1999) whooping crane (*Grus americana*) pairs that had twin colts in Wood Buffalo National Park, to determine causes of colt mortality, movements, distribution and brood habitat utilization. A total of 18 colts had transmitters attached: five (28%) fledged; five (28%) succumbed to cumulative effects (head trauma, stress, exposure and infection); four (22%) deaths were due to unknown causes (three of these went missing after they had lost their transmitters), two (11%) were believed to be taken by a fox (*Vulpes fulva*), one (5.5%) was lost to raven (*Corvus corax*) predation, and one (5.5%) died of pneumonia. Out of the 22 sets of twins monitored, one set of twins survived the summer, and on another occasion the older sibling was taken by a fox and the younger colt survived, this resulted in at least nine percent of the smaller siblings surviving. We observed that most often it is the younger (smaller) sibling that goes missing due to the following: the older one is at least two days older and when handled were on average 47.55 g ($n = 11$, $SE = 7.44$) heavier; the older one displays severe aggression towards the younger one (at one nest site over a four minute period the older sibling pecked the younger over 90 times); and the family groups depart the nest pond soon after the second egg hatches and are quickly on the move, averaging daily movements of 338.45 m ($n = 115$, $SE = 37.59$) for the first week following hatching. All of these factors work together in wearing down most of the smaller siblings and within two weeks the younger colt has perished or is unable to keep up with the family group and gets abandoned.

INTRODUCTION

Wetland marshes in and around Wood

Buffalo National Park (WBNP) represent the only continually inhabited breeding grounds of the endangered whooping crane (*Grus americana*) in the world. Whooping crane nesting sites were first observed in WBNP in 1954 (Fuller 1955) when five pairs were located. The current population numbers close to 190 individuals.

The incidence of two-egg clutches of whooping cranes is over 90% (Kuyt 1995) and hatching success is over 75% (Kuyt 1996). However, there has only been one whooping crane family arrive on their wintering grounds with two young since 1964 (it occurred in 1997). It should be noted that between 1967-1996 over 450 eggs were removed from WBNP to aid other management initiatives. Little information exists with regards to population limiting factors such as causes of colt mortality following hatching in wild whooping cranes.

The purpose of this study was to provide baseline information on causes of colt mortality and to gain information on why few whooping crane twins survive. This information will aid resource managers in understanding the variability of colt production in addition to potentially reducing mortality of colts in future re-introduction efforts.

Intensive aerial monitoring aided with radiotelemetry and ground observations from blinds were conducted in WBNP between 1997-1999. This study identified several causes of colt mortality including predation, exposure, infection, and intraspecific

aggression. However, we did not observe one primary cause of mortality, and there appears to be an accumulation of factors that result in one colt, usually the smaller one not surviving from a brood.

The study was funded by Parks Canada and the Canadian Wildlife Service (CWS). In 1998, prior to attempting radio telemetry work in WBNP, several experimental attachment techniques were conducted at the Patuxent Wildlife Research Center and we would like to thank the staff at Patuxent, with special appreciation to Dr. G. Gee and Dr. G. Olsen for their assistance and cooperation. Necropsies were performed by Dr. R.Cooper of the Calgary Zoo, and pathology work by Dr. S. Black of the Calgary Zoo. We would like to thank Big River Air Ltd., Thebacha Helicopters, and Remote Helicopters for their assistance in the aerial surveys. We would also like to thank the following for field assistance: J. Bailey; M. Bradley; G. Peterson; and D.White.

STUDY AREA

Wood Buffalo National Park, comprising 44,807 km² is located in the Subhumid Mid-boreal ecoclimatic region of Canada (Timoney 1997). Predominant bedrock underlying the nesting area consists of gypsum karst and is influenced by calcium sulphate groundwater discharge, which originates in the Caribou Hills to the southwest (McNaughton 1991). Overall, the nesting grounds are characterized as a mosaic of shallow diatom ponds, bulrush marshes (*Scirpus validus*), mixed marshes, and water sedge meadows (*Carex spp.*) (Timoney 1997). Upland areas within the

nesting area consist of narrow ridges and islands of white spruce (*Picea glauca*), black spruce (*P. mariana*), tamarack (*Larix laricina*), willows (*Salix spp.*), and dwarf birch (*Betula glandulosa*) (Novakowski 1966).

METHODS

In May of 1997, three fixed wing surveys (Cessna 172) were conducted over the whooping crane nesting area to determine the number and location of nests, and the onset of incubation. In June, the aerial monitoring was intensified with at least one flight conducted daily (35 surveys) to observe: when the colts hatched; their daily movements; and when colts went missing. The locations of the family groups were plotted on overlays on 1:15,840 colour infrared aerial photographs. Following a fixed wing flight that failed to locate all the colts, we flew in a helicopter (Aerospatiale A-Star or a 206B Jet Ranger) to the last known location of the chick(s) and conducted a ground search. In addition, two nest sites were visited within a day of the second colt hatching. Using a helicopter we landed 300 m away and hiked to the nest ponds and located the colts. These colts were weighed and marked (with a felt marker) under their wings.

In May of 1998, there were five fixed wing surveys to determine number and location of nests and the onset of incubation. During the first week in June, six nesting pairs that had twins were selected for telemetry monitoring. A helicopter was used to land 300-400 m away from the family groups, and accompanied by a veterinarian (Dr. R. Cooper) we located and caught the colts.

The colts were weighed, given a physical examination, and blood samples, and swabs (cloaca and trachea) taken. A lightweight (1.45g) BD-2G transmitter (Holohil Systems Ltd., Ont., Canada) was attached onto the dorsum of the colts. The transmitters were attached onto the skin of the colts using a cyanoacrylate glue (Vetbond tissue adhesive) and the antennas were glued into the down on the back of the colts. The transmitters had a 15 cm antenna, so on the smaller colts four cm was cut off. For three pairs, the transmitters were attached to the larger colt and for the three remaining pairs the transmitters were attached to the smaller sibling, such that only one colt per nest had a transmitter. On three occasions only one colt could be located on the ground, so for these particular colts their hatching order was estimated by their weight. Following the attachment of the transmitters each family group was monitored daily from a fixed wing for 10 consecutive days (10 surveys). Whooping crane colts with transmitters were monitored using aerial telemetry with a Telonics Model TR 2 receiver. The receiver was connected to two (RA-2A H-Type) Yagi antennae mounted onto the wing struts of a Cessna 172. A switch box controlled signal input from either antennae. When a monitoring flight failed to locate a colt(s) near the adults a helicopter was utilized to land at the last known location of the missing colt and ground tracking ensued.

In May of 1999, in addition to the nine aerial surveys to determine nest information, two plywood blinds were set up approximately 70 m from two nests. The blinds were enclosed with viewing ports on three sides and were 120 cm by 120 cm by 195 cm in height. The blinds were slung into place

using a helicopter. At the same time the blinds were put into place, we floated the eggs to determine if they were fertile and to get an approximate hatching date. We set up small two person camps 800 m-1000 m away from the nest pond and began observation sessions one to two days prior to the eggs hatching. Observation sessions in the blinds lasted from two to six hrs and varied from two to five days until the family group departed the nest pond. Information was recorded on nesting and feeding behaviour of the adults and the colts. In early June, we attached transmitters to both colts from six sets of twins. All twelve colts were located, weighed and had transmitters attached. The transmitters used were the same as in 1998 and were attached to the colts in the same manner. All transmitters attached to smaller colts had six cm of the antenna removed. Following the attachment of the transmitters aerial telemetry monitoring occurred at least daily for 15 consecutive days (19 surveys).

RESULTS

After six unsuccessful ground searches in 1997 to locate missing colts we determined that due to the relatively large movements of the family groups, the thick vegetation and wet terrain the probability of locating a small chick without the aid of a transmitter was low. Although no colts were located, information was gained on the timing of when the colts went missing, their movements and their habitat usage. Colts monitored that went missing did so between seven and 22 days following hatching, with an average of 14.29 days ($n = 7$, $SE = 2.11$). One set of twins monitored survived the summer.

In 1998, transmitters were attached to six colts ranging in age (estimated) from three to 12 days. Two colt carcasses were subsequently located intact and necropsies were performed by Dr. R.Cooper. One colt (smaller sibling) died from pneumonia and was located along the shoreline of the same pond where it was handled. The adults and remaining sibling were observed 400 m away. This particular colt had appeared weak when handled (difficulty keeping head up) the previous day. The other colt carcass (smaller sibling) had no clear cause of death identified, although it was dehydrated, and had signs of stress including mild head trauma, this colt may have been abandoned. It was located on a willow/birch ridge 75 m from where it was handled two days earlier. The adults and remaining colt were observed 350 m away. On the third mortality (smaller sibling) the transmitter was located in a raven=s (*Corvus corax*) roosting tree not far from a raven=s nest two km from where the colt was handled. The remaining three transmitters which were attached on the larger siblings either fell off or were pulled off after five, six and eight days following attachment. In 1998, colts monitored that went missing did so between days four and 22 following hatching, with an average of 9.75 days ($n = 4$, $SE = 4.13$).

In 1999, 12 transmitters were attached to six sets of twins, ranging in age from one to eight days. The day after the transmitters were attached all the chicks that were handled were observed with the adults except for one colt which was 400 m from the adults and the remaining sibling. When we conducted a ground search later that day the colt was located alive, but was laying

down and shivering under a small clump of willows on a willow/birch ridge 110 m from where it was handled. The weather was cool ($+14^{\circ}\text{C}$) with light rain. We determined that this colt was abandoned and would die of exposure if we left it, so we took the colt, kept it over night and then sent it to the Calgary Zoo. The previous day when we attached the transmitter to this particular colt, both adults were observed 70 m away from the nest with only one colt (larger one) while the smaller sibling was located by itself only meters from the nest. This smaller colt, which was less than 24 hrs old weighed 97 g (lightest of any colt handled) was moved and released with its sibling although we noted at the time that it appeared this colt was already being abandoned. This colt lived for two additional days in Calgary but died from the cumulative effects associated with advanced pneumonia. Three carcasses were located intact and necropsies were performed on them by Dr. R. Cooper. The first carcass located was floating in wet sedge. This colt had mild head trauma but the primary cause of death could not be identified, although it was likely from the

cumulative effects of trauma, infection and exposure. The second carcass located had severe head trauma and had lost 56 g in four days following attachment of the transmitter; it was emaciated and had early signs of pneumonia. This colt was located on a small sedge island in the center of a pond, while the adults were observed with the remaining (larger) sibling

430 m away. The third carcass was located on shore in dry sedge. This colt also had head trauma and signs of exposure and infection. This particular colt survived for at least one day by itself and appeared to be abandoned as the adults were observed at least 475 m from the colt for two consecutive days prior to locating the colt on the ground. The remains of two colts were found and both were suspected fox (*Vulpes fulva*) predation. Colts monitored in 1999 that went missing did so between days four and 14 following hatching, with an average of 7.57 days ($n = 7$, $SE = 1.53$). The fates of the crane colts are summarized in Table 1.

Table 1: Suspected fates of radio tagged whooping crane colts, WBNP, Canada, 1998-1999.

Colt no.	Age (days)		At death	Suspected fate
	Transmitter attachment	Transmitter off		
98-10	3		4	Raven predation
98-11	5		6	Pneumonia
98-15	5		7	*Cumulative effects
98-18	4	8		Fledged
98-40	12	5	22	Unknown
98-45	5	6		Fledged
99-1a	6		10	*Cumulative effects
99-1b	8	12		Fledged
99-2a	5		14	Fox predation
99-2b	3	7	11	Unknown
99-6a	6		8	Fox predation
99-6b	3	14		Fledged
99-7a	5	15	**	Unknown
99-7b	3		7	*Cumulative effects
99-10a	4		7	*Cumulative effects
99-10b	2		4	*Unknown
99-13a	3	12		Fledged
99-13b	1			Cumulative effects

Cumulative effects include mild-severe head trauma, exposure symptoms (usually signs of pneumonia and weight loss)

*evidence of mild trauma to the head, colt 99-1a had severe trauma to the head

**chick observed at end of June but not observed in August

Intraspecific Aggression

Based on ground observations of two nest sites that hatched both eggs in 1999, there was considerable aggression displayed between the older (larger) sibling and the younger (smaller) one. At one nest there were two bouts of aggression observed prior to the adults leaving the nest with the older colt and abandoning the younger colt. In the first bout, the larger sibling pecked the smaller one 93 times in a four minute period and in a second bout, the larger sibling

pecked the smaller one 60 times in an eight minute period. In total, the younger sibling was pecked over 150 times in a 12-minute period by the older larger sibling. About two hours after the adults departed the nest with the older colt, a raven circled the nest, landed and flew off with the smaller colt in its grasp. The adults were agitated, they alarm-called, paced back and forth but both remained with the older (larger) sibling. Observations from a second blind also revealed aggression between the colts and in one three minute bout the larger chick

pecked the smaller one 30 times. However, the smaller one also pecked at the older one several times. Out of nine smaller (younger) sibling colts that we handled for the transmitter work, four had obvious signs of trauma to the head, beak and eye region. Every one of these colts perished within four days of handling. Based on the five necropsies conducted on colt carcasses, four had evidence of head trauma and all were the smaller sibling. While it was not possible to observe any sibling aggression from the aerial monitoring it was observed that the adults rarely kept the colts separated. Only six percent (11 out of 188 observations) of the observations of family groups with two colts were of one colt with each adult. The average distance between the colts was 2.95 m ($n = 188$, $SE = 0.53$). Most (70%) of the observations (131 out of 188 observations) of family groups with two colts were of the colts two m or less from one another.

Brood Habitat Utilization

Between 1997-99, 22 broods were intensively monitored and the habitats which the families were utilizing were recorded ($n = 392$). Six different habitat types were used almost exclusively: wet bulrush (30%); dry willow/birch ridge (18%); wet sedge (15%); wet cattail (*Typha latifolia*) (14%); open water (10%) and exposed shoreline (5%). Only one observation was made of a family group in an upland (>50 m from water) and this group appeared to be moving between wetland complexes. When adults were observed brooding the chicks they were most commonly observed on dry willow/birch ridges and small islands within the ponds.

DISCUSSION

Handling

Capture of crane colts and attachment of transmitters resulted in temporary disturbance and stress to the colts and the adults. When the helicopter landed and we approached, the adults generally walked off anywhere from 20-50 m, paced back and forth, displayed, called several times and then after five-10 minutes would walk out of sight or fly off. The colt's behaviour depended on how quickly we could get to the pond where the family groups were located. In 1998, we landed further away from the family groups in an attempt to minimize disturbance. However, this simply resulted in the colts following the adults and then hiding in the sedge or bulrush further away and consequently made it difficult to locate both colts. In 1999, we landed closer to the family groups, which resulted in a reduced time in getting to their position and made it easier to locate both of the colts. Handling times varied from seven minutes to 23 minutes with an average of 16.07 minutes ($n = 14$, $SE = 1.57$). Total time from when the helicopter landed until it departed at each site was an average of 28.07 minutes ($n = 14$, $SE = 1.83$). The adults were observed with at least one colt within 12-24 hrs of handling. No colts were injured during capture and handling although the stress involved may have been additive to other factors such as infection, exposure and sibling aggression that may have resulted in a colt (particularly the smaller one) being slowed down and ultimately being abandoned. Timing of losses of study twins were comparable to losses in non study twins. In 1998, when the last study twin had

gone missing there were no other twins remaining from the six additional sets observed in the remainder of the population. In 1999, when the last study twin went missing there was one remaining set of twins out of four additional sets observed in the rest of the population. One week later this late nesting pair also lost one of their colts.

Crane Colt Mortality

This was the first study to focus on post hatching mortality in wild whooping crane colts. Over the years there have been several suspected cases of predation on eggs and colts, however there have only been a few confirmed cases. In 1977, a rare clutch of three eggs was discovered to be destroyed, apparently by large birds (Kuyt 1981). In 1978, a black bear's tracks indicated that it had raided a nest of eggs prior to hatching (Kuyt 1981). In 1979, a wolf killed a juvenile whooping crane in August (Kuyt 1981). Between 1982 and 1983 it was suspected that wolves took six of 12 radioed young whooping cranes in August and September (Kuyt 1992). During the 1996 egg collection one egg collected at a nest was empty and had a four by five cm hole punctured in it, the result of a large avian predator. Predation occurs throughout the summer but we think it is not the primary cause of young whooping crane colt mortality.

Overall, it would appear that there is an accumulation of factors working against the survival of two colts in a brood. First of all, we observed that at most nests the older colt hatched at least two days earlier than the younger one, and since these colts grow quickly, each day makes a difference in their

size and strength. The average difference in weight between the two colts from a brood was 47.55 g ($n = 11$, $SE = 7.44$). Secondly, there appears to be severe sibling aggression being displayed particularly from the older sibling towards the younger one. In this study we found that almost half the smaller siblings had outward signs of head trauma, and ground observations revealed severe aggression between the colts at the nest site. The only other ground observations made during nesting in WBNP took place in 1974 by a film crew assisted by the CWS (Muir 1976). They observed serious aggression between the colts and it was noted that the larger colt vigorously attacked the smaller one whenever it moved. The main conclusion from their observations was that this aggression is probably why only one young survives (Muir 1976). Thirdly, the family group departs the nest site within a day or two following the second egg hatching which results in the smaller sibling being forced to move before it is very strong. The observed average distance the family groups were from the nest within one week of departing the nest site was 527.85 m ($n = 157$, $SE = 62.31$) and the average daily movement of the family groups in the first week following hatching was 338.45 m ($n = 115$, $SE = 37.59$). Based on our study, when these factors are combined, it results in many of the younger siblings being worn down, and they die or get abandoned within two weeks of hatching. Out of 22 twins monitored at least two (9%) of the younger siblings fledged.

Brood Habitat Utilization

Habitat, prey abundance and distribution may also play a critical role in colt survival.

In 1997 and 1998 snow conditions and spring runoff were considered normal and most of the ponds were recharged to or near capacity. In 1999, snow conditions were well below normal and the amount of runoff and recharge was reduced. In 1999, we also observed the largest movements from the nest sites by the family groups, with the largest daily movements in June. This particular year also had the fewest colts survive. Greater energetic demands are placed on the young colts when they are forced to move further distances, in addition the colts are more vulnerable to predators such as foxes and wolves when they are moving from pond to pond. However, it should be noted that the only pair to successfully raise two young had the second largest daily movements of all pairs monitored in June.

Transmitters

There were no problems with the transmitters in 1998 except that they seemed to fall off fairly quickly. We thought that it was due to the fact that after a few days the antenna worked its way out of the colts down and the adults were pulling on it, resulting in the transmitter coming off. In 1999, we cut two additional cm off the antennas thereby reducing the amount of overhang on the colt's back and in 1999 the transmitters remained on longer. There were no technical problems with any of the transmitters. However, in 1999 we could only receive a signal from one transmitter for one monitoring flight and did not pick up the signal again. The particular colt that it was attached to also went missing and it is assumed that a predator/scavenger may have taken the colt and disabled the transmitter.

On the ground, the transmitters were easy to locate even in thick vegetation and water, in fact one was located 30 cm underground in a squirrel midden. It was believed that a fox took the colt and ate the colt near the squirrel den and then a squirrel ended up taking the remains and the transmitter underground. For the purposes of this study the method of gluing the transmitters on worked well since the first two weeks following hatching was the time period when most losses occurred. By gluing the transmitters on rather than surgically implanting them, we only had a one time disturbance to the family groups, since we did not have to recapture the colts to remove the transmitter.

Management Implications

Based on our study we found that several factors work against twins surviving, however, we did have one set of twins survive and another instance where a predator took the older colt, resulting in the younger colt surviving. The second (younger) colt seems to be insurance in case the older colt dies in the critical initial days following hatching. At least nine percent of the second younger twins survived during this study, these colts may not have been allowed to survive in this wild population under an egg collection protocol. One of the goals of the Canada/U.S. MOU on the conservation of whooping cranes is to encourage the Aransas/Wood Buffalo population to grow to 1000 individuals. In order to accomplish this in as short a time frame as possible it is necessary to leave nests with two eggs and let natural selection work to increase the fitness of the only self-sustaining wild population of whooping

cranes in the world.

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CANADA PLANTWATCH: TRENDS TO EARLIER SPRING DEVELOPMENT

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Abstract: Inter-annual changes in spring plant phenology are likely the most sensitive and observable indicators of the biotic response to climate change. In temperate zones, the timing of spring growth phases is primarily a response to accumulated temperature above a threshold value. Western Canada has shown significant warming over the last decades. Flowering data reflects this change, with spring bloom times now occurring earlier. Timing of first bloom (10% pollen shed) of aspen poplar (*Populus tremuloides*) in Edmonton, Alberta now occurs almost a month earlier than it did a century ago. Major climatic events such as El Nino events which cause Pacific ocean warming, result in earlier bloom times in western Canada. Trends to earlier spring development have been noted in many countries in Europe.

Extensive phenology surveys began in Canada in the 1890's with an ambitious program launched by the Royal Society of Canada.. Alberta has considerable recent data with volunteer observers reporting on native species since 1973. Since 1987, the Alberta Wildflower Survey has involved about 200 volunteers reporting 3 flowering stages for 15 native plants. Plantwatch (<http://www.devonian.ualberta.ca/pwatch>) began in 1995 and now receives North American bloom dates for 7 native plant species plus international data for common purple lilac (*Syringa vulgaris*). Data tables and maps of bloom times are updated regularly on the Internet. Environment Canada's Ecological Monitoring and Assessment Network now considers plant phenology as a core variable for monitoring environmental change. The Plantwatch program will thus expand in 2001, adding more plant species suitable across wide areas of Canada, moving the website to Environment Canada, involving representatives from more provinces and territories, and promoting the expanded survey with help from the Canadian Nature Federation.

INTRODUCTION

Spring plant phenology provides an effective biomonitor for climate change. In temperate zones of the earth, timing of spring growth phases (phenophases), for example, budding, leafing, and flowering of plants, is primarily a response to accumulated temperature above a threshold value. In particular,

timing of spring flowering of perennials correlates well with growing degree-days (Rathcke and Lacey 1985), and a trend to warmer winters and springs should be reflected in a trend to earlier flowering.

A. PHENOLOGY SURVEYS

“Plantwatch” involves students and the

public internationally in reporting bloom times for selected plant species via the Internet (www.devonian.ualberta.ca/pwatch). It started in 1995 focusing on teachers/students of the prairie provinces as observers (Beaubien 1996). Since 1997 it has broadened to gather data North America-wide from the public on two bloom phases of seven native plants, leaf-out data for poplar, plus international bloom data on common purple lilac. Selected “key indicator” plants include seven native species found in North America plus a cultivated species, *Syringa vulgaris* (common purple lilac). Currently the species are: aspen poplar, *Populus tremuloides* Michx.; prairie crocus, *Anemone patens* L.; saskatoon, *Amelanchier* spp; western trillium, *Trillium ovatum* Pursh.; white trillium, *Trillium grandiflorum* (Michx.) Salisb.; purple saxifrage, *Saxifraga oppositifolia* L.; and white dryad, *Dryas octopetala* L., / *Dryas integrifolia* M. Vahl.. Plant species were selected on the basis of wide distribution, perennial habit, ease of recognition by amateurs, lack of subspecies, and brief spring flowering period. Observers register on the web and report their locations and dates, and within the week their data is posted in tables and maps of flowering times. In the year 2000 the following number of observations were submitted: from Canada:112, USA: 10, Europe (England, Slovakia, Poland, Germany):25, and Japan:78, for a total of 225. In 1999 (with more publicity) we had 298 observations. Past years’ data is available on the webpage.

The Alberta Wildflower Survey is a separate entity. Beginning in 1987, it has gathered flowering dates for 15 native plants (Beaubien 1990, 1991). Criteria for species selection, potential sources of variation in

the data, and temperature requirements for bloom have been described (Beaubien and Johnson 1994). Observers include naturalists, retired people, farmers, gardeners, forest service fire tower watchers, and federal volunteer weather observers. Observations are reported by approximately 200 volunteer observers per year using mailed-in forms or Email. This survey was a resurrection of a previous survey done through the Federation of Alberta Naturalists; Charles Bird annually published first bloom data for 12 native plants for Alberta for 10 years:1973-1982 (Bird 1983).

B: HISTORIC PHENOLOGY DATA

Historical phenology records provide an essential baseline against which more recent records can be compared. In Canada, observations 1893-1922 were published annually by the Royal Society of Canada, including 177 unique seasonal events made at 297 observation stations. (Royal Society of Canada). Affiliated natural history and scientific societies gathered data on flowering and leafing of selected plants, arrival times of birds, ice break-up on rivers, etc. We have digitized this data and used it to rank 9 ecozones with respect to earliness of development. The largest group of observers were students in Nova Scotia, who reported on up to 100 events up until the 1920's. Environment Canada has posted this database [<http://www.cciw.ca/MacKay/>].

Other historic North American datasets have been described (Beaubien and Johnson, 1994).

For Edmonton, Alberta, spring flowering data is available from the Alberta Wildflower Surveys (1973 to present) as described above. As well, Russell (1962) summarized first bloom data for native

species for three prairie cities, Edmonton, Saskatoon and Winnipeg. These data were published annually by the Canadian Plant Disease Survey for 1936-1961.

C. TRENDS TO EARLIER SPRING

Warming in the western Canadian interior over the last century has been described by others at this conference. The trend has been to warmer winters and springs, which should be reflected in earlier bloom times. (Studies which link air temperatures and flowering times are numerous: Lindsey and Newman 1956, White 1995).

The long-term trend (1900 to 1997) in timing of first bloom of *Populus tremuloides* shows an advance of 26 days over this period (Beaubien and Freeland 2000). Of the four historic data sets used, the earliest Royal Society data is most limited, representing here only one observation per year for 1901-1903. However the same trend, a movement forward of .26 days/year, is shown for the well-reported years 1973-1997. Late winter temperatures over the century show a linear trend of 2 EC increase. A distinct effect of El Niño can be seen: for 20 years between 1973 and 1996, all medium and strong El Niño events (Quinn et al. 1987, Cowan 1992) are associated with early spring flowering in Edmonton. No other Canadian flowering trend data has as yet been published.

Earlier spring development is occurring in parts of Europe. Analysis of Europe's International Phenological Garden data gathered 1959-1993 reveals a lengthening of the growing season of 10.8 days since the 1960's, and specifically a trend to earlier onset of spring phenophases of 6 days (Menzel and Fabian 1999). This garden program placed cloned woody species in

scientific gardens across Europe and these plants were tracked over time by consistent observers.

Satellites have been used to detect changes in the growing season. In particular, Myneni *et al.* (1997) noted an 8-day increase in the growing season (1981 - 1991) in the northern latitudes, and an increase in spring temperatures with earlier snowmelt. This has considerable implication for migrating caribou in the NWT, whose reproductive success depends on synchrony of calving and greenup. Greenup is occurring earlier now and caribou may arrive too late for optimal foraging after struggling north across waterways normally frozen.

In the UK, trends in timing of phenological events have been described by Fitter *et al.* (1995) and Sparks and Carey (1995). These papers predict that in general for a 3.5EC increase in global temperature, spring flowering will occur about 2 weeks earlier. Sparks and Carey (1995), in examination of the 200-year Marham phenological record (up to 1947), noted a positive trend in winter temperature with earlier flowering of some plant species. In Estonia springtime has advanced 8 days over the last 80 years, with faster changes in the last 40 (Ahas 1999).

D. IMPLICATIONS OF EARLIER SPRING DEVELOPMENT

Implications of climate warming in western Canada include northward shifts in life zones, reduced reproductive ability for early blooming woody species, and potentially, asynchrony of some plants with their pollinators, or plants with their insect herbivores.

Warming in the prairie provinces will lead to increased potential evapotranspiration, and

the predicted drought will impact on plant distributions. It is predicted that the southern boreal forest will be replaced by aspen parkland (Hogg and Hurdle 1995). *Populus tremuloides* is the dominant tree of the parkland, and the trend illustrated to earlier development has implications for population dynamics. Specifically, a negative impact on reproduction can be expected on this and other early-flowering woody species such as *Salix*, *Alnus* and *Betula*. An increasing frequency of warmer winters and springs is likely to result in very early flowers being killed by subsequent frosts and the year's seed production lost (Hänninen 1991, Myking 1997). Though poplar and willow reproduce largely by suckering, they are also pioneer species that first occupy barren soils exposed by forest fire or storms. This reduced reproductive potential may negatively impact the ability of these species to move north in response to shifting climatic zones.

Both temperature and photoperiod play large roles in determining phenology of plants and animals. While climate warming results in a change in thermal regime, there is no corresponding change in photoperiod. The normal development of plants, which are locally adapted to a certain combination of light and temperature cues, will be disrupted by the predicted warming (Lechowicz 1995). Unless we know how individual species respond to temperature we cannot predict their responses to climate warming (Harrington *et al.* 1999). Plant phenology provides a way to gather extensive data on this relationship. With increasing interest in climate change as well as evidence showing increased interannual variability in weather, phenological data are being recognized as essential inputs into accurate models of biosphere response (Reed *et al.* 1994, Schwartz 1998, White *et al.* 1997).

E. PRAIRIE APPLICATIONS OF PHENOLOGICAL DATA

Applications: Phenology can be used as a valuable predictive tool in a variety of contexts. We have illustrated its usefulness in tracking the effects of climate change. As well, these data can assist foresters and farmers in predicting the optimum timing of operations such as planting, fertilizing, and crop protection. (Because spring insects and plants both develop in response to temperature, the timing of appearance of the most vulnerable stage of an insect's life cycle can be predicted by an obvious plant flowering event and harvest.) In wildlife management, such data can assist in predicting deer population changes, since more deer fawns are successful in years with an early spring. Other applications include human health (allergy season prediction) and tourism.

F. PLANTWATCH: FUTURE PROGRAM

Environment Canada's Ecological Monitoring and Assessment Network (EMAN) has selected plant phenology as a core variable for monitoring change in the environment, and is assisting with an expansion of Plantwatch. As a first step, we are working towards involving each province and territory to more effectively reach volunteer observers across our large country. With EMAN's financial assistance I sought a potential Plantwatch coordinator from each of the ten provinces and three territories, and gathered them for a two day meeting May 2000 in Ottawa. I was able to get reps from all provinces/territories (except the two most populated provinces, Ontario and Quebec) and we shared information on existing Plantwatch

programs in Canada and the why/ how/ what/ who /where/ when of coordinating a provincial/ territorial program. Nova Scotia and Newfoundland already had surveys which started in the last 4 years, and this spring new surveys on the prairies and in the northern territories will be launched. Kim Monson of the Department of Geography, University of Winnipeg, is now heading up the Manitoba Plantwatch through the Manitoba Natural History Society. Kerry Hecker of the Saskatchewan Native Plant Society, is initiating a Saskatchewan Plantwatch. This year we will select additional plant species useful on a national basis and create a new association to represent the provinces plus government and non-profit organizations.

For the 2001 season Internet reporting of flowering dates will be done on the current website (<http://www.devonian.ualberta.ca/pwatch>). For the 2002 season the web page will move to EMAN and observers will link to their own province's webpage and see a list of appropriate plants. Observers have a choice of reporting electronically on the site, or submitting their observations by mail to their coordinators. (See EMAN's Frogwatch program: <http://www.cciw.ca/emanops>, which they launched in the spring 2000 edition of Nature Canada: magazine of the Canadian Nature Federation = CNF).

Many Internet-based nature observation programs exist worldwide. For links to programs such as Journey North (North America), waterwatch (Australia), insectathon (Namibia) see the webpage of a December 2000 workshop in Bonn, Germany: <http://www.dainet.de/bmu-cbd/workshop/Bonn.htm>

Even if Canada's CO₂ emission reductions promised as part of the Kyoto accord are kept, we will still see big changes as a result of climate change. Plantwatch is a valuable tool to involve the public in tracking environmental change and thus to build awareness of the need for citizens to take action to reduce emissions! Convincing the public and industry to reduce consumption of fossil fuels and use of motorized vehicles will be a great challenge.

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TESTING AN IMPROVED POLLINATION STRATEGY FOR THE ENDANGERED WESTERN PRAIRIE FRINGED ORCHID IN THE TALL GRASS PRAIRIE PRESERVE AT VITA, MANITOBA

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Abstract: The western prairie fringed orchid (*Platanthera praeclara*) is found in the vicinity of several small areas of remnant tall grass prairie in southeastern Manitoba and before being discovered in the Tolstoi area (now Manitoba's Tall Grass Prairie Preserve) it was not known to exist in Canada. It is Canada's largest and one of our most impressive native orchids. The orchid has now been placed on Canada's list of endangered plants and its endangered status is recognized on a worldwide basis. It has become evident however, that the populations of western prairie fringed orchids in Manitoba often have very poor seed set, usually with less than 5% of plants producing viable seeds in many years. This phenomenon of low seed set is considered by certain researchers and conservationists as a possible impediment to maintaining healthy populations in the few remaining areas where the orchid is found. Higher levels of seed production would help ensure adequate reproduction over the long term and maintain core orchid populations. Preliminary research has shown that of the hundreds of potential pollinating insect species available in the area, only two species of moths are acting as pollinators and they have a unique biological relationship with the orchid. This presentation reports on the most recent results of this research into orchid pollination by moths in Manitoba's tall grass prairie.

DUST AND DELUGE: HABITAT DYNAMICS ON THE PRAIRIES

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Abstract: A distinctive feature of the natural environment in the grassland and parkland regions of the Prairie Provinces is the great variability in climatic conditions. Extremes in precipitation periods of drought or above average moisture are of regular occurrence and often have profound effects on the habitats of upland and wetland animals and plants. For example, breeding bird monitoring in the Milk River area of Alberta has demonstrated significant oscillations in numbers in totals of all species between severe drought and record rainfall years, and important differences in the response of individual species. Amphibian surveys in the dry mixed grassland have shown marked fluctuations from year to year in breeding activity and perceived population levels with respect to available moisture. In the parkland and grassland of southeastern Alberta, the location of key habitats for breeding and transient shorebirds has been quite variable between survey periods with respect to changing water levels. Based on these types of studies, it is obvious that for a broad diversity of animals and plants, optimum habitat conditions for reproduction are often very temporary and erratic. Not only are native prairie species able to thrive in this capricious environment, some appear to actually require ephemeral habitat conditions. Complications in prairie ecosystem dynamics and in our understanding of them arise because of human disturbance, range management practices, water management projects, and wildlife enhancement and management. The implications for prairie conservation include the following: (1) to conduct wildlife and habitat surveys and assessments over the range of habitat conditions in order to obtain a more complete picture of variability; (2) the conservation of large, continuous blocks of native habitat to ensure the availability of habitat diversity over a range of environmental extremes; (3) a broader, more flexible system of wildlife management, incorporating the importance of natural processes and an ecosystem/community approach into conservation programs.

INTRODUCTION

Over the last three decades, the author has been involved in a wide diversity of studies of birds, mammals, amphibians, reptiles, plants and native habitats in the grasslands

and aspen parkland of Alberta. This paper presents food for thought for prairie

conservation based upon data and general impressions gleaned over this period through research and natural history observations.

A distinctive feature of the natural environment on the Canadian Prairies is the great variability in climatic conditions. Extremes in precipitation—periods of drought or above average moisture—are of frequent occurrence and often have profound effects on habitats and wildlife. Interrelated with climatic variability are natural processes such as grazing and fire. Ongoing habitat changes induced through human activities, including water management projects and range management practices, complicate ecosystem dynamics and our ability to understand them. The following is a presentation of examples that illustrate the changeable environmental conditions of this region, wildlife fluctuations and adaptations, human disturbance and threats, and management issues.

WETLAND DYNAMICS

Perhaps the most obvious effects of fluctuating moisture conditions on the prairies can be observed in wetland dynamics. Drought periods result in receding water levels and a shrinkage of lake waters in their basins. These are often perceived as negative events. But, while there may be negative effects on some habitats and species, there are positive spin-offs for others. For example, the creation of productive shallow waters and mudflats for staging shorebirds, and exposed shores for nesting Piping Plovers.

In the case of Piping Plovers in Alberta, falling water levels in the 1980s resulted in excellent breeding conditions at numerous sites and 1986 produced the highest count of adult birds in the province. However, in subsequent years, as water levels continued to fall, habitat suitability at most of these

sites began to decline, while habitat suitability at others, including sites where this species had previously been absent or rare, increased (Wershler 1992b).

So, for Piping Plovers, critical habitats encompass a range of breeding sites, ranging from traditional well-known habitats to those that are productive on a short-term erratic basis. Concomitantly, breeding populations of this species fluctuate with respect to conditions across its range, which may be complicated by localized variability in precipitation. Water stabilization projects at Piping Plover lakes are a threat to this system. With this in mind, and given the species' rarity and spotty distribution, I have always recommended a provincial management plan that would conserve all habitats within the species range and incorporate a population goal ranging from a minimum (worst-case scenario) to a maximum (best-case scenario), to be revised as the species is better understood. This is a novel concept for wildlife management that recognizes the unique needs of the species.

A similar scenario exists for staging shorebirds. Based on initial surveys in the early 1980s, we believed we had a pretty good idea of where the key habitats were in a study area in the Reflex Lake-Sounding Lake area of the eastern Central Parkland. However, subsequent surveys revealed that concentrations of shorebirds use a greater number and variety of wetlands as habitat suitability shifts in response to fluctuating water levels (Wershler 1990). In the last two decades the driving factor has been extended drought, but in the future it could be high water levels. With this insight, the concept of critical habitat has been redefined to encompass a diversity of naturally

fluctuating wetlands within the region, including marshy wetlands that become important when some of the key saline basins dry up.

At any given time, key habitats for staging shorebirds can include some that are temporarily unsuitable. As with Piping Plovers, some habitats that are unproductive for extended periods can all of a sudden become very significant. For example, large alkali basins that have been dry over much of the last two decades have produced some of the highest counts of shorebirds in the province when productive shallow water habitats are present. These include Sounding Lake, in this region, and Pakowki Lake, in the Mixed Grassland, farther south.

Temporary wetlands are even more vulnerable to climatic extremes. The breeding activities of the Great Plains Toad are strongly associated with seasonal ponds. Maximum breeding occurs during wet years, while prolonged periods of drought can result in little or no breeding. During drought periods, this species burrows underground, possibly emerging for short periods to feed. In the Lost River area, in 1991, very localized torrential rainfall resulted in a flurry of Great Plain Toad breeding activity, following a decade or more of no confirmed breeding. The longevity of this species appears to be a key adaptation in being able to survive long dry periods between favorable breeding events (James 1998).

Numerous dry ponds within the range of the Great Plains Toad, including some historic breeding sites, have been disturbed through dugout construction or diking in order to provide livestock watering areas (Wershler

and Smith 1992). The importance of temporary water for this species is highlighted in a New Mexico study (Woodward 1983) that found larvae of amphibians, which typically bred in temporary ponds, were subjected to higher levels of predation in more permanent ponds because of the presence of predatory invertebrates that do not normally occur in temporary habitats.

Another amphibian of note is the Northern Leopard Frog, a species of special concern on the prairies because of population declines. Some of the most important populations of this species in Alberta have managed to thrive in the warmest, driest parts of the mixed grassland (Wershler 1991). Monitoring programs have documented population fluctuations associated with wet and dry periods, with little or no successful breeding in very dry years, followed by peaks of successful breeding in wetter years (Wershler 1992a). Critical to this species' survival are diverse aquatic systems that provide a variety of habitats for various stages in the life cycle, including permanent water for overwintering that is often associated with ground-water discharge (Wershler 1991). Many significant spring-fed wetlands in the Mixed Grassland and Eastern Parkland have been altered to create accessible water for livestock and the oil and gas industry.

Before white settlement, wetlands were largely temporary in nature in the drier parts of the Mixed Grassland, while permanent water and tall marsh vegetation was very localized. Today, an abundance of artificially created or enhanced wetlands occur within the region, especially in the vicinity of irrigation developments. These are often very different in character from the

original permanent wetlands that typically were either much more restricted habitats associated with groundwater discharge, or broad shallow-water basins that fluctuated more freely with the vagaries of precipitation. As a result of this new habitat, many bird species are now more abundant compared with their former numbers, including some that were previously absent. Many of these artificial wetlands exist at the expense of low-lying areas and temporary wetlands that were incorporated into the modern wetland developments.

Recently, there has been some interest in managing artificial wetlands in ways that will benefit a greater diversity of species, including shorebirds and amphibians. However, only a few studies have been carried out on wetland diversity and dynamics in native blocks of grassland and parkland habitat.

GRASSLAND DYNAMICS

While often less apparent, major oscillations in precipitation can also have significant effects in grassland habitats. For example, breeding bird monitoring in the Milk River area of southeastern Alberta revealed marked differences in totals of singing birds of all species between severe drought and record rainfall years, as well as important differences in the response of individual species (Wershler and Smith 1996). In a 5-year project (1991-95), 1992 represented one of the driest springs recorded in area, while 1993 was one of the wettest. Even though the grassland was not grazed during 1992, total singing birds of all species declined from 1991 to 1992 by 46% in June and 45% in July. Of 6 major species,

numbers of all but one, Horned Lark, declined in (June/July) numbers over this period: Sprague's Pipits by 35/34%, Western Meadowlark by 39/33%, and Baird's Sparrows by 98/97%. Horned Larks, in contrast, showed an increase of 17% in June.

As moisture conditions improved and vegetation recovered from 1992, total numbers of singing birds gradually increased, with the exception of one season (July 1994 which was very dry). By 1995, total numbers of singing birds were 76/69% of 1991 totals. Over this period, Sprague's Pipit numbers in June 1995 were equal to those of June 1991, while Baird's Sparrow numbers in June 1994 and 1995 were 35% and 20% higher, respectively, than in June 1991. In a three-year North Dakota grassland bird study (George et al. 1992), total June bird density declined by 61% from the year prior to a drought to the year of a drought. In the post-drought year, total bird density and densities for most individual species had recovered to pre-drought levels.

Periods of drought are important in the creation and maintenance of active sand dunes, habitats very important for a number of rare plants and wildlife species.

GRASSLAND MANAGEMENT

A current trend in grazing management over much of the grassland region is the implementation of conservative grazing rates for the promotion of healthy grass cover and minimal grassland and soil disturbance, and to help safeguard against the negative effects of drought. A major improvement is an appropriate rotational system that can create

a mosaic of grass cover types to satisfy a diversity of animal species, while still accommodating cattle grazing interests. An important factor for consideration, however, is the optimum size of patches within the mosaic for the maintenance of various ecosystem features. There are certain areas where management for a large diversity of habitats and species is inappropriate. These include sites with the best potential for specific communities that are not well represented elsewhere; for example, blocks of Northern Fescue Grassland and associated lush grassland species.

Prior to agricultural settlement, there were a wide range of conditions in the grasslands created by dynamic interrelated factors, including drought, fire and bison grazing. This variety obviously included extreme environmental conditions (e.g. overgrazing, bare soil, carrion and burned areas) that are avoided and poorly understood today, but that may have been very important to vegetation and wildlife dynamics.

A major feature missing on the range today appears to be extensive areas of heavy grazing. There are numerous historical accounts from the bison era that describe very heavily used tracts of grassland. What are the implications of the loss of this habitat feature on species that require heavier grazing—species including Richardson's Ground Squirrel, Burrowing Owl and Mountain Plover that have shown recent declines in native mixed grassland? For the Mountain Plover, the lack of heavily grazing on native range has been identified as a threat to the conservation of this species (U.S. Fish and Wildlife Service 1999; Wershler In prep.).

The frequency and importance of fire in the mixed grassland of Canada and its use as a potential management tool requires further investigation. The first documented nesting records of Mountain Plover in Canada were in habitat at Lost River created by a recent lightning strike fire (Wershler and Wallis 1986). At the site of another lightning strike fire, in the Milk River area, species of plants rare or uncommon in the region were found in abundance (C. Wallis pers. com.).

CONCLUSION AND RECOMMENDATIONS

Based on the foregoing, it is obvious that temporary and erratic habitat conditions are the rule rather than the exception in the prairie ecosystem. Not only are native species able to thrive in this capricious environment, some appear to actually require the fluctuating habitat conditions.

Implications for prairie conservation include the following:

- (1) Wildlife and habitat monitoring should be carried out over the range of climatic conditions to obtain a more complete picture of habitat and species' dynamics. The observation of prevailing conditions over a short-term survey can result in a biased or incomplete perspective of the status of various species.
- (2) Every effort should be made to preserve the larger blocks of native prairie habitat that remain. These offer the best opportunities to provide the spectrum of habitat options needed for habitat and species conservation.
- (3) More research is required on the relationships of missing features and natural processes on ecosystem health. These may

include bison, fire, carrion and intensive grazing.

(4) A different approach for wildlife management is needed, incorporating the importance of natural processes and an multi-species/community approach into conservation programs. Research on individual species will always be required, but management and recovery plans must consider the welfare of other species and values of the ecosystem. Biologists should strive for an appreciation and understanding of the range of documented significant features and conservation initiatives in their study areas. This would help prevent conflicts when active management work is undertaken.

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HABITAT LOSS AND FRAGMENTATION IN THE BOREAL FRINGE: CAUSES AND CONSEQUENCES FOR CONSERVATION

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Abstract: Habitat loss and fragmentation are key conservation issues on the Canadian prairies. However, relatively little is known about the consequences these processes in forested landscapes. We investigated amount and rates of habitat change across the Boreal fringe of Saskatchewan, and various cultural and environmental factors influencing pattern and rates of loss. We also investigated trends in bird populations from 1966 to 1996 across the Boreal Plains Ecoregion with data from the North American Breeding Bird Survey (BBS). Habitat loss was quantified using a geographic information system (GIS), comparing Landsat satellite imagery from 1994 with Canada Land Inventory land-use data (circa 1966). We examined 49,846 km² across the Boreal fringe of Saskatchewan. Across the study area, 4,368 km² of forest was lost between 1966 and 1994. This translated into an annual rate of deforestation of 0.87%, far exceeding the world average of 0.3% per year. Private land ownership, land suitability for agriculture and road density were all negatively correlated with forest cover. The annual rate of deforestation was more than double on private versus publicly owned lands (1.13% vs. 0.54%/year). Several long-term BBS routes with few or no observer changes were selected to assess the consequences of habitat change. Five routes in the Boreal fringe showed significantly declining bird population trends, particularly for forest, wetland and grassland birds. This contrasted sharply with a control route in the boreal forest, not subjected to fragmentation by agriculture that showed no significant declines in any species. The Brightsand, Saskatchewan, route in particular went from a high of 105 species encountered in 1987, to 67 species in 1995. Habitat loss and alteration occurred on all five fringe routes. We conclude that habitat change due to agricultural conversion of forested land and wetlands has contributed significantly to local population declines of species. Furthermore,

conservation efforts will best focused be on publicly owned lands and through encouraging economically and ecologically sustainable activities on privately owned lands.

INTRODUCTION

Habitat loss and fragmentation are key conservation issues on the Canadian prairies. However, relatively little is known concerning the consequences of these alterations in forested landscapes. Much of the previous research on habitat loss has focused on tropical forests, and little has been done in northern regions. To effectively direct conservation efforts, it is important to determine the rates of habitat loss and to identify the cultural and ecological factors influencing the loss and fragmentation of habitat (Whitney and Somerlot 1985).

In the southern portions of the boreal forest, agriculture is the dominant force of change. As early as the 1950's, Davidson (1952) recognized the risk to the boreal forest posed by rapid expansion of agriculture along its southern border. With over 150 species of birds breeding in the region, many of which are in decline, understanding the factors responsible for the conversion of forest to agriculture is important for the conservation of the biodiversity of the boreal forest.

The objective of this study was to determine the causes, extent, and conservation implications of habitat change in the southern fringes of the boreal forest, particularly in Saskatchewan. We investigated the amount and rates of habitat change across the boreal fringe of Saskatchewan, and attempted to identify the cultural and environmental factors associated with habitat change in this region. We hypothesized that land ownership, location, access to market and land quality for

agriculture would influence landscape structure and habitat change. We also investigated trends in bird populations from 1966 to 1996 across the Boreal Plains ecoregion with data from the North American Breeding Bird Survey (BBS) to determine if any decline in the populations of certain species was associated with habitat loss on the breeding grounds.

METHODS

The study area lies within the boreal fringe portion of the Boreal Plains ecozone. The Boreal fringe is the portion of the ecozone not allocated to Forest Management Agreements, and therefore is subject to private ownership and agricultural practices. We concentrated on the portion of the boreal fringe lying within Saskatchewan for assessing rates of habitat change; however, we present BBS data from across the ecozone. We selected the following five routes located in the Boreal Plain ecozone: Brightsand, Saskatchewan (53_30' N, 108_40' W), Clouston, Saskatchewan (53_06' N, 105_51' W), Athabasca, Alberta (54_50' N, 113_06' W), Two Hills, Alberta (53_44' N, 111_32' W), and Tyndall, Manitoba routes (50_04' N, 96_36' W). In addition, we selected one route from the Boreal Shield Ecozone (Bird River, Manitoba (50_25' N, 95_42' W)) that was not subjected to agricultural clearing for comparison.

We used Geographic Information Systems (GIS) to investigate landscape change. Recent land-cover was determined from 98 digital mapsheets from the Southern Digital

Land Cover project (SDLC). Data for this project came from LANDSAT Thematic Mapper (hereafter LANDSAT) bands 3, 4 and 5 taken from imagery collected between 1993 and 1994. Historic land cover was determined from Canada Land Inventory (CLI) “present” land-use data, circa 1966. CLI data were interpreted from aerial photography. Land cover for both time periods was reclassified so that all shrubs, bogs, productive and non-productive forests were considered forest cover. Cultivated lands, grasslands, farmsteads, and other anthropogenic disturbances (e.g. roads and towns) were classified as agriculture. Water was retained as a separate class.

In addition to land-cover, we assessed the impact of land ownership, road density, and towns on landscape change in the region. These data were derived from the Saskatchewan Base map, created at a scale of 1:50,000 from aerial photography collected between 1980 and 1995. Land capability for agriculture (CLI) was used to determine if land conversion for agriculture was influenced by land quality (nutrients, slope, stoniness, etc.). Latitude and Longitude were generated to determine if there was a spatial trend in where landscape change had occurred. All data manipulations and analyses were performed using Arcview v. 3.1 (Environmental Systems Research Institute, Redlands, California).

The study area was subdivided in 685 equal area hexagons (50 km²), and each hexagon was used as a sample in subsequent analyses. A series of overlays and queries were performed to identify amount of forest cover in each land-cover category for both time periods, as well as land ownership, length of roads, distance to towns and

percent of land suitable for cultivation within each hexagon.

The GIS datasets were first analyzed for autocorrelation by calculating Moran’s I. Since significant autocorrelation existed in most datasets, we developed predictive models using mixed regressive spatially autoregressive models (MRSA) using the program SPACESTATPACK (Pace and Barry 1997a,b). Mixed regressive spatially autoregressive models (MRSA) are regression techniques that account for autocorrelation in the data. BBS datasets were analyzed using two methods. Individual bird trends were analyzed using route regression analysis (Sauer et al. 1997), and species richness was analyzed using linear regression analysis. We also analyzed trends of species-habitat guilds. Trends in populations by species guilds were analysed by Brian Collins of the Canadian Wildlife Service in Hull, Quebec, using the program BBSANALYS (Collins 1998). Route trends are estimated using the methods described in Link and Sauer (1994).

RESULTS

Habitat change

We examined an area of 49,846 km², comprising 95% of the 52,357 km² Boreal fringe of Saskatchewan (Figure 1). In 1966, 35.9% of the study area was forested, this decreased to 27.1% in 1994 representing 4,368 km² of forest lost, or an annual rate of change in forest cover of -0.87% (per year) for the entire study area. Due to large differences in classification of water between time periods (Figure 1), we also removed areas with water in 1994 that were not classified as water in 1966. This gave a more

conservative deforestation estimate of 0.75% (per year).

For both time periods, the amount of forest cover was negatively correlated with the % of privately owned lands, % of land suitable for agriculture, and the density of roads (Table 1). Forest cover was greater in more northerly portions of the study area (Table 1 and Figure 1). In 1994, 18.9% of privately owned land remained as forest. In contrast, 42% of the land on Indian reserves and 55% of lands managed or leased by the provincial government were forested. There was also a marked difference in the amount of forest cover on lands classed as suitable and not suitable for agriculture. Of the lands not suitable for agriculture, 50% remained forested whereas only 22% of land suitable for agriculture remained forested. Overall, 86 % of the variation in forest cover (1994) could be explained by these variables. However, removing locally averaged spatial variation (autocorrelation) reduced this to 62% ($\chi^2 = 354.4$, $df = 8$, $P < 0.001$). Similarly, 83% of the variance in forest cover in 1966 was explained by our predictive model, but removing the locally averaged variation reduced this to 59% ($\chi^2 = 368.4$, $df = 8$, $P < 0.001$).

Deforestation rates were positively correlated with % of privately owned lands ($\chi^2 = 7.8$, $df = 2$, $P = 0.02$). The annual rate of change was -1.13% per year on privately-owned lands and -0.54% per year on public lands. Road density, land suitability for cultivation, distance to nearest town, latitude, and longitude were not significant predictors of the annual rate of change in forest cover ($P > 0.10$). Overall, 68% of the variation in deforestation rates could be

accounted for by our predictive model; however, strong spatial autocorrelation was driving this. Removing the locally averaged spatial variation reduced the model fit to only 4% ($\chi^2 = 159.8$, $df = 8$, $P < 0.001$).

Forest fragmentation was quantified using two methods. Edge density of forest was positively correlated with percent of privately-owned land ($\chi^2 = 45.8$, $df = 2$, $P < 0.001$), % land suitable for cultivation ($\chi^2 = 24.8$, $df = 2$, $P < 0.001$), and road density ($\chi^2 = 32.6$, $df = 2$, $P < 0.001$), but was negatively correlated with latitude ($\chi^2 = 13.0$, $df = 2$, $P < 0.001$). The MRSA model explained 80% of the variation in the data, but the explained variance was reduced to 54% when the spatial autocorrelation terms were removed ($\chi^2 = 438.8$, $df = 8$, $P < 0.0001$). Number of forest patches was positively correlated with road density ($\chi^2 = 11.8$, $df = 2$, $P < 0.001$) and negatively correlated with the % of privately owned land ($\chi^2 = 75.0$, $df = 2$, $P < 0.001$). Removing the spatial autocorrelation terms reduced the fit of the model from 74% to 37% ($\chi^2 = 460.2$, $df = 8$, $P < 0.001$).

Bird Trends

All but one route in the boreal fringe showed significant declines in species richness (Figure 2). Species richness declined at Brightsand, (slope = -1.65, $r^2 = 0.51$, $F = 17.55$, $P < 0.001$), Clouston (slope = -0.47, $r^2 = 0.27$, $F = 8.1$, $P < 0.05$) and Two Hills (slope = -0.92, $r^2 = 0.55$, $F = 29.23$, $P < 0.001$) and increased at Tyndall, (slope = +0.42, $r^2 = 0.44$, $F = 18.54$, $P < 0.001$). No trends were detected on the Athabasca or Bird River control route. At Brightsand, the mean number of species ($\pm$ SD) detected per year was 95.7 $\pm$ 2.7 prior

to 1990 and 74.7 ± 2.2 (Mann-Whitney U; $U=4.0$, $Z=-3.13$, $P=0.0017$) after that year. Several species declined in numbers on the boreal fringe routes, while no species exhibited any significant trends on the continuous forest route (i.e., control) (Table 2). Species showing significant declines were not restricted to any particular habitat. On the Brightsand BBS route, all guilds showed negative population trends (Table 3). Although forest and wetland birds showed the largest annual declines (-5.0% and -8.7% per year, respectively), significant declines were also detected for grassland and cosmopolitan birds (magpies, crows etc.). Athabasca showed similar results to Brightsand, except for cosmopolitan birds which increased (Table 3). Similar to Brightsand and Athabasca, populations of grassland and wetland birds declined in Two Hills and Clouston. However, both Two Hills and Clouston did not exhibit any decline in forest birds or shrubland birds (Table 3). Guild trends were different on Tyndall than they were on the other four forest fringe routes. Wetland species on Tyndall declined as they had elsewhere, but forest and cosmopolitan (disturbance-tolerant) species increased and shrubland and grassland birds remained stable.

Habitat change along BBS routes

We examined habitat change along the Brightsand BBS route to determine if it was consistent with changes in bird abundance. A significant amount of habitat change occurred along the Brightsand BBS route between 1963 and 1994 (Figure 3). Forest cover within the 400 metre buffer decreased by 51.8%. Similarly, 45.3% of forest outside of the Forest Management Area (FMA) was lost when the entire mapsheet was examined

(Figure 3). Within the BBS buffered area, there was a 12.8% decrease of waterbodies, whereas there was a 3.9% decrease of all waterbodies outside of the FMA over the entire mapsheet. Amount of land under cultivation increased by 85.6% within the 400 metre buffer, and by 117.6% for the entire mapsheet. The annual deforestation rate was 1.6% and 1.8% for the buffer around the BBS route and mapsheet respectively. Currently we lack data for other BBS routes. BBS observers indicated to us that forest clearing and wetland drainage were also common along the Athabasca, Clouston and Two Hills BBS routes; all these routes having species with negative population trends. The opposite was true of the Tyndall BBS route, where farm abandonment has led to an increase in forest and shrub cover.

CONCLUSIONS

The rates of deforestation measured in this study were considerably higher than the world average of 0.3% per year (FAO 1999). Our province-wide results are consistent with studies from across the Boreal Plains ecozone which have detected deforestation rates ranging from 0.87% to 1.76% per year (EC 1991, Fitzsimmons et al. 1997, AEP1999). The greatest influence on forest cover was clearly land-ownership and land-quality. Private landowners had far less forest on their land than did areas managed by the provincial government or native bands. Lands suitable for agriculture also retained less forest than land not suitable for agriculture but we were unable to accurately predict deforestation. However, the size of the hexagons used in our analyses may have been too large to accurately predict the local

factors influencing changes in forest cover (Turner et al. 1996).

Although declines in certain species may have been influenced by habitat degradation in the Neotropics (Sherry and Holmes 1996), many of the species that declined or disappeared on the BBS routes are not restricted to this group. Changes in bird communities were most dramatic on BBS routes that experienced the most habitat change. Neotropical migrants such as the Veery, Swainson's Thrush and Ovenbird declined in the forest fringe, but were stable on the continuous forest route. The routes showing decreases in wetland, forest and grassland associated birds were also subjected to substantial habitat change. In contrast, our control route and one route, which has apparently undergone farm abandonment, show either stable or increasing bird population trends. This strongly suggests an association between breeding habitat change and bird numbers. Kirk et al. (1997) in their comparison of surveys conducted at forested sites in boreal Manitoba and Saskatchewan between the 1970's and 1990's also presented evidence linking changes in breeding habitat and population declines of Neotropical migrants.

RECOMMENDATIONS

The availability of large expanses of publicly owned lands in the southern boreal fringe region of Saskatchewan affords the opportunity to protect large tracts of land that are valuable for the conservation of numerous bird species, especially those categorized as area sensitive. Federal and provincial agencies should implement management plans for many of these areas that would include limiting deforestation,

understory grazing and other land-uses that degrade wildlife habitat. Conservation easements and policies encouraging agroforestry should be considered to promote the retention of privately owned forests.

Our analyses provide a model for further work needed to fully understand the factors influencing habitat change. We encourage a further examination of habitat change and BBS data to identify species, regions and issues of concern and potential conservation areas to address these issues. The southern boreal forest hosts one of the richest breeding avifauna's in North America and these populations probably act as a major source for North American populations (Robbins et al. 1986, Price et al. 1995). Thus, it is essential that we implement conservation practices to reverse the declines in the continental populations of many species. Methods as described in this study provide a tool for identifying areas of concern and potential ways to implement sustainable management practices which take into account socio-economic factors.

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Figure 1. Maps showing: A) landscape in 1966; B) landscape in 1994; and C) absolute change in the amount of forested land (in km²) per 50 km² hexagon between 1994 and 1966.

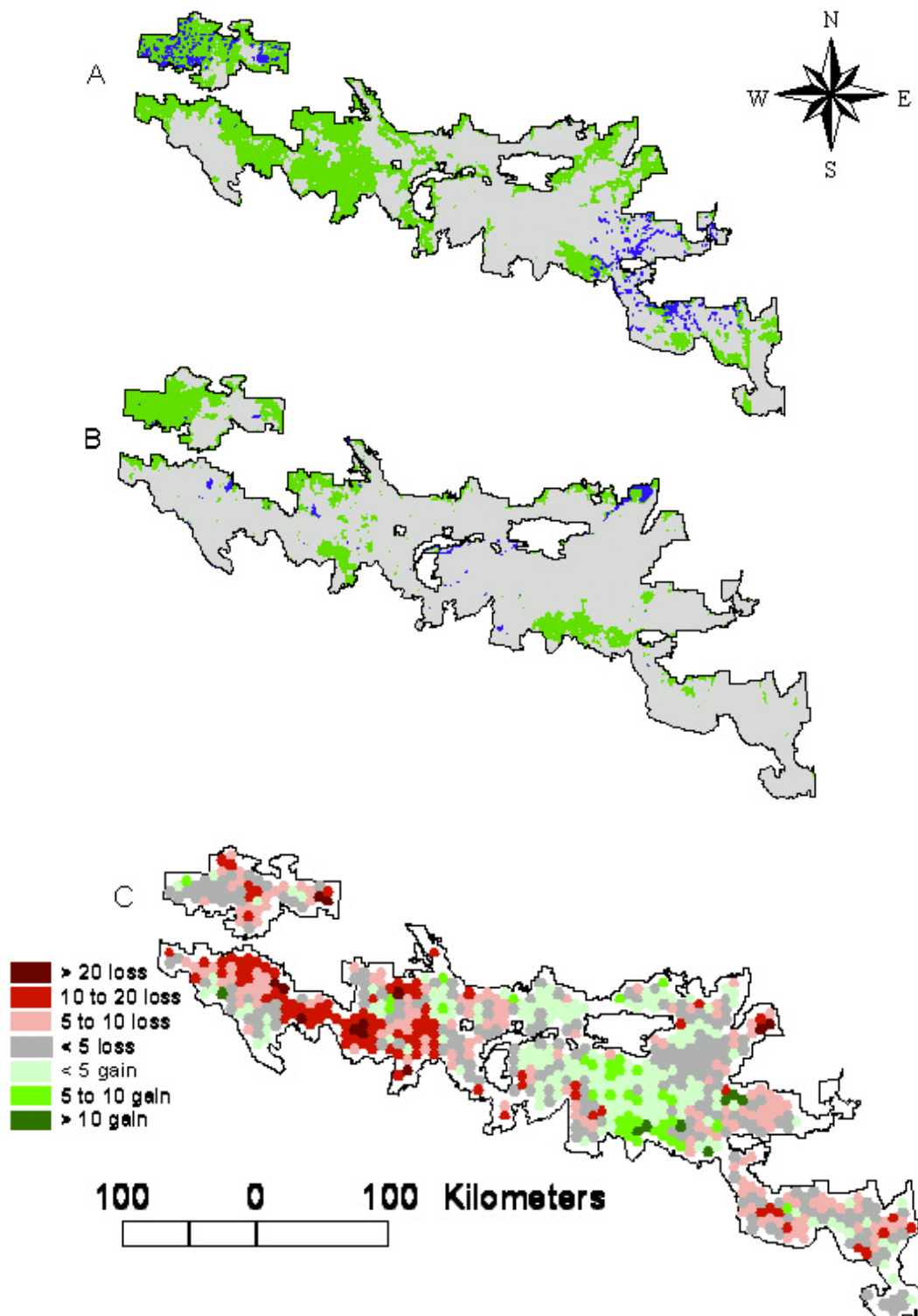


Figure 2. Number of species observed each year on the different BBS routes.

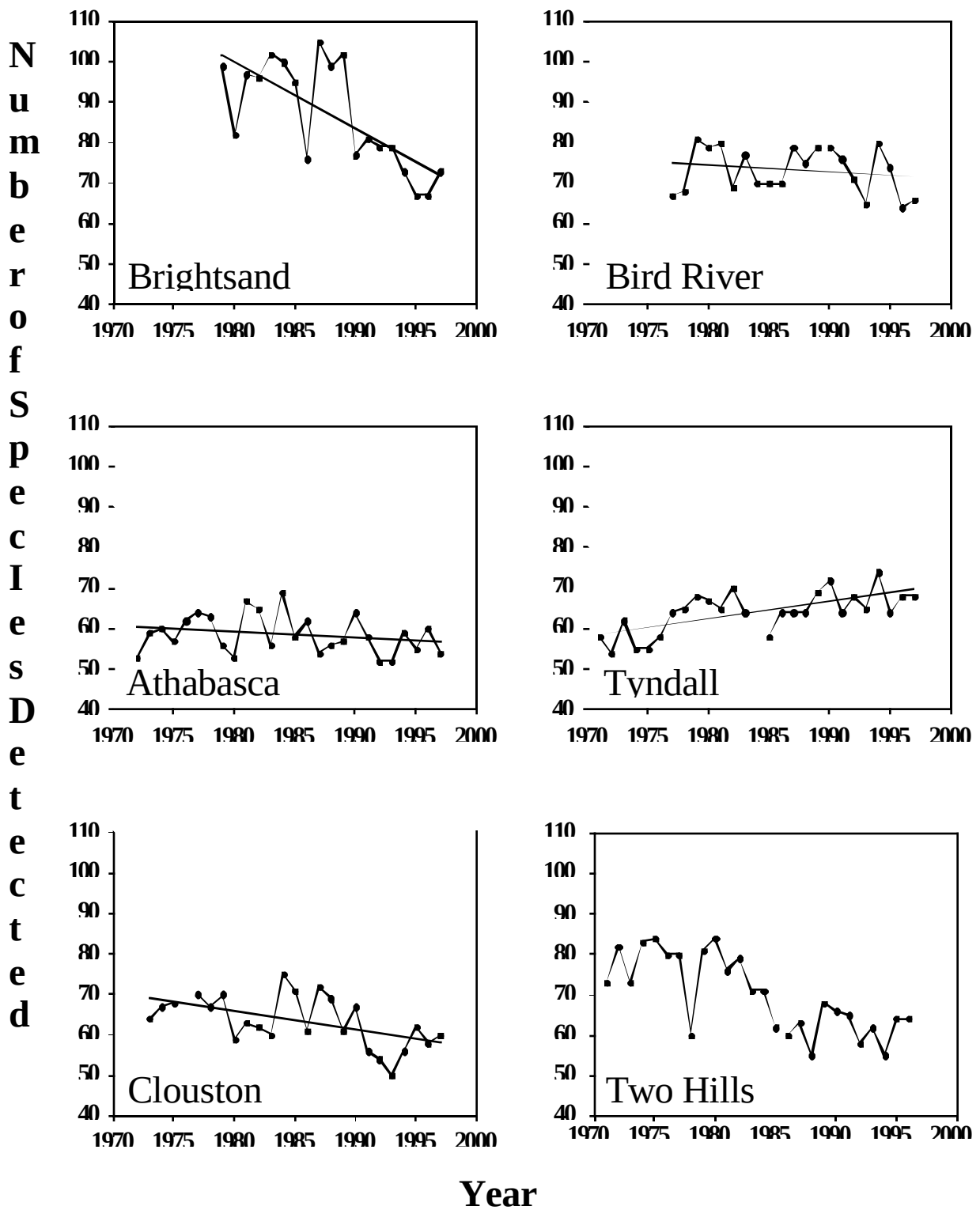


Figure 3. The Brightsand BBS route and the buffered area analysed from digital coverage for 1963 (NTS) and 1994 (Landsat TM). FMA refers to Forest Management Area.

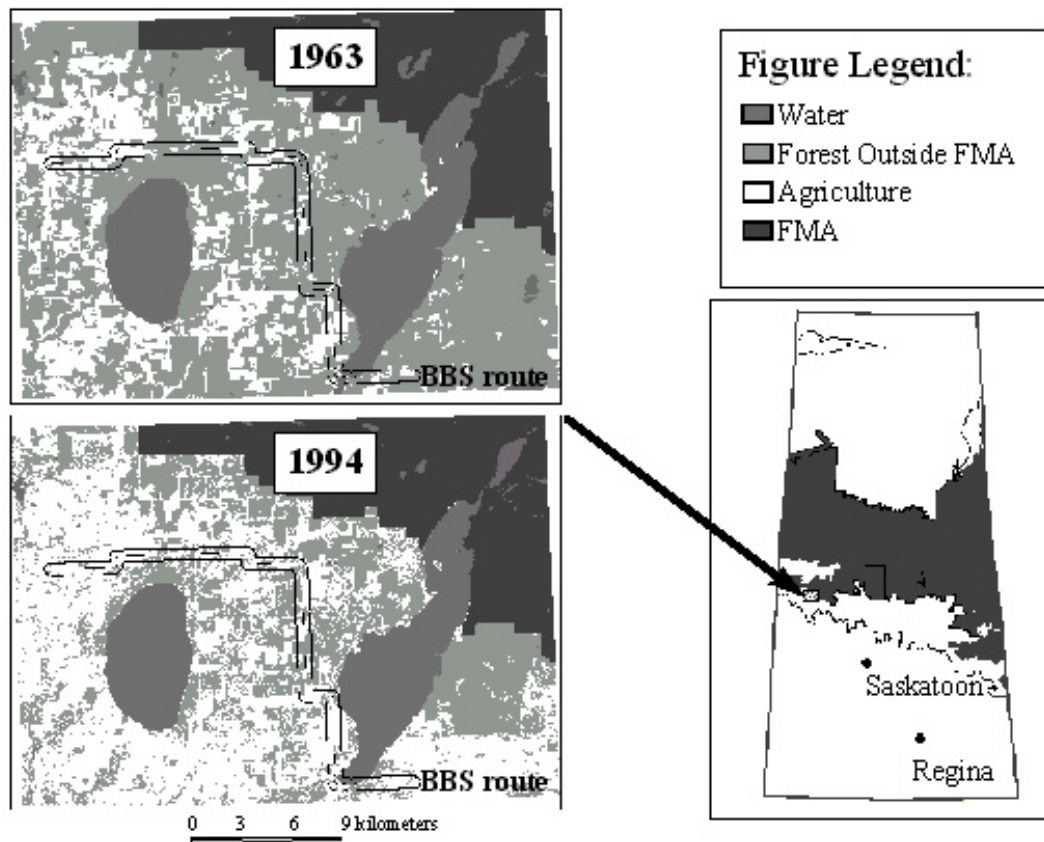


Table 1. Correlation between cultural/environmental variables and the amount of forest cover from MRSA model.

Variable	1994				1966			
	Correlation	χ^2	df	p	Correlation	χ^2	df	p
Privately owned land	negative	93.8	2	< 0.001	negative	52.8	2	< 0.001
% land suitable for agriculture	negative	50.8	2	< 0.001	negative	53.8	2	< 0.001
Road Density	negative	16.2	2	< 0.001	-	-	-	NS
Distance to town	-	-	-	NS	positive	17	2	< 0.001
Latitude	positive	18.6	-	NS	positive	20.6	2	< 0.001
Longitude	-	-	-	NS	-	-	-	NS

Table 2. Number of species showing significant trends in abundance for each route.

Route	# of significantly decreasing species	# of significantly increasing species
Boreal Fringe		
Brightsand	11	0
Clouston	4	0
Two Hills	4	0
Tyndall	8	4
Athabasca	8	1
"Control" route		
Bird River	0	0

Table 3. Annual rate of change in guild for each route.

Route	Habitat Guild				
	Forest	Shrubland	Grassland	Wetland	Cosmopolitan
Fragmented					
Brightsand	-5.0	-4.2	-2.9	-8.7	-1.2
Athabasca	-1.9	-4.1	-0.4	-6.8	0.8
Two Hills	0.1	0.1	-2.9	-8.5	-2.1
Clouston	0.8	-0.1	-2.7	-1.9	-0.4
Tyndall	0.7	-0.2	0.1	-3.5	5.9
"Control"					
Bird River	1.2	1.5	n/a	3.1	-0.2

RESTORING THE LAND AND OURSELVES: PRAIRIE RENEWAL IN URBAN LANDSCAPES

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Abstract: Do prairies play a part in most people's lives today? Do most citizens know what a prairie is? We have altered the Great Plains landscape to the extent that very little prairie remains, leaving few opportunities to interact with prairie plants, animals and indigenous cultures. In Winnipeg, as in other urban settings, extensive monocultures of lawngrass and exotic plantings have resulted in the homogenized, sterile landscapes that we experience daily. Are these landscapes an expression of our culture's deeply-rooted alienation from nature? We who attend these conferences to share important research know the impacts human activities are having on remaining prairie remnants and wildlife. Yet, for all this research, how much is changing? Is our knowledge reaching the public at large, translated into teachings and experiences that lead to transformation? Judging by the continued urban sprawl and development of "vacant" land, the answer is a resounding NO! In 1990, spurred by a tall grass prairie survey and conservation efforts begun by the Manitoba Naturalists Society, we planted approximately 35 species of native prairie seedlings in our suburban garden. Our growing awareness of the demise of prairie led us to spend time at many remnant sites to experience first-hand their beauty and diversity. Most importantly, we fell in love with the prairie. A decade later, we are transforming our front yard from lawn grass to native prairie, interspersed with fruit-bearing shrubs. As we restore the impoverished land, we are restored. Our vital connection with nature is renewed each day as we explore, rest, and delight in this diverse landscape. Our changing "yardscape" inspires curiosity and brings interesting questions from neighbours. For us, it presents a wonderful opportunity to educate. Restoring prairie ecology in urban settings is a worthy task, but it will happen only through a strong commitment to public education. People must be taught what a prairie is, and why it is important to protect remaining natural areas and restore the land. Vital knowledge and experience must be available to the public in ways that will stimulate and assist this transformation. Otherwise, what will we really accomplish?

THE ROLE OF THE WORLD TRADE ORGANIZATION IN PRAIRIE CONSERVATION

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Abstract: The World Trade Organization oversees the body of law that governs the flow of trillions of dollars of goods and services around the globe every year. More than just a commercial proposition, that flow and how it is managed can have palpable impacts on a wide range of public policy concerns.

Current negotiations on the Agreement on Agriculture, for example, are dealing with the European concept of agriculture as a "multifunctional" enterprise -- a concept that holds great promise for environmental stewardship, but perhaps great threats for prairie producers. Talks are also focusing on agricultural subsidy and export promotion regimes, which have significant effects on prices, and through them, on land use. And there is heated controversy over the seeming clash between the principle of precaution and the rules of international trade.

This session will survey some of the current issues at play in the WTO, and will discuss their potential implications for prairie conservation and sustainable resource management.

The World Trade Organization or the WTO has raised a lot of concerns over its relative short existence of five years. Some rather complex issues that have been debated quite heatedly in the area of trade and wildlife habitat conservation. The purpose of this paper is to relate the trade issues and their implications for conservation and sustainable resource management in the Prairies.

Many will probably remember the Seattle WTO meetings in November 1999, where some 50,000 protesters, representing all manner of environmental and social causes, converged on the streets of Seattle to oppose the full-steam-ahead free trade agenda of the WTO.

This meeting set the stage for a number of reviews of the WTO's social and environmental agendas and how they impact

countries. While the WTO is now commenting more on these issues, the discussions have now focused on how much is appropriate, and if the WTO is actually changing.

Many of the protesters would suggest little has happened and that much more effort is required to move forward with an agenda that is acceptable to the broader public.

Before proceeding into the effectiveness of the WTO on conservation and other environmental issues, this paper will outline what the WTO is and the powers it has. The WTO oversees the body of law that governs the flow of trillions of dollars of goods and services around the globe every

year. As of November 30, 2000, 140 countries were members of the World Trade Organization representing all of the developed countries of the world as well as many of the developing countries. Currently, developing countries outnumber developed countries in terms of membership in the WTO.

The WTO was created by the Uruguay round of Trade negotiations in 1995, and is situated in Geneva. In 2000, the WTO had a staff of 500 and a budget of \$116.5 million.

The WTO has several functions:

- Administers WTO trade agreements, which is approximately 30,000 pages of rules,
- Provide a forum for trade negotiations,
- Handle trade disputes,
- Monitor national trade policies,
- Provide technical assistance and training, and
- Cooperate with other international organizations

Within the WTO there are numerous committees and theme areas. This paper will focus on two key areas that relate directly to conservation and endangered species on the Prairies, the Committee on Trade and Environment and the Agreement on Agriculture.

The Committee on Trade on the Environment was established in 1994 under the General Agreement on Tariffs and Trade or GATT. The committee now operates under the WTO with a very broad terms-of-reference:

- To identify the relationship between trade measures and environmental measures, in order to promote sustainable development;
- To make appropriate recommendations on whether any

modifications of the provisions of the multilateral trading system are required, compatible with the open, equitable and non-discriminatory nature of the system.

To help narrow the broad mandate, the Committee has grouped its activities into 2 clusters:

- Market access, and
- Linkages between international environmental management and the trading system.

While discussions take place on the matter of the environment, the Committee does not negotiate trade rules.

Essentially, the WTO does not try and influence a country's environmental policies, but does allow countries to protect and enhance their environment to an internationally accepted level and beyond if the country can provide scientific reasons for the extra protection. While this might sound simple enough, this is considered one of the most contentious areas of the WTO. Environmental concerns have been used quite effectively to block exports from entering a country, particularly in the area of agriculture exports.

The Agreement on Agriculture developed rules for member countries to follow. The first step was the conversion of all subsidies and other trade barriers into tariffs and a systemic reduction in those tariffs. For developed countries, a reduction in tariffs by 36 percent over a 6-year period while developing countries needed to reduce their tariffs by 24 percent over a 10-year period. The least developed countries do not have to reduce their tariffs.

New rules and commitments were added to the agreement to allow governments to support their rural economies and a PEACE

provision was added to reduce trade wars between countries. The Peace provision restricts countries taking action against other countries as long as they are within their tariff targets.

The Agriculture Agreement distinguishes between domestic support programs that stimulate production directly, and those that are considered to have no direct effect. Domestic policies that have a direct effect on production and trade have to be cut back. Measures with minimal impact on trade can be used freely. These measures include government services such as research, disease control, infrastructure, and food security. The measures also include payments made directly to farmers that do not stimulate production, such as certain forms of direct income support, assistance to help farmers restructure agriculture, and direct payments under environmental and regional assistance programs. The Agriculture Agreement prohibits export subsidies on agricultural products unless the subsidies are specified in a member's lists of commitments. Where they are listed, the agreement requires WTO members to cut both the amount of money they spend on export subsidies and the quantities of exports that receive subsidies.

A separate agreement on food safety and animal and plant health standards (Sanitary and Phyto-sanitary Measures) sets out the basic rules. It allows countries to set their own standards. But it also says regulations must be based on science. The standards should be applied only to the extent necessary to protect human, animal or plant life or health. And they should not arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail. Member countries are also encouraged to use international standards, guidelines and recommendations

where they exist. However, members may use measures that result in higher standards if there is scientific justification. An example of this is the phyto-sanitary restriction imposed by Japan on exports of hay to ensure the hessian fly larva do not enter the country. The concern is that the hessian fly, once established would wipe out most of the rice crops in Japan. In this example, hay could enter Japan after it was proven to be free of the hessian fly.

A recent example of animal regulations is Canada's ban on Brazilian beef imports:

- Feb. 2 - Canada bans imports of Brazilian beef, citing concerns over mad cow disease.
- Feb. 7 - Brazilian congress demands suspension of trade agreements with Canada until the ban is lifted.
- Feb. 9 - Two senior Health Canada scientists say Canada's ban on Brazilian beef is a ruse motivated by politics and a trade war rather than health concerns.
- Feb. 13 - Inspection team consisting of food safety officials from Canada, U.S. and Mexico leave for Brazil.
- Feb. 18 - Inspection team wraps up fact-finding mission.
- Feb. 21 - Health Canada scientist suspended after speaking out about beef ban.
- Feb. 23 - Ban is lifted.

Not all environmental trade restrictions are tied to the WTO. In some countries, consumers have pressured their country to reduce imports of products because of concerns around the production process. Management practices are currently being used as a measure for consumers. For example, in Germany, honey exported from Manitoba needs to be in glass containers and not plastic ones so the containers may be recycled more efficiently. Home depot has

put pressure on its suppliers to harvest lumber using acceptable sustainable management practices. Dolphin free tuna is yet another example of consumer influence.

As mentioned in the presentations by John Morriss and Bob Sopuck, there are a number of farming realities on the prairies that need to be recognized when addressing the impacts of trade rules:

- Most owners require income from the land to support their families and their own retirement,
- The majority of the Prairies are in some form of agriculture,
- Farmers are facing very tight margins with low prices and high input costs,
- Agriculture has a heavy dependence on export markets with close to 80 percent of the production going to export markets, and
- Agriculture policies that go to increased production are not trade friendly and as a result are countervailable.

The WTO does have the potential to increase the number of markets open to prairie farmers, but not in the short term. As many countries still have high tariff structures. The reduction in domestic farm subsidies has placed Prairie farmers at a disadvantage in many export markets because not all exporters are operating at the reduced level of support. As a result, farmers are looking for higher returns from their land sometimes at the expense of conservation. Although farmers are for the most part good stewards of the land, it is becoming more difficult with their current situation. New ideas are required that are environmental, socially and economically friendly.

The concept of Multifunctionality has potential for landowners, and from a WTO perspective this concept offers many advantages and needs to be addressed further. Agriculture may be defined as multifunctional when it has one or several roles or functions in addition to its primary role of producing food and fiber. These additional functions might include long-term food security, rural viability, cultural heritage, land conservation, agricultural landscape, agri-biological diversity, and phyto-sanitary/sanitary health. While trade rules limit the amount of support farmers can receive for production increases, there are virtually no limits on domestic policies that do not alter production or trade volumes with goals of environmental protection and enhancement, more jobs and food security. These "multiple" functions are extremely valuable, but the market does not currently reward them. Multifunctionality of agriculture is not a substitute for sustainable development. It is an operational concept, which does not aim, like sustainable development, at defining relationships between economy, environment and social issues. Rather it operationalizes a part of the sustainable development concept: the nature of the links between trade and non-trade functions of agriculture and the economic tools that reward these functions. The concept of Multifunctionality was developed in the European Union and used extensively to support agriculture. It is particularly used in countries with little room for agricultural support as outlined by the trade rules. The Conservation Reserve Program, in the United States has many characteristics of multifunctionality, as well as the proposed Alternate Land Use Services (ALUS) from the Keystone Agriculture Producers in Manitoba. Several trade meetings are scheduled, and new developments are expected from the Agreement on Agriculture, so things can

change. Other trade agreements, such as the North American Free Trade Agreement and proposed agreements such as the Free Trade Area of the Americas, will also have an impact of the environment and conservation.

It is important the conservation voice is heard in these venues to ensure the protection and conservation of the Prairies.

EVOLUTION OF A WOODLOT PROGRAM - THE ROAD FROM SELF-INTEREST TO COMMON GROUND

Shane Tornblom

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Abstract: In addition to providing the essential elements of habitat - water, food and cover B woodlots represent an untapped resource for private landowners. This presentation chronicles the evolution the Manitoba Habitat Heritage Corporation's (MHHC's) strategy for promoting woodlot management as a means of conserving and enhancing remnant wooded habitat in southwestern Manitoba. As a provincial crown corporation, MHHC works primarily with private landowners to integrate fish and wildlife habitat conservation into land use practices. The primary challenge for MHHC's Manitoba Agro Woodlot Program was to develop a strategy that showed how trees could contribute to the "bottom line" of both farming and wildlife habitat, despite the lack of traditional forest industry markets. In the process, the Program progressed from the issue of self-interest to creating community interest and ultimately common ground. The Program attempts to maximize returns to landowners, micro forestry operators and communities, by promoting small-scale harvesting and local value added processing. MHHC fostered development of the rural micro forestry industry and its role in stewardship by delivering training workshops and promoting a unique community-based marketing strategy.

SNAKE HIBERNACULUM INVENTORY, MONITORING, AND MANAGEMENT

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Abstract: Snakes have received considerable more study in Alberta over the past decade.

Reptile work includes:

- 1) snake hibernaculum inventory
- 2) red-sided garter snake relocation study
- 3) public education (posters and talks) cooperating with Plains Rattlesnake monitoring.

The snake den inventory was initiated to collect information on locations of hibernacula in the province. Over 300 dens have been reported to date. A relocation study was conducted to determine whether snakes could be moved from one snake den to another (and would return to that new den). An informational snake poster is being printed.

ALBERTA AMPHIBIAN MONITORING PROGRAM - COOPERATION IS THE KEY

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Steve Brechtel

Alberta Environment

Abstract: Alberta Conservation Association and Alberta Environment have been cooperatively involved in a variety of amphibian monitoring programs over the past four years. Projects are focused on public education, data collection, monitoring, and management.

Amphibian work includes:

- 1) volunteer monitoring (education)
- 2) RANA (Researching Amphibian Numbers in Alberta)
- 3) Long-toed Salamander monitoring.

A new study will be looking at the effectiveness of the North American Amphibian Monitoring Program (USGS) as a tool for determining population trends of data deficient species using call surveys. Cooperation is the key to running these various programs, and many agencies and individuals provide funding, in-kind support, and volunteer time. This all feeds into the Alberta Species at Risk Program.

IMPACTS OF ROTATIONAL GRAZING AND RIPARIAN AREA MANAGEMENT ON CATTLE OPERATIONS IN PRAIRIE CANADA

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Abstract: This multi-agency, multi-province study, led by Brenda Chorney and Rea Josephson, Department of Agricultural Economics and Farm Management, University of Manitoba, focused on cattle producers that have adopted rotational grazing and/or off-site watering and/or controlled access to riparian areas in their overall grazing management strategy. A detailed mail-out survey questionnaire produced 341 responses (41% response rate) that provided a producer profile and detailed assessments of landowner perceptions of the impact of their system changes on pasture resources, herd management, livestock production and income. A large majority of producers reported positive impacts on production and income from their system changes. The survey also summarized producer motivations, costs, barriers to change and avenues for further research. Implications for land and water conservation programming are discussed.

The entire study may be viewed, in PDF format, at the MHHC website: <http://www.mhhc.mb.ca>. Hard copies may be obtained by contacting MHHC at mhhc@mhhc.mb.ca or by writing to MHHC, 200 - 1555 St James St, Winnipeg MB, R3H 1B5.

THE CONSERVATION OF RURAL SOCIETY

Robert D. Sopuck

Delta Waterfowl Foundation, Manitoba

Abstract: The rural prairie economy is still dependant on the production and or harvesting of natural resources into intermediate products for further processing by other economic systems. Wheat is sent away to be milled into flour, hogs are processed in urban plants, and so on. The export nature of Canadian prairie agriculture makes the economy of the region uniquely vulnerable to global market pressures. This vulnerability is exemplified by the nearly continuous decline in grain prices for the last one hundred years. As prices decline farmers adopt new technology to stay ahead but the new technology only serves to increase grain yields worldwide and further depress prices. And the full effect of biotechnology is yet to be experienced.

Environmental resources on private farms have been described as public resources produced at private expense. This property rights dilemma is at the core of today's heated debates about environmental policy in the agricultural regions of Canada. As farmers try to survive in a challenging economic environment they cannot afford to change their farming practises in ways that will benefit the public at large but do not contribute to the farm's bottom line. Many environmental advocates and policy makers, usually from an urban base, are quick to advocate regulation of private activities on private farms without realizing the devastating effect that this may have on the economic performance of agriculture not to mention the implicit theft of private property rights that this often entails. Two examples spring to mind; Environment Canada's buffer zone regulations on glyphosate use and the new Federal Species at Risk Act.

The only environmental policies that will work for rural people and for the environment at large are those that contribute to the growth, diversification, and health of rural society. There are a number of existing programs and policy proposals that will do that and these are discussed in this paper.

Robert Sopuck was born and raised in Winnipeg, Manitoba. He received his B.Sc. from the University of Manitoba in 1973 and Masters from Cornell University (1975) in Ithaca, New York. His thesis topic dealt with rainbow trout population dynamics in the Finger Lakes area of upstate New York. His first career was in fisheries management at both the federal and provincial level as well as with the private sector. From 1979 to 1988 he lived on his farm south of Riding Mountain National Park and operated a grain and oilseed farm, a small outfitting business, and carried out consulting work in the areas of environmental and resource management. From 1988 to 1996 he coordinated the sustainable development initiative for the province of Manitoba. At that time, as well, he was a member of the Canadian delegation to the Earth Summit in Rio de Janeiro and was Manitoba's observer on the Board of the

International Institute for Sustainable Development. In 1993 and 1994 he carried out a major project for Canada's National Round Table on the Environment and Economy dealing with agriculture and trade policy which became a chapter in the book *Conservation of Great Plains Ecosystems: Current Science, Future Options* (1995). He left government in 1996 and took a position with the Pine Falls Paper Company as Director of Environmental Programs. He was also on the Board of the Manitoba Habitat Heritage Corporation.

In 1998 he moved back to his farm where he currently resides. He is an Adjunct Professor in the Department of Rural Development at Brandon University and is a consultant in the field of environmental and natural resource policy with a strong bias towards rural issues.

He and his wife Caroline live on their 480 acres of land, a portion of which has been officially recognized by the Province of Manitoba as an Ecologically Significant Area.

My talk today will focus on the people of the Prairies and specifically, agriculture, the culture of agriculture, and the communities that are supported by agriculture. From an environmental and economic standpoint, this is where the action is. From a sustainable development perspective, it is around agriculture where the greatest ferment lies. This is where we have the great clashes between public and private rights, where the ups and downs of the global marketplace are most keenly felt, and where the "rubber hits the road" in terms of conservation policy and practice.

Peter Apedaile from the University of Alberta notes:

"Rural systems are above all human systems. They are characterized by human activities which transform natural resources into intermediate products for further processing by other economic systems. Forestry, agriculture, mining, and fishing are typical rural activities. These are carried out by human interventions in the ecosphere, principally the biosphere. Humans are an integral part of the biosphere."

Unfortunately, as Canada urbanizes, this last sentence is forgotten. This is because an urban society, unless active measures are taken, becomes increasingly detached (astonishingly so, actually) from the natural world and those processes that literally "put bread on the table." This detachment from nature sets the stage for, at best, simplistic and wrong-headed policy prescriptions, however well-intentioned to, at worst the creation of extremist environmental and animal rights groups whose activities threaten rural economies. A classic and common example of the former is the advocacy of a regulatory approach – familiar to urban dwellers – to rural landscape issues. In order to deal with these pressures it is vital that farm and conservation interests understand the world as it is and develop strategies to deal with it.

But before I deal with the conservation of rural society, we need to ask some fundamental questions, "Why even care about rural society?" or "What is so different about rural society that makes it special and hence worth saving?" These are tricky questions since they deal with the thorny

issue of group characteristics. When applied to race or gender matters, these types of discussions quickly lead us into very treacherous waters.

Fortunately, the topic at hand is not quite so dangerous so let's take a look at what makes rural society special. And special it surely must be, given all of the departments of rural development in universities and governments across the world. However, this only tells us that people think rural society is unique but does not attempt to describe its characteristics. Quite frankly, I'm not sure that I can but I'll try. Maybe its former city people like me who have "gone country" who can best describe these differences since we know both environments.

One thing that is special about rural life is the concept of personalism, the provision of services by identifiable human beings in post offices, co-ops and stores that transcend a mere cash transaction and reflects their social identity. When you shop, you chat, catch up on local news, and generally are made to feel welcome. The flip side of this is the "everyone knows my business" complaint which makes it difficult to be too different, which often causes young people to leave. Having said that, while being "different" can be threatening to rural people, being an eccentric is just fine. Rural societies view eccentrics as sources of amusing stories, but they are treasured for their uniqueness. And could I tell you stories.....

The fact that everyone knows everyone else creates unspoken and unwritten rules of behaviour. One rule is that personal animosities are forgotten in a crisis and you must be there for your neighbours in an emergency; no questions asked. Borrowing stuff is fine, even expensive stuff, and you can take your time in giving it back. Houses

are usually unlocked and anyone can use your place in an emergency. When asked for, help is given, but there is the "Cosmic Accountant" that keeps track (sort of) so you better give help as often as you ask for it. Statistics Canada reports that there are more volunteers per capita in rural areas than in cities. A good reputation is everything and you can lose status real fast if you behave beyond the pale. Among farmers, other people's private property is respected, it's almost a religion where I live. I recall a fine neighbour, now deceased, who was telling me in his laconic way about a farmer we both knew but who was not well-liked. He looked at me and said, about that farmer, "Well, you know Bob, nobody neighbours with him." Just about the most damning indictment I can think of, for sure.

Personal freedom is prized, it's a fierce and stubborn independence that is a part of most agrarian societies. Now, you may find this at odds with the unwritten code of behavior described above but agrarian cultures based on private land ownership seem to have struck the right balance between private discipline, community responsibility, and personal liberty.

Individuals prefer to reside in rural areas. Ray Bollman from Statistics Canada showed that 59% of residents of the urban core want to live in a more rural environment while rural farm residents were the most satisfied of all Canadians with their current residence. This fierce attachment to "Place" will be discussed further. Bollman showed that the higher the human population density, the higher the proportion of people who want to move to a more rural area. As a biologist, I wonder if this preference for rural areas is almost genetic since we as a species evolved in wide open spaces and have only recently been aggregated in cities.

Just as an aside, Bollman noted that urban to rural mobility is faster than the reverse. This was indicated by the higher rural growth rate, versus the urban rate, from 1971-1976 when rural economic conditions made this possible. Interesting.

Victimization rates are higher in urban areas for all types of crime with the greatest difference being for break and enter. Urban residents are also more likely than their rural counterparts to perceive levels of crime higher in their neighbourhood than elsewhere and to feel that crime is increasing. Firearms ownership, on percentage basis, is much higher in rural areas which somewhat belies the conventional wisdom that high rates of firearm ownership create crime. Where I live I'd be hard-pressed to think of any household that does not have at least one firearm. Maybe the criminals all know it too and have decided to leave us alone. Who knows?

Rural voting patterns are very different between rural areas and cities on the Prairies. Agricultural regions vote right-wing and cities vote centre-right to left. I could not figure this out for the longest time. Conservative parties always emphasize free markets which seems at odds with the plethora of government farm programs out there; farm programs often initiated by conservative governments. Then it hit me; it's all about freedom. Conservative parties do not threaten the liberties of farm people like left wing parties appear to do. That's the crucial difference.

Rural economies are much more dependent on the goods producing sector of the economy versus the service sector dominance in cities. This results in a utilitarian attitude to natural resources and even if a rural resident is not directly

involved in a resource industry they observe resource use on a daily basis. Whether it is logging trucks on the road, the smelter on the edge of town, fishing boats in the harbour, venison steaks on the barbecue, or tractors in the field, rural people are reminded on a daily basis where their bread and butter comes from. To many rural people, wilderness preservation without use or management is a "waste."

As another aside, all of what we have in terms of actual "stuff" originates in rural areas. Just look around the room you are in right now and try to find something, anything, that was either not grown or dug out of the ground. You cannot.

Lastly, no description of agrarian societies would be complete without an acknowledgement of the astonishing array of skills that exist on Canadian farms. A diversified farmer must be an agronomist, mechanic, marketer, veterinarian, welder, weatherman, and chemist. These skills are passed on to their children and it is common knowledge in heavy industry, the military, and other resource industries that "farm kids" make great workers. It was the farm labour "pool," for example, that built western Canada's oil industry.

Before we get into the nitty gritty of conservation on agricultural landscapes we should say a few words about the agricultural economy. Quite simply, for grain and oilseed producers, it's a disaster. Prices keep falling and input costs keep rising. Increased natural gas prices are projected to result in a 50% increase in fertilizer prices this year alone. And that's on top of previous price increases. Barring a major crop failure somewhere, prices will continue to go down as more efficient technology is coupled with the aforementioned skill set of farmers who just

can't stop increasing production. We all get cheap food but farms keep getting bigger in order to achieve the required economies of scale. From the social side, just imagine how a farm family must feel about leaving their home, especially given the strong attachment to the land and their homes described above. It's not all bad news for rural areas and there are alternate visions for agricultural regions but it's too late for those who are currently leaving their farms. Given my own fierce attachment to my land, I cannot imagine what those people must be going through.

So what does all this mean for conservation and environmental management, if anything? Well, firstly it means that prairie conservation advocates had better realize that they are playing against a backdrop of struggling grain farms, wrenching economic change, and a rural society that is very stressed. They absolutely cannot absorb higher costs.

Furthermore, they are playing on a landscape that largely does not belong to them nor are they especially welcome. I should qualify that last point, "not especially welcome unless they can help with the current farm crisis." This is not to say that conservationists should not try since there are very real environmental issues on the Prairies that need to be addressed. Such real issues include water management, water quality, bio-diversity conservation, soil management, and riparian habitat protection to name a few.

The wrong type of environmental regime would devastate rural communities especially those based on the production of commodities. The American rural sociologist David Freshwater put it well when he said:

"For a community that remains dependant on primary production, higher environmental costs of production and declining real product prices associated with environmental restrictions spell economic degeneration. These communities bear the full burden of the growing demand for environmental preservation."

What this all means, and it cannot be repeated too often, is that a disproportionate share of the burden of developing a clean environment – a public value - falls on the shoulders of rural communities particularly when the policy prescription is a regulatory approach.

Well, how should environmental advocates approach conservation on the private land Prairie landscape given the present socio-economic situation. Some suggestions:

Firstly, do not threaten or appear to threaten the ability of farm communities to survive. The regulatory approach to conservation, an oft-recommended strategy of many environmental groups, poses one such threat to rural livelihoods. The U.S Endangered Species Act and its northern cousin, the Federal Species at Risk Act are but two examples of the regulatory approach gone wild. These acts were developed/proposed (SARA is not law yet) over the strong objections of rural interests. If your goal was to completely turn off rural people to conservation it is difficult to conceive of a more effective strategy than to implement these two acts. The U.S. act is nothing more than the confiscation of private property without compensation. Not only is it ineffective in conserving species, it actually harms species conservation by discouraging farmers from participating in any conservation programs for fear that they might attract the "attention" of an endangered species and hence the regulators.

This leads to a practice of ignoring the “rules” or active resistance to their stated goals. In North Dakota, a state hard hit by the grain crisis, I was told, during a visit last year, to not even to use the word “sustainability” since it is viewed as an environmentalist’s word.

Secondly, do not develop environmental laws that have the perverse effect of causing environmental damage. How can that be you say? Here’s an example of one that is one the books right now. According to the label on containers of the popular herbicide Round-Up, it is illegal to spray within 15 metres of wetlands or wildlife habitat, even on private land. Seems fine on the surface but this regulation actually accelerates the destruction of wildlife habitat. Let me explain. Round-up is a non-selective, non-persistent herbicide which is the basis of most conservation farming systems and is the only defense against tough perennial weeds like quack grass. That 15 metre buffer zone would quickly become infested with quack grass and unfit to farm. If you picture the normal Prairie quarter section with its wetlands and bits of forest cover with the odd shelter-belt across it you can appreciate the amount of farm land that this regulation would render non-productive if obeyed to the letter. The farmer has 2 options; spray up to the habitat and be illegal or eliminate the habitat and, in an oblique way, comply with the law. This senseless environmental regulation, which is still on the books by the way, actually encourages the destruction of wildlife habitat and we have no way of knowing how much habitat has been destroyed by these types of regulatory blunders.

Thirdly, and now we start to get positive, conservationists should acknowledge the contribution that rural economies make to society and defend the rights of rural

communities to exist. When was the last time that you heard an environmental activist say something as follows: “ We want to ensure that your rural communities thrive, grow, and prosper and what do you need from us to achieve that goal while improving the environmental quality of your region and the country at large?” Some conservation organizations, especially those directly involved with North American Waterfowl Management Plan, have learned this lesson well and are viewed, by and large, as friendly to rural communities.

Fourthly, develop, promote, and encourage land management activities that improve both the economic and environmental performance of private farms. The best examples are the various grazing systems that have been developed with the help of conservation agencies like the Manitoba Habitat Heritage Corporation among others. Not only do these systems protect water quality through riparian habitat protection, they have been shown to improve cattle weight gains and hence make more money for the producer. Talk about win-win! Another soon-to-be real success story are the new winter wheats and canolas that are coming on stream. Much of this work was funded by Ducks Unlimited, to their very great credit. Planted in the late summer or fall, these winter crops require no cultivation in spring, efficiently use spring run-off, and provide much improved nesting habitat for ducks. Another win-win. Just as an aside, one of the best things conservationists can do for the environment and rural communities is to purchase the products that promote sound land management. In other words “If you really care about the environment you should eat beef and wear a fur coat.”

Fifthly, the conservation community should become strong defenders of rural life in the

face of unfounded attacks from urban-based environmental activists and animal rights extremists. Don't get me wrong. You must not be a simple apologist for all things rural but when your rural allies are under unfair attack, stand up and be there for them; it will pay huge conservation dividends. One example is how the Pregnant Mare's Urine (PMU) industry was being attacked by animal rights groups. From a landscape conservation point of view, there are few other farming systems as conservation-friendly as PMU. These operations utilize pasture and hay lands, thus promoting permanent cover and reducing soil loss, and harvest grassy hay late in the summer thus creating optimal nesting cover for a wide variety of Prairie birds. They also make money and help diversify the local economy. Another win-win. Let's be there for them. The benefit for conservation is that you will be much more welcome when it comes time to deal with conservation issues i.e. you will be seen as trusted allies and credible partners. This is exemplified by the productive and growing partnerships between the cattle industry and conservation groups in the whole area of riparian habitat management and water quality protection. On the flip side, it is the wise rural interest group that seeks non-farm allies to help defend the rural economy and sustainable land management.

For my remaining time I would like to discuss a proposal being advanced by Keystone Agricultural Producers, Manitoba's largest general farm organization. This proposal, known as Alternate Land Use Services (ALUS), is the only way, in my view to deal on a large enough scale with the pressing conservation problems on the Prairies. To reiterate, these problems are water quality and quantity and biodiversity conservation with water being far and away number one. The resolution of

these issues is complicated by the fact that most of the land in Western Canada is privately owned and there is a mishmash of property rights in various environmental resources. You own the soil but not the water; you own the crops and trees but not the wildlife and so on. This issue is further complicated by the fact that all of the economic incentives for farmers are geared towards maximizing production. Thus the private farmer does everything he or she can to improve the economic performance of the farm, often at the expense of those public resources, such as wildlife, that are not "paying their way." Or to put it another way, "Wildlife is a public resource produced at private expense."

The issue of environmental property rights or, more appropriately the lack thereof, effectively prevents private landowners from expanding the supply of public environmental goods or as Pierre Crosson from Resources for the Future noted:

"The absence of property rights in, and hence prices for environmental services reflects a kind of institutional failure which inhibits the expansion of the supply of the services in response to a growing demand for them."

If this is true, and I think it is, then the only viable approach to environmental management on private land on the Prairies is one that directly supports farmers to change their farming practices in order to deliver "ecological services" to the rest of society. This is the concept of "multi-functionality" whereby society agrees that private farms are not just food factories but contribute other products to society such as clean water, biodiversity, clean air etc.

Keystone Agricultural Producers (KAP) has developed a concept paper entitled “Alternate Land Use Services (ALUS): Multi-functionality in Practice: Broadening the Base of Agricultural Income,” that outlines this approach (see KAP’s web site; www.kap.mb.ca). I like the concept of “Services” as opposed to “Set Aside” because the provision of services is a much more “saleable” idea than merely letting land be “idle” as implied in “set aside.”

This concept shows real promise because it will address real environmental problems, such as water quality over a wide range of the landscape. The ALUS idea has the following benefits:

1. It will improve environmental performance on Canadian farms
2. It will get dollars into farmers’ hands and will diversify the rural economy
3. It will be supported by urban people
4. It will be supported by a broad range of conservation interests
5. It does not distort trade

The United States is considering such a program on top of its highly successful Conservation Reserve Program based on the January 7, 2000 news release from then Vice-President Al Gore that stated:

“Vice President Al Gore announced today that the Administration will seek nearly \$1.3 billion in FY 2001 for conservation programs that help family farmers take steps to protect water quality and the environment and to preserve farmland. This conservation package is part of a larger Administration budget proposal to strengthen the farm safety net (my underline).

“Farmers are among the most important stewards of our land and water,” Vice President Gore said. “Despite the accomplishments made in recent years in stopping soil erosion and protecting water quality, agriculture’s environmental challenges are multiplying. The initiatives that I am announcing today will provide needed financial support to our family farmers as well as tremendous environmental benefits to the American people.”

I especially like the explicit connection of financial support for on-farm conservation and the strengthening of the farm safety net in addition to the statement that all Americans will benefit from this program.

In the proposal being advanced by KAP there are many issues still to be addressed such as funding, complexity, effect on the existing rural economy, wildlife depredation and so on. However, we will not be starting from scratch since we can call upon the experience of the U.S. Conservation Reserve Program, the North American Waterfowl Management Plan, and the various riparian management programs that are already on the landscape to help us design the program.

I firmly believe that the Alternate Land Use Services idea being advanced by KAP is a concept that should be pushed very vigorously by farm and conservation groups in Manitoba and indeed in all of Canada. If we all line up to support KAP, this idea just might fly and I give all credit to KAP for advancing such a bold policy proposal. It’s a good one.

In closing, I hope that I have been able to present a view of rural society that we can all support. Believe it or not, I am optimistic about the future of rural Prairie communities

and their ability to transform themselves and attract new people. Let me explain.

The telecommunication revolution has made anything possible. When we first moved to the “bush” in 1979 there were 8 people on our party line and our ring was “one long and two short.” I still live here but the world’s information is at my disposal (a dubious blessing, I’ll grant you). Email allows us to carry on a consulting practice, send documents, keep up with the stock market, access data bases, and take tourism bookings. For the first time, rural people are not at an information disadvantage compared to city folks. We can organize politically, keep abreast of government policy, get new ideas, and read newspapers from around the world. I know of farmers who check prices via the Internet, rural engineers who consult with international clients, a local store keeper who publishes books, and rural tourism businesses with web sites.

Rural areas should use these technologies to attract people from the so-called “information industries.” I just know there are consulting engineers, stock brokers, biologists, designers, artists, policy analysts, writers, and financial planners who would love to ply their trades from rural Canada. They just need to be shown how. We have low cost real estate, beautiful landscapes,

safe communities, and wonderful outdoor recreation without the intellectual isolation that used to characterize rural areas. You can have it all. We do.

What then, is my ultimate vision? Grain farms will get bigger and farm the best land. It’s a fact of life. We will see a thriving livestock industry. We will have value-added processing, micro- enterprises, and assorted support services. Conservation practices will continue to improve. We will see an influx of “knowledge workers” into rural Manitoba once they realize that their net incomes will increase while the work still gets done. Their new knowledge will add value to rural communities and they will become staunch defenders of the rural way of life.

Rural communities need to conceive of alternate futures and be willing to adapt and change. The conservation community needs to be part of this process and work on the rural landscape in ways that preserve a way of life for those who chose to remain on the land and to conserve that landscape for future generations. How this is carried out is critical, because after all we are talking about the homes and livelihoods of people with a strong sense of place and deep roots on the land. If we as a conservation community take the time to understand and be sensitive, rural society could have a very bright future.

THE INVASION OF SMOOTH BROME (*BROMUS INERMIS*) ON THE LAST MOUNTAIN LAKE NATIONAL WILDLIFE AREA—IMPLICATIONS FOR MANAGEMENT AND MONITORING

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Abstract: Native grassland ecosystems of the Canadian Prairies have faced dramatic pressures in the last 100 years. These include habitat loss and fragmentation due to intensive agricultural practices, exotic species invasion, and the lack of natural disturbance. While larger areas of grassland are relatively healthy, smaller fragmented grasslands face further degradation due to the invasion of aggressive non-native species. Much of the mixed-grass prairie remaining on the Last Mountain Lake National Wildlife Area is highly fragmented and surrounded by agricultural lands. These lands face incredible pressure by exotic species including smooth brome (*Bromus inermis*), crested wheatgrass (*Agropyron cristatum*), and toadflax (*Linaria vulgaris*). In order to control these undesirable species, management practices including burning and grazing have been re-introduced to inhibit the spread of exotics, and stimulate native species. The goal of this study was to find a simple method to examine the effectiveness of these management practices on target exotic species in particular smooth brome. Using a differential GPS system, clones were mapped in the summer of 2000 on a selected control site. By recording the outer perimeter of individual brome clones, a digital map was created of the control site. By comparing the current map with a data set recorded in 1986, the extent of brome invasion could be examined directly. It was found that smooth brome had invaded substantial portions of the control site, and that the GPS method was a useful tool in analyzing vegetation characteristics of native prairie.

OVERVIEW

The Last Mountain Lake National Wildlife Area, located in the moist mixed-grass prairie ecoregion, is comprised of wetlands, agricultural lands, and large areas of fragmented native prairie. In total, the Wildlife Area encompasses 15,600 ha. Of those lands, less than 50% can be classified as native prairie and an even smaller portion can be characterized as pristine (less than 10%).

The native vegetation has come under great pressure from invading exotic species including *Agropyron cristatum*, *Agropyron repens*, *Linaria vulgaris*, *Poa pratensis*, and *Bromus inermis*. Because of the climatic characteristics of the moist mixed-grass prairie, *Bromus inermis* can readily out-compete native grasses; brought over from Europe without its natural pests, smooth brome thrives in the moist and ecotonal regions of the Northern Great Plains. It rapidly displaces native vegetation, forming large monocultures, which are much less

suitable for wildlife habitat and native biodiversity.

Biology of *Bromus inermis*

Smooth brome is a perennial grass introduced from Eastern Europe in the late 1800's. It is favoured by the agricultural sector because of its excellent sod-forming abilities, tolerance to drought, good palatability for livestock, and good forage and seed production (Roberts, C., Kallenbach, Robert L., 2000). Its drawbacks are that it is susceptible to grazing between its tillering and flowering stages. Shoot apices are sensitive to being cut, and re-growth is limited (Ibid., 2000). Despite its acceptance in the realm of agriculture, it is extremely destructive to the mixed-grass prairie because of its ability to out-compete and displace native species. Its competitive ability along resource gradients (most importantly water and nutrient availability) follow the theories proposed by Tillman (1988) whereby species inhabiting sites of higher abiotic stress prevail by competitively excluding the species that are better competitors at sites of lower stress. It has been shown to thrive under moist conditions, rapidly displacing native grasses and is still competitive under low moisture conditions (Nernberg and Dale, 1997). However, they point out that some native species effect greater relative growth reduction of *Bromus inermis* under low moisture levels, such that its competitive ability is reduced (Ibid., 1997). This demonstrates that its competitive ability is linked to soil moisture. Soil moisture is influenced by litter levels; a reduction of litter leads to decreased soil moisture and in turn decreases the competitiveness of smooth brome (Smith, Karen, 2001, pers. comm.)

Smooth brome spreads both by seed and by rhizomes. Rhizomatous growth is crucial in the understanding of its expansion. It forms large clones spreading outwardly at a noticeable rate in just a few years. These clones are easily observed because they are virtually devoid of native vegetation within and their boundaries with native vegetation are so distinct. If a native prairie is left unmanaged, conditions become favourable for the rapid spread of smooth brome. However, because of its reduced competitive ability under low moisture levels, its poor recovery from cutting or burning during tiller through to flower development, and its distinct clonal nature, certain control methods can be used to inhibit the spread of smooth brome.

History of Smooth Brome and Prairie Management at Last Mountain Lake National Wildlife Area

The Last Mountain Lake National Wildlife Area (NWA) has a priority to protect and manage all flora and fauna species. While this is a holistic approach to conserving wildlife, it does not afford aggressive management strategies for targeting invasive species. The lack of management in the past has resulted in the rapid expansion of smooth brome on the area. In 1992, a prairie habitat restoration program was established by Dean Nernberg to "re-establish and rehabilitate diverse native prairie habitat for migratory birds and all other indigenous prairie species through appropriate restoration, rehabilitation, and management." Following this, management strategies were proposed to meet wildlife conservation goals while still targeting the rehabilitation of native prairie habitats, including the control of exotic species.

RESEARCH

To monitor the effectiveness of these new management strategies, various methods of research have been conducted. These include the installation of permanent stakes around selected sites to monitor the advancement of smooth brome. Because of its clonal nature, smooth brome forms very definitive boundaries during its advancement into native prairie. Thus, the expansion can be readily recorded by measuring the change in clonal size or boundary location over years. Secondly, digital maps have been created to characterize the species composition of vegetation communities within the entire National Wildlife Area. These have been used to monitor large-scale changes to the grassland community. Thirdly, transect analysis has been carried out on selected sites on the NWA to monitor finer scale changes in species composition. In addition, GPS surveying has been undertaken to accurately record the size and location of brome clones on a small scale. This may be used in combination with satellite imagery to observe larger scale changes in the progression of smooth brome invasion on the NWA. Because of the large scale of the project and the amount of time and labour required for the various research methods, we have come to the conclusion that GPS/GIS and satellite imagery will be the most effective strategy to monitor the changes in smooth brome expansion over time.

MANAGEMENT STRATEGIES

Three main management strategies have been employed on the National Wildlife Area (NWA) to rejuvenate native prairie and to

control exotic species. These include the appropriate use of burning, grazing, and herbicide applications. Each technique is used under specific circumstances, and must be assessed for its benefits and limitations. An effective tool that has been used on smaller-scale treatments is the use of herbicide applications. To target smooth brome, a pre-growth burn is undertaken in the spring to remove litter with little stress to the smooth brome or native species. This promotes early lush growth of smooth brome which grows more rapidly than the native grasses and creates a height differential (Willson, Stubbendieck, 1997, Romo, J., Grilz, P., 1995). With this height differential, smooth brome can be targeted by wicking with a 30% glyphosate solution early in the growing season when smooth brome is energetically more susceptible. Re-growth and seed production are prevented the year of this treatment. Romo and Grilz (1995) have shown successful results with this approach. While useful on small prairie plots (less than a few square miles), this technique is extremely labour intensive and has many inherent logistical problems--it is very difficult to use on a large scale (Nernberg, 1996).

Prescribed burning is another management tool which has been used to control the advancement of exotic species on the National Wildlife Area. Typically, it has been carried out early in the growing season when the majority of the inflorescences of smooth brome are between the bolting and early heading out stages. The timing usually coincides with the leafing out of snowberry (buckbrush). Burning at this time, when the greatest amount of root reserves have been mobilized for above-ground growth, impacts upon smooth brome when it is the most

susceptible This reduces root reserves and re-growth, and prevents seed production. Furthermore, fire eliminates litter build-up, recycles nutrients (theoretically decreasing the competitive ability of smooth brome because of decreased water and nutrient availability), and stimulates native vegetation. While large-scale burning has been successful, it involves a great deal of labour, knowledge, experience, and a helping hand from mother nature to be successful. Most importantly, prescribed fires can be implemented only when there is sufficient litter to carry a fire, particularly a backburn. These conditions may take 2-3 years to develop, further limiting its practical application.

Since 1995, systematic grazing has been used on the National Wildlife Area to reduce litter build-up, stimulate native prairie, and prevent seed production and expansion of exotic species. The intensive grazing treatments are often used for a 2-3 week period between mid-May and mid-June when the root reserves of smooth brome are at their lowest. This impacts upon smooth brome by reducing re-growth to 25 – 50% compared to ungrazed treatments (Nernberg, pers. comm., 2001) and by preventing seed production. There are some concerns and investments when using prescribed grazing. The use of cattle or other herbivores is labour intensive. Fencing or cross-fencing and water supply are issues that must be satisfied when dealing with cows. Secondly, while targeting invasive species like smooth brome, other native cool-season grasses may be suppressed as well. Repeated grazing over many years may change the composition of the grassland to favour warm-season native grasses. Furthermore, riparian damage may be a problem in some

areas. It is important to realize that this technique, like many land management activities, takes a large-scale long-term approach. Changes may be measured on the scale of decades (Smith, Karen, 2001, pers. comm.). Nonetheless, grazing will theoretically reduce the competitive ability of smooth brome by reducing moisture and nutrient levels. It will reduce re-growth and prevent seed production of targeted exotic species. Most importantly, prescribed grazing often can be applied almost anytime, anywhere, year after year as needed.

CONCLUSIONS

Based on the findings of this and other similar projects being undertaken for the conservation of native prairie, we have come to several important conclusions. Firstly, we have found that the lack of active grassland management in the past has exacerbated the problem of exotic species on the NWA. Secondly, we have come to realize that grazing is the most cost-effective and logistically feasible tool for the management of smooth brome and other exotic species on the Last Mountain Lake National Wildlife Area. It has proven to be the least labour intensive and the most suitable approach to large-scale grassland management. Secondly, with the emergence of new technologies like GPS and IKONOS satellite imagery, the collection of scientific data has become cheaper, more powerful, and less labour intensive than traditional methods. Traditional methods like transect analysis have thus far failed to detect significant large-scale changes with respect to smooth brome when it is apparent that they have indeed taken place on the National Wildlife Area (Smith, B., 2001). Based on digital mapping and GPS surveys conducted

in 2000, a test site showed an increase in smooth brome of greater than 100% since 1986. Finally, it should be noted that the management approaches used here are based on theory. Because of the nature of large-scale approaches, it may take years before any definitive conclusions can be made. If they are not successful, drastic measures will have to be taken to control the spread of smooth brome and other problematic exotic species.

THE POLITICS OF PROTECTING NATURAL AREAS IN SASKATCHEWAN

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Abstract: In recent years, Saskatchewan has achieved protection for over four million acres of natural landscape in our Representative Areas Network program (RAN) through a variety of cooperative and inclusive approaches and agreements. Progress is accomplished through cooperation rather than confrontation. Benefits and recognition are essential for all partners in protecting natural areas.

In 1887, the north end of Last Mountain Lake in southern Saskatchewan was designated as North America's first Migratory Bird Sanctuary. This was Saskatchewan's first protected area. It remains today in its natural state and continues to attract large numbers of migratory birds.

In 1916, the Federal Government created Menissawok Park near Maple Creek and Nemiskam Park near the hamlet of Nemiskam, Alberta to help prevent the continued demise of the pronghorn. In 1922, Wawaskesy Park was created in what now is the Suffield Military Reserve. These three Grasslands National Parks were short lived. By 1947, all three were abolished with the general comment, "no longer required for park purposes." (December 1974 Blue Jay by: Dr. C. Stuart Houston)

Saskatchewan created its first Provincial Parks in 1931 following the Natural Resources Transfer agreement of 1930 whereby the Federal Government transferred crownland to the province. Today, Provincial Park lands comprise 1,253,680

hectares in 34 parks and parkland reserve lands.

In 1927, Prince Albert National Park was created in central Saskatchewan and consists of 387,000 hectares.

In 1925, 12 Migratory Bird Sanctuaries were created including: Old Wives Lake, Quill Lake, Lenore Lake, Basin & Middle Lakes, Chaplain Lake, Crane Lake, Bigstick Lake, Cabri Lake, Whitebear Lake, Redberry Lake, and Manitou Lake. These sanctuaries included 26,700 hectares of surrounding prairie uplands.

That same year, 12 public shooting grounds were established to compliment the sanctuaries to protect more wetlands and upland habitat for wild fowl. These areas included: Good spirit, Willow Bunch, Lake of the Rivers, Twelve Mile, Eagle, Jackfish & Murray Lakes, Ponass, Muddy, Shallow, Goose & Cypress Lakes.

The 12 sanctuaries and 12 public shooting grounds reserved most of the large lakes in southern Saskatchewan for wildlife at this early date.

Drought in the 1930's and agricultural demands following World War II resulted in 26,700 acres of upland habitat being lost around all the sanctuaries, except for Last Mountain Lake by 1956. In 1951, all the public shooting grounds were abolished at the request of agriculture.

Ironically, during the 1980s and 90s, time, energy, and money has once again been spent to secure some of these original sanctuaries. Unfortunately, much of the native landscape that once surrounded these wetlands is gone. (June 1985 Blue Jay by: Phil Taylor, CWS for more detail.)

In 1957, Dr. George Ledingham proposed the establishment of a Grasslands National Park in the Val Marie area of southwest Saskatchewan. The idea received strong support from colleagues, the Saskatchewan Natural History Society, Canadian Nature Federation, and a host of other organizations and individuals.

The land for the proposed park was 95% crownland, leased out to ranchers for grazing. For the most part, the mixed grasslands were well managed and preserved in a natural state. However, irrigation development and grain subsidies resulted in some of these grasslands being cultivated. For the next four decades, continued lobbying at the provincial and national level saw the proposed Grasslands Park advance at a snail's pace.

In the early 1970's, Saskatchewan Premier, Alan Blakeney, received more mail supporting the creation of the park than he did on any other issue. In 1973, the Saskatchewan Natural History Society had the Hon. Jean Chretien, Minister of Parks Canada, speak at their 25th anniversary annual meeting. He was fully supportive of a Grasslands Park.

Acquisition of the land base for the park on a willing seller – willing buyer approach was launched. Ranchers were paid for leased land as if it were their own. Then the transfer of provincial crownland to the Federal government took years to complete. Then the province wanted to do a thorough exploration for coal, oil, and gas before transferring mineral rights, which added more years to the process. Then the province was using the Grasslands Park as a bargaining chip to obtain a Federal license for the Rafferty/Alameda dam projects. Then the province wanted to retain title to the waterways, namely the Frenchman River. More years lost.

By the year 2000, legislation was introduced and passed in Parliament to officially proclaim the Grasslands National Park. However, we are still waiting for Royal Assent of the Bill in Ottawa.

George Ledingham celebrated his 90th birthday earlier this month. I am sure that he had no idea that competing interests and politics would delay his dream of a Grasslands Park for so long.

In 1970, at the request of licensed hunters in Saskatchewan, the government added an additional fee to hunting licenses. The new fee would go into the Wildlife Development Fund and be used for the acquisition of natural habitat. The Fund is still in place and some 74,000 hectares of prime habitat have been acquired throughout southern Saskatchewan.

It is interesting that the Liberals, Conservatives, and yes, the government that I was a part of (NDP) all tried to divert the earmarked money from the Wildlife Development Fund for other government programs. Fortunately, intense public outcry and lobbying killed the political agenda

every time. I might add that friends both inside and outside government almost killed me too.

In April 1981, Dale Hjertaas observed an obscure article in the Leader Post indicating that the NDP Government was going to sell off millions of acres of crownland. Ten years earlier, Alan Blakeney stated in 1971 when he became Premier that, “our crown jewels are not for sale”, meaning our crownlands will not be sold. Indeed, from 1971 – 81 the government did not sell any crownland. The conservation community had become complacent thinking that our crownlands were secure once again.

Hjertaas called me, as I was the President of the Saskatchewan Natural History Society. Thus began a 15-year marathon to prevent the sale and destruction of crownland containing natural habitat.

Letters, briefs, meetings with politicians, political memberships, conventions, and resolutions resulted in the creation of the Wildlife Habitat Protection Act in 1984. Excellent work by people like Dale Hjertaas and Dennis Sherratt in government, extensive consultation with landowners, and a persistent lobby by the conservation community eventually saw 3.4 million acres of native habitat enrolled in the Wildlife Habitat Protection Act by 1995. These lands will not be sold, cleared, broken, or drained. Grazing and haying by leases can continue.

One elected individual in our caucus did everything he could to prevent land from being protected in the Act. Ranting & raving along with threats to vote against government policy prolonged the enrollment of many thousands of acres of land for four years; but at the end of the day, science, facts, concrete public support and perseverance won the day.

For now, our crownlands are secure; but keep checking the newspaper for obscure little articles announcing the government has again changed its policy.

The 1980s were the decade of cooperation among conservation organizations. It began in 1980 when the government of the day told Ducks Unlimited that they could no longer develop projects unless they paid for the waterfowl crop damage. Ducks Unlimited came to the Saskatchewan Natural History Society and the Saskatchewan Wildlife Federation for support. Until this time, the three groups worked rather independently of each other. However, we joined forces and took on the government, which eventually backed down. From this standoff, Saskatchewan launched the Heritage Marsh Program. Several major wetlands were secured, complete with lure crops and bait stations to deal with waterfowl crop damage.

When the North American Waterfowl Management Plan was launched a few years later, Saskatchewan was chosen as one of the first places to implement the program, largely because of our experience and location.

In 1986, the World Wildlife Fund, led by Monte Hummel, came to the prairies to launch the “Wild West” program at the first Prairie Conservation and Endangered Species Conference in Edmonton. This conference and program brought conservationists from the three Prairie Provinces together for the first time. This very successful program helped to spur the provincial governments forward to protect important natural areas and eventually led to the Endangered Spaces Program.

I vividly recall Hummel’s annual visits to Saskatchewan to meet with the appropriate Ministers regarding the province’s progress made in meeting their Endangered Spaces Commitment. Monte’s not always tactful

approach never failed to leave the Minister fuming mad. Monte, not one to beat around the bush, would tell the Minister he had failed to meet his commitment and he had to do better or the WWF will not be able to give him a very good grade. When I would drop Hummel off at the airport to return to Toronto, he would say his job was to come out and stir the pot and our role is get the Minister to do his job and deliver protected areas. Invariable, the Minister would have a somewhat less than complimentary appraisal of Monte's visit. One minister was heard to say with respect to Hummel, "the only good thing that has ever come from the east is the sunrise." But we made some progress.

In 1986, on the day I became President of the Saskatchewan Wildlife Federation, Premier Grant Devine announced the Rafferty/Alameda Dam project. These dams could destroy some of the best and only remaining habitat in southeast Saskatchewan. Riparian /river valley habitat is the most threatened type of landscape in North America.

This battle is a story in itself. Bullying, death threats, surveillance, personal attacks, senate hearings, numerous media interviews, court battles, and other fun things were all apart of this protected area battle which was eventually lost, despite three court victories for us. There are two books on the subject.

At the same time, we were fighting the Rafferty/Alameda Dams; Cliff Wallis, Martha Kostuch, and Friends of the Old Man River were fighting a similar battle in Alberta. If nothing else, hopefully these fierce battles which brought governments to there knees will prevent future governments from plundering ahead on mega projects without following proper environmental review processes.

In 1990, I was asked to speak on the Rafferty/Alameda Dam conflict at the Saskatchewan NDP executive meeting. My presentation seemed to be well received. The first question from the audience was; "will you run for us in the next election?" I ignored the question and went on to the next one.

Before I left the platform, Roy Romanow stopped me and said that they were serious and they wanted me to run for them in the upcoming provincial election.

After talking to a lot of friends, I decided to enter politics. There is a saying; "Friends don't let friends drive drunk." The same could be said that "friends don't let friends enter politics." My bird banding and nature photography days were greatly reduced. I did gain in one area – my waste line!

The Indian Head constituency had never been won by the NDP or CCF before. Much to my surprise, I won a seat in the 1991 election. I was re-elected in 1995 and became Minister of Environment and Resource Management. When I assumed the position, I was confronted with a proposal of possibly closing 10 of our 30 Provincial parks. This time, I was on the inside lobbying Cabinet colleagues and supportive backbenchers. The public and NGO community rallied on the outside. We won and kept our parks open and operating.

Prior to 1996, we did a lot of groundwork through the public consultation in identifying areas for protection in Saskatchewan. We were striving to achieve the Endangered Spaces Program commitments under our Representative Areas Network (RAN) program. My department (SERM) led the RAN program. With the year 2000 deadline approaching, commitment to completing the RAN program by the Premier and Government,

and the fear of Monte Hummel's annual visits, we made significant gains in establishing protected areas. Our efforts brought us an F+ grade.

With the cooperation of the Federal and Provincial government and organizations, the late 1990s saw millions of hectares receive protected status.

RAN INSERT

In 1992, there were approximately 1.8 million hectares protected under various designations recognized by the World Conservation Union (IUCN) categories I to IV.

In 1997, Saskatchewan unveiled its Representative Areas Network initiative through publication of an Action Plan that outlined under-represented landscape areas that should be sought within a comprehensive Network. As a starting point, the Network considered all lands in the province that came under some level of protection to be contributory to the goals and objectives of the program. This included almost three million hectares of lands protected as provincial and national parks, wildlife refuges, ecological reserves, and wildlife habitat lands.

Since launching the Representative Areas Network program in 1997, an additional 1.6 million hectares of ecologically important sites have been formally added to the Network. This brings the total to approximately 4.7 million hectares of protected land.

The list of representative areas designated since October 1997 is long and diverse, affecting virtually every ecoregion in the province. Newly protected Crown Land areas include:

- 27 parkland reserves in the Pasquia Porcupine Forest in eastern Saskatchewan. Totalling some 76,488 hectares, these sites capture a mix of forest, riparian areas, bog, and peatlands.
- McCusker Lake Ecological Reserve, Primrose Lake Ecological Reserve and Primrose Wildlife Refuge all contained within the Cold Lake Air Weapons Range in northwestern Saskatchewan. Totalling near 171,000 hectares, these sites capture a combination of rolling uplands and undulating plains.
- MacDowell Bog Protected Area, a small (57 hectares) but unique site lying south of Prince Albert, contains numerous provincially and nationally rare plant species, as well as an unusually high number and variety of orchids.
- Douglas Provincial Park Expansion added 1,300 hectares to the 6,144 hectares already designated within this natural environment park adjacent to Diefenbaker Lake.
- Wapawekka Hills Representative Area lying south of La Ronge includes 67,715 hectares of rugged and pristine wilderness. The steep slopes and plateaus of the Wapawekka Hills support a diverse abundance of wildlife, mature trees, and rare plants. The site also holds traditional cultural values for local Aboriginal people who have used the area for generations.
- Seager Wheeler Lake Representative Areas Ecological Reserve is a large (177,921 hectares) black spruce-tamarack lowland area lying just south of Deschambault Lake. This site is home to a variety of wildlife including the great Grey owl and the provincially protected woodland caribou.

Over 1.2 million hectares of private land and lands not administered by Environment & Resource Management have also been recognized within the Network through

cooperative partnership arrangements. The province has forged partnerships for land and water management with:

- Ducks Unlimited Canada, covering the 364,230 hectares of marshlands and associated uplands managed by Ducks Unlimited in Saskatchewan.
- Saskatchewan Wetlands Conservation Corporation covering 10,522 hectares of wetlands, remnant prairie, and riparian areas administered by this government agency.
- Redberry Lake Pelican Project, including 6,585 hectares at Redberry Lake, along with its associated uplands. Renowned for many years within Saskatchewan for its large and diverse resident populations of rare or threatened waterfowl, this site was also recognized in early 2000 as part of an International RAMSAR site.
- Prairie Farm Rehabilitation Administration (PFRA), an arm of Agriculture Canada, maintains 728,460 hectares of pastures in Saskatchewan. Containing some of the largest remaining parcels of unbroken native grasslands in the prairies, this pasture system offers a significant contribution to the objectives of the Representative Areas Network.
- Canadian Wildlife Service, administrators of 10 Migratory Bird Sanctuaries covering 54,390 hectares throughout southern and central Saskatchewan, support the principles and objectives of the Representative Areas Network through management of these sites.
- Potash Corporation of Saskatchewan – Rocanville, owners of a 1,489 hectare parcel of open grasslands and aspen bluffs in southeastern Saskatchewan, entered into a partnership agreement with the department to continue to conserve the land's biological diversity in an area that has otherwise been developed for agricultural purposes.

- Canadian Forces Detachment – Dundurn enforced an agreement with the department to recognize the ecological integrity and biological diversity of the 22,000 hectare Dundurn camp, home to a range of mammals, birds and plants in a rich mixture of open grassland, shrub/grass communities and poplar stands.
- Private lands containing native prairie located across southern Saskatchewan have also been protected through conservation easements. Easement agreements ensure that the land will remain in its natural state in perpetuity supporting a variety of wildlife, birds, and plants regardless of changes in land ownership.
- Selected purchases made through the Fish & Wildlife Development Fund also secured lands across southern and central Saskatchewan that contain native prairie, bluffs, and riparian features that support a range of wildlife species.

Work is continuing with First Nations and industry in officially establishing nine more RANs as outlined in red on the map.

- Selwyn Lake Upland – 280,000 hectares
- Tazin Lake Uplands – two sites – 443,000 hectares
- Churchill River Upland – two sites – 610,000 hectares
- Mid Boreal Plain – three sites – 387,000 hectares
- Mid Boreal Lowland – Lobstick Lake – 90,000 hectares

If and when completed, another 1.8 million hectares will be added to the RAN system.

As a note of interest, we are very appreciative of the support and cooperation of the PFRA in participating in the RAN program. However, we have yet to achieve the same success with the Provincial

Agricultural Department. There are some 324,000 hectares of native grasslands and aspen parklands in provincial pastures that need to be secured.

So how are we doing in meeting the goals of the Endangered Spaces Program when we look at each Ecoregion in Saskatchewan?

- Selwyn Lake Upland – 12.5% -- if completed as proposed
- Tazin Lake Uplands – 13.7% – if completed as proposed
- Athabasca Plain – 3%
- Churchill River Upland – 10% – if completed as proposed
- Mid Boreal Plain – 17%
- Mid Boreal Lowland – 15%]
- Boreal Transition – 8%
- Aspen Parkland – 6%
- Moist Mixed Grassland – 6%
- Mixed Grassland – 15%
- Cypress Upland – 21%

From 1885 – 1985 about 5% of the land base in Saskatchewan was afforded some form of protection. In the last 15 years, from 1985 – 2000, we have doubled the protected areas network in Saskatchewan to about 10% of the provinces landscape.

I have identified a number of examples where steps were taken in the past to protect important natural areas including; grassland parks, migratory bird sanctuaries, shooting preserves, agricultural crownlands, Wildlife Development Fund lands, and Provincial Parks.

I have also shown how with a lack of public support or interest, and complacency, many of these areas were lost. However, when conservationists, backed by the public, were there to stand up and defend our natural areas, we were able to save most of them.

We can not afford to become complacent. There will continue to be a variety of

competing interests eyeing our protected areas, waiting for the right political climate and opportunity to push their agendas at the expense of our natural areas.

Dr. George Ledingham spent a lifetime working towards the creation of a Grasslands National Park. We must make the same commitment to ensure that our treasured, protected, natural areas remain secure and intact for future generations.

Thank you and it is great to be here at a most successful and enjoyable conference.

DEVELOPMENT OF STANDARDIZED GUIDELINES FOR PETROLEUM INDUSTRY ACTIVITIES THAT AFFECT PRAIRIE AND NORTHERN REGION VERTEBRATE SPECIES AT RISK LISTED BY THE COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA.

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Abstract: Petroleum development guidelines exist for a variety of prairie wildlife, particularly species of concern. For each species of sensitive wildlife, the guidelines identify restrictions on passive and development activities for industry and other wildlife disturbances. The restrictions typically include setback distances from nests or dens and timing of disturbances. These guidelines vary between the three prairie provinces both in the species on each list and the details of the assessments. In many cases, there are discrepancies between provincial jurisdictions that make it difficult to justify the guidelines to industry. This paper will outline the results of efforts to standardize the guidelines and mitigation strategies for a variety of species of concern on the Canadian prairies.

INTRODUCTION

Environmental assessment guidelines exist for a variety of wildlife, particularly species of concern in prairie Canada. Current guidelines include species of national, provincial and local concern. For each species of sensitive wildlife, the guidelines identify restrictions on passive and development activities for industry and other wildlife disturbances. The guidelines typically include setback distances from nests or dens and timing of disturbances.

In southern Saskatchewan, as the list of species at risk grew, guidelines were developed in response to requests from industry to help in their planning and implementation of projects. Setback distances were based on interviews with other researchers and personal observations.

Timing guidelines generally revolve around the breeding and brood rearing requirements of the animal. These guidelines were implemented in 1995 and are currently regularly used in the grassland ecoregion of Saskatchewan.

In southern Alberta, Alberta Environment staff adopted the Saskatchewan example as a working model and modified the guidelines to reflect species of local concern. Discussions are presently underway to modify these guidelines so that they can be applied for use on any species or significant habitat in Alberta. Other areas of the province have not formally developed guidelines.

Manitoba utilizes publications that are specific to minimizing the environmental impact of activities such as the construction

of roads, utility corridors and stream crossings. Buffer considerations are used that may be varied after the critical timing period and Manitoba Conservation staff routinely provide comment on development activities.

Environment Canada has developed a list of guidelines for some of the Prairie and Northern Region species at risk in response to projects that are subject to review by a national agency (i.e., National Energy Board).

The guidelines vary between the three prairie provinces both in the species on each list and the details of the assessments. These discrepancies between jurisdictions make it difficult to justify the guidelines to industry.

The information for the guidelines in this report was based on broad consultation, the best available knowledge, existing local management, and reflects the varying degrees of impact that activities associated with the Petroleum industry may have on these Committee on the Status of Endangered Wildlife in Canada (COSEWIC) species.

METHODS

Representatives from the Petroleum industry were consulted in an effort to develop a method that would reflect the range of activities that could impact species. The

suggested method plots the Type of Disturbance, Magnitude of Disturbance, and Risk in a 3D matrix. This method is based on the premise that not all developments are the same in terms of magnitude and risk and thus should warrant different setback distances and timing restrictions. The level of designation of an animal on the COSEWIC list was not included in rankings as this process should apply equally to all organisms but will focus on COSEWIC in the interim.

For example, on native prairie, drilling a minimal disturbance shallow sweet gas well is much different in construction method, total disturbance, and risk than drilling a deep sour oil well. The deep sour oil well usually requires leveling the lease and the rig may be on site drilling for weeks. In comparison, the drilling of a shallow gas well requires little if any clearing, the access road that the drilling rigs use is undisturbed native prairie and the well is usually drilled within 24 hours.

Categories of the range of activities were sent out to Petroleum industry representatives who were asked to rank them. When asked to comment on ranking the values for the matrix, industry representatives were asked to consider that a hypothetical area is “pristine” with no previous development in the area as explained in the following examples.

LEVEL	ACTIVITY
LOW	surveying, drive by
MEDIUM-LOW	<i>interpolated</i>
MEDIUM	short term e.g., 24-hr minimal disturbance drilling event
MEDIUM-HIGH	<i>interpolated</i>
HIGH	permanent structures e.g., roads, buildings

Participants were asked to provide comment on the LOW, MEDIUM and HIGH categories. The MEDIUM-LOW and MEDIUM-HIGH categories were added to offer more flexibility to the matrix.

The rankings were then compiled and redistributed for additional comments. It was emphasized to industry that for many of the species being considered there was no science to back up the setback distances and that the biological information would be based on a broad consultation process and for most species, anecdotal evidence.

Thirty-two species listed by COSEWIC were assessed. Species-authorities included government and non-government personnel from the prairie and northern regions of Canada. They were also asked to consider the animal living in relative isolation from human disturbance when commenting on critical dates, suggested setbacks, rationale for setbacks, suggested mitigation and any known disturbance studies. Existing guideline information and recommendations from other persons were not made available during the interview (except where interviewees had developed guidelines in their jurisdiction) so as not to influence responses. No emphasis was given to the COSEWIC designation as all wildlife should be treated equally through this process and emphasis given to ecosystem approaches for recovery.

The critical dates, suggested setbacks, and rationale for the setback distances were compiled and sent out to the original interviewees and in addition, to a broader range of species-authorities for final comment.

In discussions with both biological and industry representatives, it was stressed that these Guidelines are meant to be a work in progress and that the final document will not

be static. The information contained in this report must be continually updated to reflect changes in development practices and species knowledge.

RESULTS

A list of the 32 COSEWIC species considered can be found in Table 1.

Ten industry representatives, representing 7 industry organizations, were consulted while developing the Matrix Values for Petroleum Industry Activities for this project. These Values can be found in Table 2.

During the biological consultation process, 96 interviews were completed, 127 people were contacted for a total of 223 species authorities in British Columbia, Alberta, Saskatchewan, Manitoba, Northwest Territories, Nunavut and various locations in the United States (NOTE: some people have experience with more than one species).

Table 3 contains the compiled listings of Setback Distances and Critical Timing. These lists for the 32 species being considered are organized into species groups of AVIFAUNA (birds), MAMMALS, and HERPTILES (amphibians and reptiles). An example of the matrix is found in Figure 1.

Species-authorities were consulted either in person, by phone, fax or email. Environment Ministers from Alberta, Saskatchewan and Manitoba were also contacted and received a copy of the report.

Species-authorities could not be contacted for the following species: Grey Fox, Ivory Gull, Least Bittern, Northern Prairie Skink and Ross' Gull. Some species already have existing local management groups and/or guidelines that are under development, therefore, guidelines were not developed for the Woodland Caribou (e.g.,

www.deer.rr.ualberta.ca/caribou/bcrp.htm) Grizzly Bear (e.g., www.gov.ab.ca/env/regions/nes/hilites.html) and Polar Bear (contact Dr. Ian Stirling).

This project was presented as a working paper at a meeting of the Alberta Chapter of The Wildlife Society on March 10-11, 2000 in Lethbridge, Alberta, Canada. Conference participants were encouraged to contribute to the project with some excellent contacts established. In addition, a 1997 document entitled "The Effects of Linear Developments on Wildlife: A Review of Selected Scientific Literature" compiled by Arc Wildlife Services Ltd, Calgary, for Canadian Association of Petroleum Producers Calgary, Alberta, was obtained at the Conference and is available on request from Environment Canada. Contact Paul Gregoire for more information.

DISCUSSION

The development of standardized guidelines for setback distances, timing, and mitigation strategies is the continuation of a process that began in Saskatchewan in 1994 and does not end with this document. These Guidelines must be updated to reflect changes in development practices, species knowledge, existing research and literature. A cursory review of the literature found that for most of the species, no studies have been conducted to document the effects of disturbance on critical portions of their life cycle.

Environment Canada is in the process of completing a literature search on selected COSEWIC species that should contribute additional information on the effects of disturbance for these species.

As industry practices evolve and the matrix values are tested, adjustments to these

guidelines will need to be made. When a company is considering a project it should first try to schedule the project so it will have the least impact on species, for most species this will mean constructing outside of the breeding season. If avoiding this critical period is not an option, then the guidelines should be applied for planning and operational purposes.

If a company must develop within the critical times, historic species information is available from provincial databases (i.e., Conservation Data Centers) that highlight historic "hot spots". The onus would then be on the developer to hire qualified personnel to conduct surveys within the project area so that current locations of nests/dens can be located. If a den or nest is found within the recommended setback distance, an evaluation should be made to assess existing land-use/above ground structures and topography in the area to determine if the setback can be relaxed. This would be done in consultation with the proper regulating authority.

Industry Matrix Values are based on perceived impacts and will need to be revised as more knowledge is gained. There was some debate about the low weighting of *Pipeline* in the *Type of Disturbance* for the Petroleum Values. The concern with the low weighting was that pipeline right-of-ways become trails and then roads. If a pipeline right-of-way does become a trail or road then setback distance would automatically increase to that of Access Roads.

A few comments that appeared more than once as suggested mitigation that could help species and make projects more cost effective are listed below:

1. Construct outside of the Critical Time periods.

2. Encourage traffic control programs to reduce vehicular traffic and speeds, day/night.
3. Reclaim with native species for both diversity and structure.
4. Reduce fences and powerlines where possible.
5. Narrow right-of-ways.
6. Detour around sensitive areas.

It must be emphasized that the 32 species being considered for this project are at risk in Canada for a variety of reasons. Over 2/3 of these species rely on the prairie for a significant portion of their breeding cycle. Though the perceived impact of industrial development on these species can not be dismissed, it is not the only factor at work. Urban development, fragmentation and degradation of habitat are but a few influences along with natural cycles that must be included in discussions of species recovery efforts. Species recovery is not the responsibility of a single industry but of society as a whole as it considers, "What is the worth of a Piping Plover?"

RECOMMENDATIONS

1. Complete literature review of impacts of human activities on wildlife.
2. Consider cumulative effects of all projects.

3. Incorporate data into a computer program for ease of data manipulation and sharing.
4. Continue cooperative partnerships between jurisdictions and encourage information sharing.
5. Encourage cooperative multidisciplinary studies to investigate effectiveness of setback distances, timing restrictions and industry matrix values. Future research should focus on determining the perceived effects and impacts of activities on species and their habitats.
6. Each jurisdiction adopt this process and expand it for its own species at risk.
7. Incorporate other activities into the framework i.e., ecotourism, mining, agriculture, etc.
8. Explore impacts to fossorial animals by seismic activities.

Funding for this project was made possible by Environment Canada's – Environmental Assessment Research and Development Fund. A full version of this report (including Rationale For Setback Distances and Critical Timing, Guidelines used by various jurisdictions and Contact Lists) can be found at www.ec.gc.ca in late spring 2001.

Table 1. List of COSEWIC species considered

COMMON NAME	SCIENTIFIC NAME	STATUS	REVIEWED
1 Anatum Peregrine Falcon	<i>Falco peregrinus anatum</i>	Threatened	1999
2 Black-tailed Prairie Dog	<i>Cynomys ludovicianus</i>	Vulnerable	1999
3 Burrowing Owl	<i>Athene cunicularia</i>	Endangered	1995
4 Eastern Loggerhead Shrike	<i>Lanius ludovicianus migrans</i>	Endangered	1991
5 Eastern Short-horned Lizard	<i>Phrynosoma douglassii brevirostre</i>	Vulnerable	1992
6 Eastern Yellow-bellied Racer	<i>Coluber constrictor flaviventris</i>	Vulnerable	1991
7 Ferruginous Hawk	<i>Buteo regalis</i>	Vulnerable	1995
8 Great Plains Toad	<i>Bufo cognatus</i>	Vulnerable	1999
9 Grey Fox	<i>Urocyon cinereoargenteus</i>	Vulnerable	1979
10 Grizzly Bear	<i>Ursus arctos</i>	Vulnerable	1991
11 Ivory Gull	<i>Pagophila eburnea</i>	Vulnerable	1996
12 Least Bittern	<i>Ixobrychus exilis</i>	Vulnerable	1999
13 Long-billed Curlew	<i>Numenius americanus</i>	Vulnerable	1992
14 Mountain Plover	<i>Charadrius montanus</i>	Endangered	1987
15 Northern Leopard Frog	<i>Rana pipiens</i>	Vulnerable	1998
16 Northern Prairie Skink	<i>Eumeces s. septentrionalis</i>	Vulnerable	1989
17 Ord's Kangaroo Rat	<i>Dipodomys ordii</i>	Vulnerable	1995
18 Piping Plover	<i>Charadrius melodus</i>	Endangered	1985
19 Polar Bear	<i>Ursus maritimus</i>	Vulnerable	1999
20 Red-Headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Vulnerable	1996
21 Ross' Gull	<i>Rhodostethia rosea</i>	Vulnerable	1996
22 Sage Grouse	<i>Centrocercus u. urophasianus</i>	Endangered	1998
23 Sage Thrasher	<i>Oreoscoptes montanus</i>	Endangered	1992
24 Short-eared Owl	<i>Asio flammeus</i>	Vulnerable	1994
25 Sprague's Pipit	<i>Anthus spragueii</i>	Threatened	1999
26 Swift Fox	<i>Vulpes velox</i>	Endangered	1998
27 Western Loggerhead Shrike	<i>Lanius ludovicianus excubitorides</i>	Threatened	1986
28 Whooping Crane	<i>Grus americana</i>	Endangered	1978
29 Wolverine	<i>Gulo gulo</i>	Vulnerable	1989
30 Wood Bison	<i>Bison bison athabasca</i>	Threatened	1988
31 Woodland Caribou	<i>Rangifer tarandus caribou</i>	Vulnerable	1984
32 Yellow Rail	<i>Coturnicops noveboracensis</i>	Vulnerable	1999

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Table 2. Matrix values for petroleum industry activities

NUMERICAL VALUES ASSIGNED TO CATEGORIES		
LOW	1-3	
MED-LOW	4-6	
MEDIUM	7-9	
MED-HIGH	10-12	
HIGH	13-15	

TYPE OF DISTURBANCE		WEIGHT
Pipeline		1
Access Roads		3
Well site		3
Compressor Station, Oil Battery or Straddle Plant		5
Temporary Surface Facilities e.g., camps		1
Permanent Surface Facilities e.g., pig traps, risers, cathodic protection		4

MAGNITUDE OF DISTURBANCE			
Pipeline	Plowed in		1
	< or = to 6"		2
	8"-10"		3
	12" - 20"		3
	> 20"		4
Shallow Gas Well and Associated Facilities			1
Deep Gas Well and Associated Facilities			2
Oil Well and Associated Facilities			4
Permanent Facility	<100x100 m	With Noise e.g., Small Compressor	4
		No Noise e.g., Small Pigging Station	3
	>100x100 m	With Noise e.g., Straddle Plant	5
		No Noise e.g., Tank Farm	4
Temporary Facility e.g., Camps, Stockpile Sites			1
Access Roads	Permanent		4
	Temporary		1

RISK			
Facilities	Liquids		4
	Gas	Sweet	1
		Sour	4
	Oil	Sweet	4
		Sour	5
	Water		1
	Condensate		4
	Roads	Summer Use	3
		Winter Use	1
		All Season	5

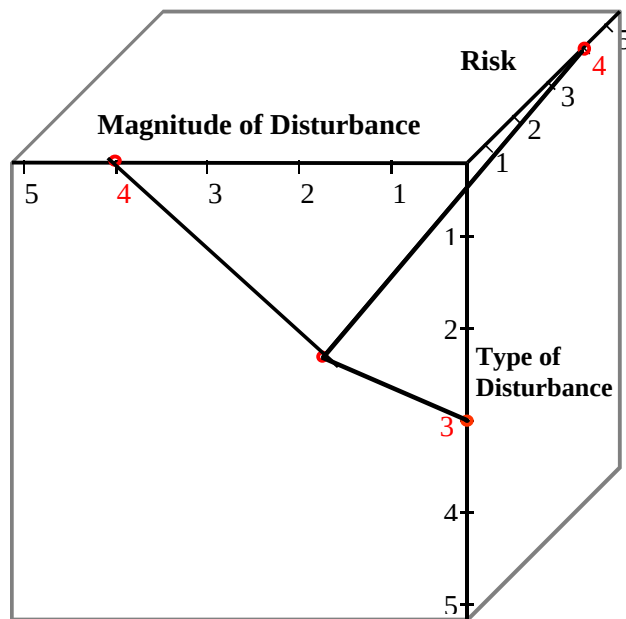
Figure 1. Matrix Example

Consider the following scenario: ABC Oil and Gas is planning to drill and construct associated facilities for a **deep sweet oil well** in known owl habitat between **May 15 – June 7** and want to know how far away they need to be from a burrowing owl nest.

- 1) Look up values in **Disturbance Values for Petroleum Activities** (See Table 2):

TYPE OF DISTURBANCE	Well site	3
MAGNITUDE OF DISTURBANCE	Oil well and Associated Facilities	4
RISK	Oil - Sweet	4

- 2) Plot as in diagram:



- 3) Look up **Numerical Values Assigned to Categories** (See Table 2): $4 + 4 + 3 = 11 = \text{MED-HIGH}$
- 4) Look up **MED-HIGH** in SETBACK DISTANCES AND CRITICAL TIMES – AVIFAUNA (See Table 3) for **burrowing owls** within the proposed dates = setback of 400 m.
- 5) Assess existing land-use/above ground structures and topography in the area in consultation with the proper authority to determine if the setback or timing can be relaxed.

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

AVIFAUNA

SPECIES	TIMING	ACTIVITY	SETBACK	RANGE
			(METERS)	(METERS)
1 BURROWING OWL (N=40)	Apr 1 - July 15 (nesting fledging)	LOW	200	0-500
		MED-LOW	250	
		MED.	300	200-1000
		MED-HIGH	400	
		HIGH	500	500-1000
	July 16 - Oct 15 (dispersal, pre-migration)	LOW	100	100
		MED-LOW	150	
		MED.	200	200
		MED-HIGH	300	
		HIGH	500	500
	Oct 16 - Mar 31 (winter)	LOW	10	10
		MED-LOW	100	
		MED.	200	200
		MED-HIGH	300	
		HIGH	500	500
2 FERRUGINOUS HAWK (N=7)	Mar 15 - July 15 (nests)	LOW	500	100-1000
		MED-LOW	500	
		MED.	750	100-2000
		MED-HIGH	850	
		HIGH	1000	400-3000
3 IVORY GULL (N=0)	NONE SUGGESTED			
4 LEAST BITTERN (N=0)	NONE SUGGESTED			
5 LOGGERHEAD SHRIKE (N=22) Note: applies to <i>L.l. kaibitorides</i> and <i>L.l. nigrans</i> in Manitoba only	May 1 - Aug 15 (nests)	LOW	50	10-100
		MED-LOW	100	
		MED.	250	100-500
		MED-HIGH	250	
		HIGH	400	100-500
6 LONG-BILLED CURLEW (N=5)	Apr 15 - July 15 (nests)	LOW	100	100
		MED-LOW	100	
		MED.	200	100-200
		MED-HIGH	200	
		HIGH	200	100-200
7 MOUNTAIN FLOVER (N=2)	May 1 - July 31 (nests)	LOW	200	200
		MED-LOW	300	
		MED.	400	200-500
		MED-HIGH	500	
		HIGH	500	200-750

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

AVIFAUNA

SPECIES	TIMING	ACTIVITY	SETBACK (METERS)	RANGE (METERS)
8 PIREGRINE FALCON (N=26)	Apr 1 - Aug 15	LOW	300	100-500
		MED-LOW	400	
		MED.	500	500-2000
		MED-HIGH	750	
		HIGH	1000	500-2000
9 PIPING PLOVER (N=16)	May 1 - July 31 (nesting, brood rearing)	LOW	200	100-500
		MED-LOW	300	
		MED.	400	200-500
		MED-HIGH	500	
		HIGH	600	400-1000
	Aug 1 - Sept 30 (dispersal, migration)	LOW	100	100
		MED-LOW	100	
		MED.	200	200
		MED-HIGH	400	
		HIGH	600	800
10 RED-HEADED WOODPECKER (N=2)	Apr 15 - June 30	LOW	0	0
		MED-LOW	50	
		MED.	100	100
		MED-HIGH	100	
		HIGH	100	100
11 ROSS' GULL (N=0)	NONE SUGGESTED			
12 SAGE GROUSE (N=20)	Mar 1 - July 15 (leks)	LOW	500	200-500
		MED-LOW	750	
		MEDIUM	1000	500-3200
		MED-HIGH	1000	
		HIGH	1000	1000-3200
	Apr 15 - June 15 (nests)	LOW	200	200
		MED-LOW	250	
		MEDIUM	300	
		MED-HIGH	400	
		HIGH	500	500
	July 16-Feb 29 (leks)	LOW	100	
		MED-LOW	500	
		MEDIUM	1000	
		MED-HIGH	1000	
		HIGH	1000	1000-3200

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

AVIFAUNA

SPECIES	TIMING	ACTIVITY	SETBACK (METERS)	RANGE (METERS)
13 SAGE THRASHER (N=1)	May 15 - June 30	LOW	100	100
		MED-LOW	100	
		MED.	200	200
		MED-HIGH	250	
		HIGH	200	200
14 SHORT-EARED OWL (N=8)	Mar 25 - Aug 1	LOW	100	100-200
		MED-LOW	200	
		MED.	300	100-500
		MED-HIGH	400	
		HIGH	500	100-800
15 SPRAGUE'S PIPIT (N=8)	Apr 21 - Aug 31	LOW	50	0-100
		MED-LOW	100	
		MED.	200	50-250
		MED-HIGH	200	
		HIGH	250	100-400
16 WHOOPING CRANE (N=12)	May 1 - Aug 15	LOW	500	100-1000
	Sept 15 - Nov 1 (staging areas)	MED-LOW	1000	
		MED.	1000	1000
		MED-HIGH	1000	
		HIGH	1000	1000
17 YELLOW RAIL (N=4)	May 1 - July 15	LOW	100	0-100
		MED-LOW	100	
		MED.	150	100-200
		MED-HIGH	250	
		HIGH	350	200-350

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

MAMMALS

SPECIES	TIMING	ACTIVITY	SETBACK (METERS)	RANGE (METERS)
1 BLACK-TAILED PRAIRIE DOG (N=2)	YEAR ROUND	LOW	0	0-100
		MED-LOW	125	
		MED.	250	0-500
		MED-HIGH	350	
		HIGH	500	0-1000
2 GREY FOX (N=0)	NONE SUGGESTED			
3 GRIZZLY BEAR	REFER TO LOCAL MANAGEMENT PLANS AND/OR EXISTING GUIDELINES			
4 ORD'S KANGAROO RAT (N=4)	Apr 1 - Aug 15 (breeding)	LOW	50	0-50
		MED-LOW	100	
		MED.	250	200-250
		MED-HIGH	250	250
		HIGH	500	200-750
	Aug 16 - Nov 15 (pre-winter)	LOW	50	50
		MED-LOW	250	
		MED.	500	500
		MED-HIGH	500	
		HIGH	500	1000
	Nov 16 - Mar 31 (winter)	LOW	50	50
		MED-LOW	100	
		MED.	250	250
		MED-HIGH	250	250
		HIGH	500	750
5 POLAR BEAR	REFER TO EXISTING ENVIRONMENTAL IMPACT ASSESSMENTS			
6 SWIFT FOX (N=9)	Feb 15 - Aug 31 (breeding rearing emergence)	LOW	500	500
		MED-LOW	500	
		MED.	500	500-1000
		MED-HIGH	500	
		HIGH	2000	2000
	Sep 1 -Feb 14 (winter)	LOW	100	100
		MED-LOW	250	
		MED.	500	500
		MED-HIGH	500	
		HIGH	2000	2000

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

MAMMALS

SPECIES	TIMING	ACTIVITY	SETBACK (METERS)	RANGE (METERS)
7 WOLVERINE (N=3)	YEAR ROUND (dens)	LOW	0	0
		MED-LOW	100	
		MED.	250	
		MED-HIGH	250	
		HIGH	500	500
8 WOOD BISON (N=10)	Apr 1 - Sept 1 (calving, rut grounds)	LOW	0	0
		MED-LOW	0	
		MED.	0	0
		MED-HIGH	500	
		HIGH	1000	1000
	Mar 1 - Apr 15 (winter range)	LOW	500	500
		MED-LOW	500	
		MED.	500	500
		MED-HIGH	750	
		HIGH	1000	1000
9 WOODLAND CARBOU	REFER TO LOCAL MANAGEMENT PLANS AND/OR EXISTING GUIDELINES			

Table 3. Setback distances and critical timing (N = Number of species-authorities contacted)

HERPTILES

SPECIES	TIMING	ACTIVITY	SETBACK (METERS)	RANGE (METERS)
1 EASTERN SHORT- HORNED LIZARD (N=5)	Mar 15 - Nov 15	LOW	50	0-100
		MED-LOW	100	
		MED.	200	0-200
		MED-HIGH	200	
		HIGH	200	0-200
2 EASTERN YELLOW- BELLIED RACER (N=3)	YEAR ROUND	LOW	100	100
		MED-LOW	150	
		MED.	200	200
		MED-HIGH	500	
		HIGH	1000	200-2000
3 GREAT PLAINS TOAD (N=5)	YEAR ROUND	LOW	10	0-100
		MED-LOW	200	
		MED.	400	100-1000
		MED-HIGH	500	
		HIGH	500	100-1000
4 NORTHERN LEOPARD FROG (N=10)	Apr 1 - Oct 31 (breeding & dispersal, pre-winter)	LOW	10	0-50
		MED-LOW	100	
		MED.	200	100-500
		MED-HIGH	350	
		HIGH	500	100-1000
5 NORTHERN PRAIRIE SKINK (N=0)	NONE SUGGESTED			

SPRUCE WOODS PROVINCIAL PARK – PRAIRIE MANAGEMENT PLAN

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Abstract: A prairie management plan has been developed and implemented at Spruce Woods Provincial Park since 1996. The plan is intended to help organize, coordinate and record vegetation management activities, and to help make interpretation an inherent part of prairie management. The plan establishes a vision and specific objectives for mixed grass prairie within the park. Floral inventories were conducted to help establish goals or measurable targets for the condition of each of 16 prairie sites in the park. Upon identifying threats to the integrity of the prairie, specific management prescriptions to address these concerns are developed, implemented and assessed annually. An adaptive management approach is used in developing management prescriptions. Management prescriptions may include burning, mowing, grazing, and chemical and biological control of non-native species. Prairie management has become an integral part of maintaining a healthy landscape at Spruce Woods Provincial Park. Through the Prairie Management Plan the following have been accomplished:

- Prairie sites have been burned on a 5-year rotation since 1992.
- Permanent sample plots have been monitored since 1996.
- Experimental mowing to control aspen encroachment has occurred annually from 1996 to 1999.
- One site has been included a Rotational Grazing Demonstration Project for southwest Manitoba
- The leafy spurge control program has been expanded with a greater focus on biocontrol.
- Interpretive programming informs hundreds of park visitors each year about mixed grass prairie and prairie management.
- Invitations for research associated with prairie management have been extended to all Manitoba Universities.

A prairie management plan has been successfully implemented at Spruce Woods Provincial Park since 1996. Improved prairie health, a sound management program, and greater public awareness are some of the benefits that have accrued. I will describe how this plan was developed, how it is implemented, and some of the results of implementation - our successes. I

will also describe what I see as some of the strengths of the plan.

Spruce Woods Provincial Park lies along the Assiniboine River in southwest Manitoba. It is between the communities of Glenboro and Carberry. Within Manitoba's park system, Spruce Woods represents the Assiniboine Delta Natural Region. The park's 269 sq.

km hosts a complex of spruce parkland, upland deciduous forest, riverbottom forest, open and stabilized sand dunes, and mixed grass prairie. It contains an area of open sand dunes – The Spirit Sands – which is the most obvious remnant of the ancient Assiniboine Delta. One can find in the park remnants of agricultural fields as well as some fields still being used for haying and grazing. Spruce Woods is one of the ten most heavily used parks in Manitoba and is a popular area for family camping and outdoor activities.

The idea of a Prairie Management Plan for the park started to take shape in 1996. Burning grasslands for purposes of litter control and reduction of fire hazard had been done for three to four years and some direction was needed to guide the expansion of that burning to larger prairie areas. The biocontrol program for leafy spurge had diminished some years earlier with the retirement of key staff. There was a need to rejuvenate the biocontrol program and to rationalize the increasing costs for chemical control.

A proposal from regional Manitoba Conservation staff was put forward in 1996 to Parks and Natural Areas Branch and to the Critical Wildlife Habitat Program (CWHP) to develop this plan. With favourable responses from both, a management team was formed, consisting of the Regional Parks Manager, the CWHP Prairie Technician, the district Natural Resource Officer, and a Resource Management Planner from Parks and Natural Areas Branch.

This team considered the issues of maintaining biodiversity, landscape integrity, the increasing complexity of resource management, and the value of interpretation as a prairie management tool

to establish these objectives for the Prairie Management Plan.

- To maintain or improve the diversity, health and vigor of the prairie sites within Spruce Woods Provincial Park and specifically to:
 - Decrease the incidence of non-native species such as smooth brome and leafy spurge
 - Increase the density of native mixed grass species
 - Ensure there is no net loss from current prairie area where woody species can effectively be set back;
- To provide greater opportunities for the interpretation of mixed grass prairie and of management of mixed grass prairie;
- To be able to effectively communicate interdepartmentally and to the public, direction and progress on prairie management at Spruce Woods;
- To coordinate this management work with management work for other wildlife species, notably elk and prairie birds; and
- To facilitate scientific research on mixed grass prairie.

Not all of Spruce Woods is prairie, so we had to define the areas to which this plan would apply. Our approach was to select the biggest and best prairies in the park as a starting point, and to add other sites that might bring other values to the program. To select these sites a vegetation cover map, airphoto mosaic and field truthing were used. A total of 16 sites were selected. The majority of these are native prairie, most with little if any disturbance or non-native species. Three of them had been cultivated or sod seeded in the past but were included because they are large grassland areas in prominent locations that can aid in public awareness. One of the three was, and continues to be, used for grazing.

In the plan, each of the 16 prairie sites has a specific management prescription. The prescription includes some brief background information, such as area and soil conditions, an initial species list, and the specific management objectives for the site. Most importantly it includes the management activity log. This is a record of what management activities have been done and what is scheduled. An ortho-image map shows the prairie and the management sites, such as permanent sample plots, within it. In most cases these management sites are recorded using GPS and then entered into a GIS database.

The plan was initially one volume, however very soon we realised there was a need to keep the field inventory data in a readily available form. This led to the creation of the Technical Record volume of the plan. This document contains data on each of the 16 prairie sites in the park. For each there is a map, a description of the sampling methodology used at the site, the field inventory sheets, and in some cases a photo record from described photo points.

Last year a third volume evolved. The Leafy Spurge Control - Technical Record was created to have a ready file of the biocontrol and chemical control efforts in the park since the first biocontrol work in 1981. This volume is still in preparation but will contain sampling methodologies, biocontrol details and other information.

The plan, in all three volumes, is very much a workbook for the management team. It is meant to be carried in the truck or backpack, it should get notes scribbled in it, and the pages should become dog-eared and dirty. This is not an “approved” plan that is static; it is updated each year. It is always changing as more information is available,

more management decisions are made, and as more is learned as we use an adaptive management approach.

Each fall and spring the management team meets to review previous work and to establish the work program and budget for the following year. Funding has been obtained from Parks and Natural Areas Branch to undertake these projects, and the plan has been instrumental in obtaining this funding. Projects are implemented by the Carberry District of Manitoba Conservation using staff at Spruce Woods Park. Inventory work is done through the CWHP with support funding from Parks and Natural Areas Branch. Total funding ranges from \$3,000 to \$5,000 per year.

I will briefly describe seven major accomplishments we have had with the plan.

1. All but one of the 16 prairie sites have been burned at least once, on a five-year rotation.
 - All of our controlled fires have been in the early spring. One uncontrolled fire was in June. These fires have improved the vigor of every prairie site. Big and little bluestem, in particular, have thrived in the post burn sites. We have found with some of the sites that there is insufficient litter build-up to sustain a fire on a five-year cycle. These sites will now be burned on an 8–10 year cycle.
2. Permanent sample plots at six prairie sites have been monitored since 1996.
 - Composition and density of species is recorded. This is usually done the year before a burn and the summer right after the burn. All the survey data is maintained in the Technical Record volume of the Plan.

3. Experimental mowing to control aspen encroachment has occurred annually from 1996 to 1999.
- The intent was to mow and then burn aspen, with subsequent control by fire alone. We found that sites with considerable juniper or a very light litter build up did not burn well enough to control the aspen. Another site, with no juniper and more litter, was mowed in 1996 and burned in 1997 and now has almost no evidence of an aspen stand being there.
4. One site has been included in a Rotational Grazing Demonstration Project for southwestern Manitoba.
- The cattle producer utilizing this site has installed the additional fencing and water sources for a twice over grazing regime. Annual monitoring tends to indicate improved health of the prairie and no reduction in cattle weight gain. The producer is now interested in extending this program to the rest of his operation.
5. The leafy spurge control program has been expanded with a greater focus on biocontrol.
- We now have over 170 biocontrol release sites in the park. Most of these have *Aphthona* beetles and a few are *Lobesia* leaf tier moths. Park staff attend the annual leafy spurge symposium to keep abreast of the latest in spurge control. We will also begin a site monitoring program this summer.
6. Interpretive programming informs hundreds of park visitors each year about mixed grass prairie and prairie management.
- In 2000 at least 1,678 people attended the various interpretive programs which dealt with mixed grass prairie. These

programs include amphitheatre shows, guided hikes and car caravans to prairie sites.

7. Invitations for research associated with prairie management have been extended to all Manitoba Universities.
- In June of 2000 a tour for a group of Professors from each of Manitoba's universities was held. An invitation was extended to the Universities to use the park for education purposes, for research associated with mixed grass prairie, or for research based on our management of mixed grass prairie.

In the five years we have used this plan at Spruce Woods, there have been several observations which I think are worthy of note for other prairie managers:

1. One of the strengths of this plan is that it is a "working" plan. The management team makes the decisions and has full responsibility for the plan, and changes the plan accordingly.
2. There is support and involvement at all levels in the Department. From the Directors and managers who approved the proposal 5 years ago, to the District Supervisor, to the operator who mows the aspen and spreads the beetles.
3. There are champions on the management team who keep the plan alive.
4. There are benefits to the District staff – the people who do the on-site work – when their jobs are made easier in some way or when they receive accolades from park users.
5. The tasks, especially of monitoring, are manageable. We don't do tons of

monitoring, but enough to keep us informed of what's happening.

6. There is a need to support the development and training of the staff involved.

7. An adaptive management approach facilitates prompt implementation of projects and applied learning from projects.

In closing, I am pleased to be able to say that the Prairie Management Plan for Spruce Woods has been one of our most effective resource management projects within Manitoba's Provincial Parks.

PINE MARTIN REINTRODUCTIONS IN RIDING MOUNTAIN NATIONAL PARK

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Abstract: Riding Mountain National Park (RMNP) initiated a reintroduction of the pine marten (*martes americana*) in 1991. Over a two year period, from 1991 to 1993 a total of 68 marten (37_ and 31_) were reintroduced to RMNP. These animals were obtained from the Duck Mountains, north of RMNP and were released using a hard-release method. Early monitoring efforts included radio-collaring and tracking and winter snow track-transects. In 1997 a new survey was designed following the methodology outlined by Zielinski and Kucera (1995). Photographic bait stations were established in areas of prime habitat. Habitat delineation was based on a Habitat Suitability Index. We hypothesized that by 1998 marten populations in RMNP should have expanded so that marten occupied all the available suitable habitat in the park. Failure to detect marten at a significant number of sites within the park would have suggested to us that marten had failed to re-establish themselves in the park. Following the two year survey we concluded that marten have been successfully reintroduced to RMNP. The marten population has grown and marten have occupied a minimum of 70% and a maximum of 93% of the available habitat in the core part of the park. Additional incidental sightings and observations indicate that marten continue to move throughout the park in search of suitable habitat.

INTRODUCTION

Historical fur records from the Riding Mountain House Trading Post which, was near Lake Audy, indicated that marten (*Martes americana*) pelts were traded there in the early 1900's. In 1932 H.U. Green recorded that marten had become extinct in Riding Mountain National Park (R.M.N.P.) sometime in the 20 years previous to his investigations due to over-trapping and habitat loss. Soper (1953), summarizes the

information he had available at that time as follows: "At one time, this species occurred in fair numbers over at least the eastern and northern watersheds of Riding Mountain in heavy coniferous forest." Before the reintroduction, no reliable marten sightings were recorded since the establishment of the park in 1933.

Riding Mountain National Park is located in the forest-agricultural transition zone of southwestern Manitoba approximately 225 kilometers northwest of Winnipeg. The

park encompasses 2,978 km² of land characterized by mixed coniferous and deciduous forests, interspersed with grasslands and bogs, providing a varied habitat for wildlife (P.C.P. 1987). The park was established in 1933 to preserve a representative example of the Manitoba Escarpment, which rises 475 meters from the surrounding lowlands.

In the 1979 Park Resource Description and Analysis the park is described as being 78% covered by forest, this information was obtained utilizing information from the 1960 forest inventory. This is broken down to 18.5% mixed, 69.4% hardwoods and 12.1% softwoods.

The pine marten prefers habitat composed of pure old growth coniferous forest but they will also occupy softwood dominated mixed wood stands. Bearing this in mind, up to 30.6 percent of the park may be acceptable marten habitat, an area of 613.96 km² (Frey, 1994).

In 1991 a management plan for the reintroduction of pine marten was written and approved by park management. Managers approved the reintroduction based on an analysis of habitat available to marten and after conducting a study of the potential prey base in the park.. Park wardens reintroduced 68 marten over a three-year relocation period. The decision to reintroduce marten was based on a study of habitat, potential prey and the direction from the National Park Policy, which states that:

“A species of plant or animal which has been native to, but which is no longer present in the park area, may be reintroduced:

- i) if the effect on other plants and animals is acceptable; and*
- ii) if such action is compatible with park objectives; and*

iii) if such action does not pose serious problems for neighboring land uses.”

METHODS AND RESULTS

From October 19, 1991 to November 24, 1993 a total of 68 pine marten, 37 males and 31 females, were reintroduced into RMNP. Seed stock was obtained from Duck Mountain Provincial Park, located approximately 100km north of RMNP. The Duck Mountain marten are descendants of 42 animals re-introduced from Ontario in 1969. Logistically, Duck Mountain Provincial Park was an ideal location because transportation time was under two hours.

Trappers who had registered trap lines in the Duck Mountains were contracted to live trap the marten using 23x23x80 cm tomahawk live traps covered with spruce boughs and 23x23x60 cm wooden box traps. Live marten were picked up immediately from the trapper's residence and transferred to a central holding area where they were placed in mink cages with a nesting box at one end. They were fed ground-up deer meat mixed with commercial mink food. All the animals were taken to a veterinary clinic where they were drugged with 0.1 - 0.2 cc of ketamine hydrochloride. If they were not rendered completely unconscious from the drug, they were gassed with halothane gas. Once they were unconscious, they were ear tattooed, sexed, aged, treated with flea powder and examined for their overall state of health. If they appeared to be in a deprived state they were given a small dose of penicillin. A record sheet was kept on each animal from the time of capture until release. Once there were sufficient numbers to warrant a release, the animals were transferred to the release site in plywood transfer boxes and released.

The release site chosen was the Whirlpool Lake area. This site was chosen on the basis of ease of access, presence of suitable habitat and potential for dispersal control. The area is dominated by coniferous forest. Jackpine (*Pinus banksiana*) - black spruce (*Picea mariana*) forest, jackpine-white spruce (*Picea glauca*) forest and black spruce forest are found in this area. Immediately to the south is the large 1980 Rolling River burn. It was hoped that this recent burn would restrict movement to the south and encourage movement north into the mature forest.

A hard-release was chosen over a soft-release. Hard-release involved the simple opening of the traps at the release location and monitoring of the marten until he or she reached cover and disappeared. The large amount of acceptable habitat and the restrictions to marten movement out of the park made this method of release more logistically

During the first year of the reintroduction five animals were radio collared with collars manufactured by AVM Instruments. The collars were an adjustable bolt-fastening type with an external whip antenna ranging from 25 cm to 30 cm long. The results of the radio telemetry monitoring were very poor; five out of six collars stopped transmitting right after, or within three days of the release of the collared marten. Evidence indicated the long whip antennae were very irritating to the marten and they chewed them off soon after they were released.

During the second year of the reintroduction, eight (4males & 4 females) were collared with tuned loop antenna radio collars manufactured by AVM Instruments. Of the eight collars, three quit functioning prematurely; one was recovered off a marten that was located dead under the snow, and four were recovered off marten that were live trapped in late February or early March. Home range data was obtained for five of the eight collared marten using the program HOME RANGE (Ackerman et al. 1990) (Figure 3). Using the harmonic mean method with a 95% confidence interval the mean home range size for the five collared marten was 8.9 km². The mean size for females was 9.35 km² and for males 8.337 km². Using a 75% confidence interval the mean home range size for females was 4.48 km² and for males 5.391 km². Raine (1982) found for juvenile marten in southeastern Manitoba the mean for females was 7.2 km² and for males 8.9 km². Most home range studies have determined that female home range sizes are consistently smaller than male home ranges. The small sample size and the fact that the marten were recently reintroduced are logical explanations for the mean size of female home ranges being larger than the male home ranges at the 95 % confidence interval.

Only three marten (two males, one female) provided enough data for calculation of core areas. For the female the core area was 1.813 km² and the mean for the two males was 2.955 km². The small core area size is a good indication an abundant prey base exists for the marten in the park.

Figure 3. 92-93 Marten Home Range Comparisons

Marten #	Harmonic Home Ranges (km ²)			Minimum Convex Polygon (km ²)		
	95%	75%	Core	100%	95%	75%
1	8.389	4.278	1.813	49.315	20.970	1.335
4	15.660	7.004		9.380	7.310	2.980
6	7.660	5.137	2.673	14.115	11.675	4.080
7	4.011	2.168		2.800	2.155	0.905
8	9.014	5.645	3.237	28.760	10.750	2.485
Average	8.947	4.846	2.574	20.874	10.572	2.357

Note: Martens 4 & 7 had no significant core area

As a follow up to the reintroduction a monitoring study was developed in 1997. During the following two winter seasons of 1998 and 1999 a study was implemented based on the techniques written by Zielinski and Kucera (1995) and published by the US Department of Agriculture, Forest Service.

The following calculation was used to estimate a hypothetical population size of 1,316 martens by the fall of 1998.

$$N = \sum \{N_x (\text{reproducing } \_) (r) + N_x (\text{survivorship})\}$$

It was assumed that female martens have a mean litter size of 2.85 young per year, they have one litter per year and are sexually reproductive at two years of age. In any given year 29% of the total population has the potential to be reproductive. A survivorship rate of 0.71 was used (Gibilisco, 1994).

Our null hypothesis was based on the assumption that if the marten population in Riding Mountain National Park had reached a population of 1,316 by 1998, they should have occupied all areas of preferred habitat. Marten would be expanding to fill areas of less suitable habitat or would be competing against each other for resources. Successful reintroduction was to be measured by marten

being detected at camera bait stations established in areas of preferred marten habitat. Significant deviation from a hypothetical norm of marten occupying 100% of available habitat in the park would have suggested to us that the reintroduction had not been successful.

The study was based on methods described in the manual "American Marten, Fisher, Lynx and Wolverine: Survey methods for their detection" written by Zielinski and Kucera in 1995. TrailMaster TM500 monitors and the associated TrailMaster TM35-1 camera kits were used. The cameras worked very well in a variety of weather conditions.

Monitoring sites were selected based on the ranking given to various habitat types in a Habitat Suitability Model (Allen, 1982). The Habitat Suitability Model was created using SPANS GIS and took several variables into account. These included: vegetation maps obtained from satellite imagery (Walter & Kenkel, 1997); ranking of vegetation variables (canopy closure, overstory species structure, successional stage of stand, downfall and debris on ground); and telemetry and sightings of marten were included as a minor consideration (Jensen, in press). An overlay of preferred habitat was created on 1:50 000 topographic maps. Camera locations were

selected based on size of preferred habitat and accessibility. Large portions of road-killed animals (moose and elk) were used to maximize the attractiveness of the bait station. A piece of burlap soaked in fish oil was also used as an added attractant. The sampling period was during the winter months to facilitate movement to the bait stations (by snowmobile) and to minimize interference with the bait from black bears.

Sixteen camera stations were established and monitored over the two year period. Of these sixteen sites, marten were conclusively detected (from photographic record) at eleven sites, 69% of the selected preferred habitat in the park. At sites ten and eleven, marten tracks were observed within 500m of the bait station. Given that this is within the possible home range size of marten, this increased the probable observation at the bait stations to thirteen sites, 81% of selected preferred habitat within the park. Additionally, two of the bait stations monitored during the study period occurred in areas where the total area of preferred habitat was less than 2km². Given that this is less than the expected home range size it might be possible to remove these stations from the analysis. Removal of these two stations would result in 93% detection in selected preferred marten habitat within the park.

CONCLUSION

Marten have been successfully reintroduced to Riding Mountain National Park. The species has expanded its range and grown in population to occupy more than 70% of available preferred habitat within the park. The results from this survey lead researchers to suggest that the reintroduction of marten the park has been so successful that all available preferred habitat has been filled

and that juvenile marten are expanding in the park in search of other suitable habitat.

RECOMMENDATIONS

This survey effort has successfully detected the presence of marten in more than 70% of preferred habitat in RMNP. This suggests that the marten reintroduction initiated in the early 1990's was a success. The methods and results from this survey should not be used as long term monitoring data. It is suggested that future monitoring be casual and focus on the recording of incidental observations and casual detection and search as a part of other duties (patrol, visitor surveys etc). If park managers feel, as a result of incidental observation or environmental change, that marten populations may be facing a decline in the near future a serious population monitoring effort should be initiated.

This survey was successful in meeting its goals, of establishing the presence or absence of marten in RMNP. Long term population monitoring, if required, should be based on considerable planning and statistical evaluation before implementation. Small sample size and large variance would reduce our ability to detect change over time.

Although this is an occasion for some celebration it would be unwise to assume that *Martes americana* will forever reside in the park. Changes in vegetation as a result of fire, climate change or disease may alter the habitat required by marten, and other boreal species, to survive. Many authors, both scientific and popular, have written about the increasing ecological isolation of Riding Mountain National Park (Searle, 2000). To ensure the long term viability of marten populations in Riding Mountain National Park and in Manitoba, north-south corridors

of intact, contiguous habitat should be created. Management initiatives to create habitat corridors between the Duck Mountains and Riding Mountains should begin as soon as possible.

ACKNOWLEDGEMENTS

The reintroduction of *Martes americana* to Riding Mountain National Park has been the work of many dedicated people. The people of Canada must be thanked for their vision in the creation of the National Parks system and the National Parks Act. The Act and its subsequent policies allows for the reintroduction of species like the pine marten. Parks managers should be commended for their vision in the Park Management Plan and for their action in seeing the reintroduction to fruition.

Any program, no matter how great the vision, relies entirely on the dedication and perseverance of staff members to carry it out. In a project that requires working in cold temperatures, at all hours of the day and often alone, the stamina of staff is paramount. National Parks staff who have helped and guided the program are: Park Wardens Pat Rousseau, Sharon Irwin, Marcy Nemetchek, Barry Desmoulin, Brad Lloyd, Terry Hoggins, Roger Baird, Gordon Pylypuik, and Sean Frey, who was also a great assistance in his new role as GIS Specialist; and volunteers Alison Amero, and Troy Pollock.

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SASKATCHEWAN'S PRAIRIE CONSERVATION ACTION PLAN: AN EXAMPLE OF AN EFFECTIVE PARTNERSHIP

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Abstract: In 1997 a new, action-oriented Prairie Conservation Action Plan was developed for Saskatchewan through a partnership of industry, federal and provincial government agencies, non-government organizations and academic institutions. The partnership's vision is to sustain the native prairie in a healthy state in which natural and human values are respected. The 5 goals of the Saskatchewan Prairie Conservation Action Plan (SK PCAP) are: (1) to sustain a healthy native prairie grazing resource; (2) to conserve the remaining prairie resource; (3) to maintain native prairie biological diversity; (4) to promote the sustainable use of native prairie to enhance the quality of life; and (5) to promote education and develop communication programs. Relative to those goals, the SK PCAP partners developed 29 objectives and 85 action items whose progress is tracked annually through the production of Partner Updates.

Chaired by the Saskatchewan Stock Growers Association, the partnership manages the SK PCAP through a consensual and cooperative approach. Within the plan, the partners all agreed on which components they would deliver, and to systematically review progress and to reassess goals and deliverables. Most importantly, time-lines were built into the original plan along with the deliverables, to enable monitoring and assessment. A coordinator was hired with funds pooled among the partnership for concerted, effective delivery.

In addition to its role in coordinating conservation activities and reporting on progress, the SK PCAP has also been effective in securing funding for a variety of prairie conservation initiatives for partner agencies and itself. This article summarizes SK PCAP progress and shortfalls, discusses the various prairie conservation initiatives led by the SK PCAP, and describes plans for the future.

BACKGROUND

The initial Prairie Conservation Action Plan was written for the Canadian prairies under the leadership and with the financial support of World Wildlife Fund Canada in 1989.

This original plan was visionary and very detailed. When it expired, an evaluation of the plan and its effectiveness were undertaken by an Ad Hoc committee led by Saskatchewan Environment & Resource Management (SERM). This review determined that while the original plan was very well written, it had little effect on the activities undertaken in the last five years. In reviewing the 1989 Plan it was apparent that none of the goals were fully met and that some goals had seen very little progress.

A principal shortcoming was that the Plan lacked mechanisms to ensure that actions were in fact executed, and results monitored.

Another shortcoming was that there was no grassroots involvement in the Plan's creation and delivery. As a result, the people who actually manage the Saskatchewan grasslands, the ranchers, were not involved. It was originally left to the goodwill of the participants to take on the tasks that all thought they could or should do, and work to realize the original 10 goals. The results of this review were reported to the Prairie Conservation and Endangered Species Conference in Lethbridge in 1995.

Following the review, the Ad Hoc committee formalized itself into a group to renew and

rewrite the Prairie Conservation Action Plan.

At this time SERM and the Saskatchewan Wetland Conservation Corporation (SWCC) approached the Saskatchewan Stock

Growers Association (SSGA) to garner its support and offered it the opportunity to lead

the process. The importance of achieving the goals of the new Prairie Conservation Action Plan within the context of sustainable agriculture in Saskatchewan, prompted the committee to establish a process for renewal of the original Plan. The process involved bringing together a partnership of various provincial and federal organizations and NGOs, collectively called the Saskatchewan Prairie Conservation Action Plan (SK PCAP) Committee, to revise and create a new version of the Plan.

DRAFTING THE NEW PLAN

Issues such as Canada's proposed Federal Endangered Species Legislation and growing public confusion over the role of livestock grazing in conservation of native prairie led the SSGA to assume a lead role in developing and implementing the second SK PCAP. A series of meetings were organized. More than 16 organizations/agencies involved in native prairie conservation in the province were invited. Many organizations and agencies had very diverse perspectives

and, in past, some of these organizations had held adversarial positions on issues. A professional facilitator, Dennis Phillippi of Natural Resource Options (Bozeman, Montana), was hired to assist the process.

Understanding one another's views and concerns through open dialogue broke down many of the barriers between people and agencies. Through great effort and compromise, consensus was reached. Considerable time was spent in developing a shared vision, but once this vision was set, an increased comfort level was present in the group. A true partnership began to form. The Vision of the Saskatchewan Prairie Conservation Action Plan (SK PCAP) is:

“The native prairie is to be sustained in a healthy state in which natural and human values are respected”

Of principal importance is that this vision is “habitat or ecosystem based” versus “species based” and it includes humans as part of the ecosystem.

The partnership decided on **5 Goals** that were necessary to conserve Saskatchewan's remaining native prairie:

1. To sustain a healthy native prairie grazing resource,
2. To conserve the remaining prairie resource,
3. To maintain Saskatchewan's native prairie biological diversity,
4. To promote the sustainable use of native prairie to enhance the quality of life, and
5. To promote education and develop communication programs regarding the conservation and sustainable use of native prairie.

Goal-specific Objectives and Actions deemed necessary to achieve these goals were discussed, agreed upon and outlined. Then, most importantly, the partners volunteered their involvement and actions, and then agreed on who should lead and deliver each objective. Perhaps most importantly, they documented these details. The partners also decided that they would search for funding to hire an Implementation Coordinator, whose role would be: to keep everyone informed of progress; coordinate meetings and updates, and; write proposals and deliver communications-related activities in collaboration with SWCC and other partners.

One of the special things about this native prairie conservation implementation strategy is that the process is chaired by the SSGA; thus the SK PCAP is a producer-led conservation initiative. Interestingly, in spite of the ire that this approach draws in other jurisdictions, the SK PCAP has received national and international attention for the way it addresses collective native prairie conservation issues. The partners are pleased with their success, and do not hesitate to point out that it was producer involvement that gave the process credibility, which has resulted in the successes to date.

ACTIVITIES

- The creation of a “forum” where Partners with diverse perspectives feel comfortable with each other; this Partnership has helped to create a feeling of working towards a common goal.
- The partnership is attractive to funding agencies, and is very successful in sourcing funds for various native prairie conservation projects; in particular, Agriculture and Agri-Food Canada’s Canadian Adaptation and Rural Development in Saskatchewan (CARDS) Program, the Canada Millennium Partnership Program, and Environment Canada’s Habitat Stewardship Program. Considerable time has been spent developing proposals which meet SK PCAP objectives that have not yet been realized.
- Interprovincial coordination with Alberta and Manitoba versions of the PCAP.
- Review progress, and publish annual Partner Updates to document progress made by the partners on the 85 action items identified in the Plan. These inventories are used to identify conservation shortfalls and accomplishments. Two Updates have been published, and a third is to be published in August 2001. They are available from the SK PCAP office in Regina.
- The SK PCAP Partnership has added 5 new Partners (for a present total of 21 organizations/agencies/associations) and another 3 potential Partners have expressed strong interest in joining the Saskatchewan PCAP
- Official provincial designation of Native Prairie Appreciation Week (the first of its kind known in any Canadian province).
- Promotion of an official candidate for a provincial “native grass” emblem (the first of its kind undertaken in any Canadian province).
- Conducted a multi-disciplinary workshop “Romancing the Prairies”, June 1999, which brought together ranchers, naturalists, and resource specialists from environmental and agricultural agencies.
- Development and continued delivery of the “Cows, Fish, Cattle Dogs & Kids Game Show” on riparian stewardship for Grade 4-6 students
- Participation and delivery of the Eco-Extravaganza to 10 schools in southwest Saskatchewan in 2000 and 14 schools in the Missouri Coteau in 2001. The Eco-Extravaganza features fun, interactive, outreach programming for K to 6 students by SK PCAP and some of its Partners, on native prairie conservation and stewardship.
- Conduct quarterly meetings to review progress and determine shortfalls in delivery.
- Coordination of the partners proposals for the Missouri Coteau Project, funded by the Habitat Stewardship Program.
- Deliver the communication component of the Manitoba and Saskatchewan PCAPs, Reconnecting Lands and People Project, funded by the Canada Millennium Partnership Program

- Production of posters, articles, and fact sheets to increase awareness of prairie conservation issues.
- Development and maintenance of a website www.pcap-sk.org

One of the most important accomplishments of the SK PCAP Partnership is the positive relationships that have evolved between SK PCAP Partner groups and agencies that were adversaries in the past, and now work together to meet common objectives.

FUNDING

The SK PCAP Partners would like to thank the following:

- Ducks Unlimited Canada - annual core funding support
- Saskatchewan Environment and Resource Management's Fish and Wildlife Development Fund - annual core funding support, and funding support for the Cows, Fish, Cattle Dogs and Kids Game Show
- Saskatchewan Agriculture and Food - annual core funding support
- Cattle Marketing Deductions Fund - annual core funding support
- Saskatchewan Stock Growers Association - provides a volunteer Chairperson and administrative support
- Saskatchewan Wetland Conservation Corporation - proposal writing, fund-raising, communications and financial management expertise
- Agriculture and Agri-Food Canada's Canadian Adaptation and Rural Development in Saskatchewan (CARDS) Program - funding for SK PCAP implementation
- Agriculture and Agri-Food Canada's National Soil and Water Conservation Program - funding support for the Cows, Fish, Cattle Dogs and Kids Game Show
- Environment Canada's Habitat Stewardship Program - funding for stewardship activities, and support of continued SK PCAP implementation
- The Canada Millennium Partnership Program - supporting the Reconnecting Land and People Project
- Environment Canada, Canadian Wildlife Service for website development

THE FUTURE OF THE PCAP IN SASKATCHEWAN

The 5 year term of the current plan will expire in 2002. Partners intend to complete an evaluation of the Plan, and publish the results as the Partner Update #4 in 2002. A third PCAP for Saskatchewan will be drafted in 2002 while funding and administrative support is still in place. Much progress has been made at getting new, key partners involved (municipal government, first Nations, Oil and Gas Industry etc.). However, much work remains to make all environmental groups and land-use

stakeholders comfortable with the SK PCAP process. The role that the SK PCAP Partners will take in dealing with controversial issues has been a source of potential strife which the Partners have been able to overcome. New challenges are looming in this regard. The SK PCAP will continue active involvement in communicating with the general public, about the importance of native prairie and the key role that the ranching community plays in conserving it.

The biggest challenge will be maintaining a feeling of “synergy” among SK PCAP Partners now that the program is not new and many of the key individuals in it are being forced to move on to other challenges. In closing, implementing conservation programs on the Canadian prairies requires working with a large number of private landowners, lessees, rural and urban municipalities, provincial and federal governments, first Nations and a host of interest groups. We are hopeful that together we can achieve more than any one of us can achieve alone.

Eco-Extravaganza Teacher Evaluation

Thank you for your participation in the Eco-Extravaganza. We would appreciate it if you would fill out this evaluation to let us know if you and your students enjoyed it and to help us improve programming. Please circle the correct response and/or provide your comments to the questions below.

1. Did you find the Eco-Extravaganza worthwhile? Yes No
2. What did you like best about the Eco-Extravaganza?
3. Which aspects of the Eco-Extravaganza need improvement?
4. The Eco-Extravaganza is: Too long Too short Just the right length
5. Are there any other topics that should be included in the Eco-Extravaganza? Please list.
6. Other comments?

We would greatly appreciate feedback from your students on the Eco-Extravaganza. We welcome letters, poetry, artwork or any other medium in which your students would like to express themselves.

Name of School: _____ Grade: _____

Name (optional): _____

Please send evaluations and student comments to Eco-Extravaganza at the address listed above.
Thanks again for your participation and support.



Saskatchewan Prairie Conservation Action Plan

The ECO-Extravaganza is Coming to YOUR Community

The Prairie Conservation Action Plan (PCAP) and Partner organizations including Saskatchewan Wetland Conservation Corporation, Grasslands National Park, Nature Conservancy of Canada, the Saskatchewan Burrowing Owl Interpretive Centre and Ducks Unlimited Canada will be delivering the Eco-Extravaganza to 14 schools in Saskatchewan's Missouri Coteau this winter. Environment Canada's Habitat Stewardship Program is a major sponsor of this event. Our goal is to provide educational programming to grade K-6 students on native prairie ecosystems and their conservation and management. Presentations will be delivered mornings at the following schools:

Jan. 22 - Rockglen	Feb. 6 - Crane Valley with Artesian
Jan. 23 - Assiniboia Elementary	(Spring Valley) and Viceroy participating
Jan. 24 - Bengough	Feb. 7 - Ogema with Pangman participating
Jan. 25 - Coronach	Feb. 8 - Gladmar with Lyndale (Oungre)
Jan. 26 - Assiniboia 7 th Avenue	participating
Feb. 5 - St. Olivier School, Radville	Feb. 9 - Willowbunch

In addition to the school visits, PCAP and its Partners are also hosting 4 public information meetings with the theme "CAN CONSERVATION AND AGRICULTURE CO-EXIST?"

Whether you're a farmer, rancher, teacher, birder or conservationist, the Prairie Conservation Action Plan (PCAP) and its partners invite you to attend evening public information meetings at one of the four locations highlighted above in **bold type**. Landowners and representatives of agencies working in south central Saskatchewan will be available to discuss:

**Sustainable land-use management
Technical and financial assistance
Stewardship programs**

**Educational resources
Conservation easements
Ecotourism**

Doors open at 6:30 p.m. and presentations begin at 7:00 pm. Coffee and donuts available. In addition to the organizations involved with the Eco-Extravaganza, you'll also hear from the Saskatchewan Stock Growers Association, Grazing and Pasture Technology Program, Saskatchewan Environment and Resource Management, Saskatchewan Agriculture and Food, and the Saskatchewan Prairie Conservation Action Plan.

**For more information and to
register, contact
Karyn Scalise at 352-0472,
Heather Felskie at 692-8710 or
Tom Harrison at 731-4404.
There is no cost associated with
these meetings and they are for
information purposes only.**



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Saskatchewan Prairie Conservation Action Plan
CAN CONSERVATION AND
AGRICULTURE CO-EXIST?

Whether you're a farmer, rancher, teacher, birder or conservationist, the Prairie Conservation Action Plan (PCAP) and their Partners invite you to attend public information meetings at one of the four following communities:

Assiniboia Elementary School on Jan.23
Coronach School on Jan. 25
Radville St. Olivier School on Feb. 5
Crane Valley School on Feb. 6

Landowners and representatives of agencies working in south central Saskatchewan will be available to discuss:

Sustainable land-use management	Educational resources
Technical and financial assistance	Conservation easements
Stewardship programs	Ecotourism

Doors open at 6:30 and Presentations begin at 7:00 pm. Coffee and donuts available. You'll hear from the Saskatchewan Stock Growers Association, Ducks Unlimited Canada, Saskatchewan Wetland Conservation Corporation, Nature Conservancy of Canada, Saskatchewan Burrowing Owl Interpretive Centre, Grasslands National Park, Grazing and Pasture Technology Program, Saskatchewan Environment and Resource Management, Saskatchewan Agriculture and Food, and the Saskatchewan Prairie Conservation Action Plan..

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AN INTRODUCTION TO SASKATCHEWAN'S ECO-EXTRAVAGANZA ON STEWARDSHIP EDUCATION

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Abstract: In January 2000, Grasslands National Park (GNP), the Prairie Conservation Action Plan (PCAP), the Saskatchewan Wetland Conservation Corporation (SWCC) and the Saskatchewan Burrowing Owl Interpretive Centre (SBOIC) joined forces to deliver educational programs for grade K to 6 youth in south-western Saskatchewan. Representatives from the various organizations travelled to 10 rural schools, making contact with approximately 700 students and 50 teachers. GNP provided a multi-media slide show set to music on species at risk and the Park's role as a prairie steward. PCAP delivered Cows, Fish, Cattle Dogs and Kids - an interactive game show which demonstrates concepts of riparian stewardship. SWCC engaged students in the Project WET activity *Macroinvertebrate Mayhem* - an active game which familiarizes students with the effect of environmental stress on aquatic invertebrates, and how they can be used as indicators of water quality. The SBOIC provided an opportunity for students to learn about Burrowing Owls, and to meet Luna, an imprinted Burrowing Owl through their *Owls on Tour* program. Evaluations received from teachers and students were very positive.

The Eco-Extravaganza was delivered to fourteen schools in south-central Saskatchewan in January 2001. The Nature Conservancy of Canada (NCC) and Ducks Unlimited Canada (DUC) also participated in these visits, delivering activities on shorebirds and wetland habitat, respectively. Evening "town hall" meetings for landowners were also featured on the 2001 tour. The purpose of

the town hall meetings was to familiarize community residents with stewardship and educational programs that are being delivered by PCAP Partners in the Missouri Coteau.

This article summarizes the content of the “Eco-Extravaganza”, includes a discussion of planning and delivery considerations, and sets out plans for the future.

THE PROGRAM IN 2000

The Eco-Extravaganza is a traveling road-show that brings together different organizations, who go out to rural communities and schools to increase awareness of native prairie and riparian areas. The organizations that were involved in the 2000 program are: Grasslands National Park (GNP), the Saskatchewan Prairie Conservation Action Plan (PCAP), the Saskatchewan Burrowing Owl Centre (SBOIC) and the Saskatchewan Wetland Conservation Corporation (SWCC). An individual from each organization delivers an activity that meets their organization’s mandate or goals.

In the fall of 1999, Grasslands National Park was looking for ways to increase its exposure to area residents, using interpretation and education. After developing ideas for educational programming aimed at school children, the Park began to look for specific activities and programs to meet their goals. GNP and PCAP joined forces in January 2000, to present an outreach program for children, aged Kindergarten to grade six. This program would include the message of good stewardship of the land and water. Like every good creative work, there is a cascade effect when concept moves to commitment, and a project develops a life of its own. Soon, an invitation was extended to Saskatchewan Wetlands Conservation

Corporation (SWCC), and the Saskatchewan Burrowing Owl Interpretive Centre (SBOIC) expressed interest in joining the ‘fun’. What began as a concept for one government organization, had now grown to four partners committed to delivering a youth-based program. This synergy speaks of the close-knit relationships among organizations who are partners in the Saskatchewan PCAP.

The program consisted of five “segments”. First, the partners were introduced. Then a multi-media show by the GNP (approximately 30 min.) was presented to the entire audience at once, usually in the gymnasium. This slide show introduced the students to the evolution of grasslands, the current ecosystem which includes many endangered species, and highlighted GNP as a steward of native prairie. The game show *Cows, Fish, Cattle Dogs and Kids!!!*, works best with large groups since audience participation and cooperative decision making are key elements. As such, this activity was delivered to all K-6 students in the gymnasium, after GNPs multi-media show, and before students were separated by grade(s) to participate in the concurrent, smaller group sessions. These smaller group sessions included an active, tag game about ‘bugs’ as indicators of water quality (SWCC) for older children, and an introduction to a live Burrowing Owl (SBOIC) for younger children. (See “Partners’ Perspectives” for more details).

From January 24th to 29th, 2000, we traveled to ten schools in ten communities (Lafleche, Limerick, Mankota, McCord, Gravelbourg, Cadillac, Ponteix, Val Marie, Climax and Frontier) delivering a program twice a day. The schools ranged from those with approximately one hundred students, to a school of 22 whose students all arrived at the hall with their classroom slippers. In total, this program was delivered to over 700 students. Students were told that if they gave feedback, as outlined on an evaluation form, their names would be included in draw packages for t-shirts from GNP, posters from SWCC and PCAP, and puzzles from SBOIC. Ten percent of those students (80) took the time to respond afterwards with a letter and artwork. Four students from the participating schools won the prize packages.

PLANNING OF THE 2001 ECO-EXTRAVAGANZA

A meeting was held in October 2000 to begin planning the Eco-Extravaganza that would be delivered during the winter. After reviewing the previous year's program, a few changes were made:

1. Scheduling. In January 2000, ten schools were visited during a one week period. Presenters delivered two presentations per day at different schools, which were, in some cases, located more than an hour's drive apart from each other. This schedule became grueling, and the program suffered due to presenters becoming ill toward the end of the week. Presenters involved in the 2000 Eco-Extravaganza recommended that only

one school visit per day would be preferable. It was decided that the 2001 program would be delivered to ten schools over a two week period, and that all visits would be held in the morning to provide a free afternoon for presenters. We also agreed that a one week break should be held between tours to provide ourselves with time to attend to office duties and to reduce the physical demand of being on the road. School tours were subsequently scheduled for the week of January 22-26 and the week of February 5-9. We recommend avoiding other major commitments, especially those requiring travel, during the scheduled break.

2. Town-Hall Meetings. Because of the time allotted for each community, every afternoon and evening was free. Participants began to explore the idea of holding evening meetings for the parents and other adults in the community. This would allow local residents to find out about conservation programs in the area, and potential benefits to residents and landowners.

3. Full Morning Program. Because of interest by other conservation groups (namely NCC and DUC) and the recommendation from 2000 to provide all students with the opportunity to participate in SBOICs *Owls On Tour* program, the organizers expanded the Eco-Extravaganza to a full morning. This allowed specific programming for younger and older groups, as well as

the flexibility to take on a wide range of school sizes.

4. Target Area: In 2000, the target area for the Eco-Extravaganza was the area surrounding GNP. For 2001, the target area was the Missouri Coteau. Environment Canada awarded funding to PCAP for activities in the Missouri Coteau, which included the Eco-Extravaganza. SWCC and NCC also received funding from Environment Canada for stewardship activities in the Missouri Coteau. Communities visited in 2001 were also selected by their proximity to schools visited in 2000, and included: Rockglen, Bengough, Coronach, Radville, Crane Valley, Ogema, Gladmar, Willowbunch and Assiniboia (two elementary schools). Students from schools in Spring Valley, Viceroy, Pangman and Oungre were bused to schools in neighbouring communities visited by the Eco-Extravaganza.

5. Funding: In 2000, each organization was responsible for providing staff time for program development and delivery and for covering staff expenses. Some of the groups found it difficult to contribute towards expenses, and would not have been able to participate in 2001. However, in 2001, while staff time for program development and delivery was still covered by the participating organizations, expenses were covered by Environment Canada's Habitat Stewardship Program. Funding support for travel expenses allowed us to continue and

expand programming in 2001.

In November 2000, schools in the 2001 target area were contacted to determine their interest in having the Eco-Extravaganza visit their school. Interested schools were mailed an information package containing information on the PCAP and the Partners involved in the delivery of the Eco-Extravaganza, a draft program (Appendix 1) and a confirmation/checklist (Appendix 2) which schools were required to return to the PCAP office once a date had been confirmed. The confirmation/checklist provided schools with an outline of their responsibilities, and requested that a contact person from each school be assigned to act as a liaison with the PCAP Coordinator for future planning. School contact persons were also requested to fax a map providing directions to the school and to indicate where parking would be available to provide easy access to the gymnasium. This recommendation was made by presenters who participated in the program that was offered the previous year.

A second contact was made with the schools approximately two weeks after the information packages were mailed out. During this contact, schools provided information on the number of classes and students in each grade so that timetables could be tailored. Schools also indicated dates that would not be suitable for them in our planned itinerary (two separate weeks in January or February). This allowed us the flexibility to schedule visits to optimize effective program delivery. Our primary consideration was school size as larger schools needed two concurrent presentations by the SBOIC, requiring two SBOIC staff. Our secondary consideration was the distance between schools.

Information obtained during the second contact allowed us to schedule school visits (Appendix 3) and tailor presentations for each school (Appendix 4). This information was faxed to school contact persons and a third telephone contact was made to confirm dates and to request the schools to sign the confirmation/checklists and fax them to the PCAP Coordinator along with the maps. A final telephone contact was made to school contact persons immediately prior to the visit to discuss details and to ensure they were clear on their responsibilities as Eco-Extravaganza hosts.

THE ECO-EXTRAVAGANZA, 2001

We rented a cargo van and a 4-door Sport Utility Vehicle and had magnetized “Eco-Extravaganza” signs made up to identify us in the communities we visited. We stayed in centrally located hotels, in Assiniboia and Bengough respectively, during our two weeks on the road. This program requires working closely with each other for many hours each day so we booked single hotel rooms, instead of doubling up, to provide ourselves with some private time and space during our tour. We agree that, when possible, it is preferable to use a community as a home base rather than to switch accommodations. Although we usually ate lunch in the community we visited in the morning, we recommend selecting a “home-base” community that offers decent meals and quiet, relatively comfortable hotel accommodations.

The program took an entire morning of time for the students involved. First, the PCAP representative introduced all of the presenters and their respective organizations

(5 minutes). Then an interactive multi-media presentation called *Sanford (the Sage Grouse) Sings the Blues* highlighting GNP and its roles in protecting and conserving species at risk was presented to the entire assembly by GNP (30 minutes). While all of the students were still assembled, they played the game show *Cows, Fish, Cattle Dogs, and Kids!!!* which was delivered by PCAP. After the game show, the students would split into groups of no more than 25, and head off to different classrooms. Small group activities included: *Macroinvertebrate Mayhem*, an active game of tag which uses the macroinvertebrate assemblage to evaluate water quality, by SWCC; *Bird Quest: Prairie Shorebirds*, an introduction to identification of shorebirds, their lives, and habitat, with an emphasis on the endangered Piping Plover, by the NCC; *Owls on Tour*, where students meet a live Burrowing Owl and learn about this endangered species, by SBOIC, and; *Wildlife Habitat Relay*, a game in which students match wildlife with their preferred habitat, by DUC. These activities each took 30 minutes, and were conducted in concurrent sessions to accommodate each particular school. A general assembly including all students, teachers and Eco-Extravaganza presenters was convened at the end of the morning in the gymnasium. This assembly allowed us to thank the teachers and students for their participation, present each school with a resource kit, and to distribute evaluation forms to the teachers and posters from Grasslands National Park to teachers and students.

EVALUATIONS

In 2001, PCAP and SBOIC jointly developed an evaluation for teachers (Appendix 5) which was distributed at the

end of the morning. The evaluation form also requested teachers to invite their students to provide their feedback on the Eco-Extravaganza in the form of a letter, poem or artwork. To date, 31 teachers have filled out evaluations, and more than 31 classes have submitted artwork and letters. All teachers stated that the program was worthwhile! One comment by the principal of Assiniboia elementary school was: *“This wasn’t simply a fun morning with a few facts thrown in. Each presenter had a clear, focused agenda to convey a message of the need for conservation. It was evident that thoughtful planning and careful preparation took place beforehand. Presenters displayed the ability to think on their feet and adapt to suit the needs of their audience”*.

PLANNING FOR EVENING TOWN HALL MEETING

At the initial planning meeting in October 2000, it was also determined that evening town hall meetings for landowners and other community residents would be held in conjunction with the Eco-Extravaganza. The purpose of the meetings was to familiarize residents with the PCAP as well as stewardship and educational programs that were being delivered by PCAP partners in the Missouri Coteau. With assistance from Saskatchewan Wetland Conservation Corporation (SWCC), the Saskatchewan Stock Growers Association (SSGA), and Saskatchewan Agriculture and Food (SAF), we organized two town hall meetings each week for a total four meetings. Communities were selected based on their geographic location to optimize landowner participation. Once communities were

selected, school contact persons were consulted to determine if we could use their gymnasium or a large class room for the evening meetings. Flyers describing the Eco-Extravaganza and announcing the town-hall meetings (Appendix 6) were delivered to schools for distribution to students to take home with them prior to our visit. Other flyers announcing the town hall meetings (Appendix 7) were posted in community post offices, skating rinks etc. by PCAP staff and distributed in a mail-out by Saskatchewan Agriculture and Food Extension Agrologists. SWCC also contacted area landowners involved in their stewardship programs and invited them to attend. In addition to Eco-Extravaganza Partners, local SSGA members and SAF Extension Agrologists were also invited to deliver presentations.

PARTNERS PERSPECTIVES:

Grasslands National Park (Initiator; Coordinator 2000; Participated in 2000 and 2001)

Grasslands National Park (GNP) is one in a system of protected heritage areas that includes National Parks, National Historic Sites and Heritage Canals across Canada. GNP represents the mixed-grass prairie region in that system. In addition to protecting this amazing resource, the park is presented to the people of Canada for their enjoyment, understanding and appreciation, in ways that leave it unimpaired for present and future generations. Education and interpretation are cornerstones to that presentation.

During the fall of 1999, the staff at GNP discussed avenues that would enable the park to broaden this presentation. Particularly, the staff focused on the education of children. We desired to instill in them an environmental ethic through education so they will grow to act in ways that will benefit the preservation of native prairie. The staff decided that a children's outreach program, delivered through schools, would accomplish this objective. After investigating other conservation organizations' programming for children, a partnership was formed. The Saskatchewan Prairie Conservation Action Plan, the Saskatchewan Burrowing Owl Interpretive Center, and the Saskatchewan Wetland Conservation Corporation each contributed an entertaining and educational session, appropriate for the age of the children (See the other organizations' activities described below).

GNP's contribution to the morning of educational programming was a slide show and narration about the Park. Slides illustrating all different aspects of the Park, from large, sweeping landscapes to close-ups of the creatures that live there, were shown. The narration tied all of these dimensions together, reviewed the history and evolution of the prairie, and discussed current management of the grasslands. The narration also provided information on species at risk and the Park's role as a prairie steward.

For GNP's purposes, we decided to travel to rural schools that were within the region of the park during January. There were three reasons for this:

- The park wanted to strengthen relationships with area residents and provide them with a benefit to having a National Park in their region - essentially good neighbour relations
- While there is certainly value in connecting with children from urban settings, the park staff decided that urban children often receive many programs like this. We wanted to give rural children a special experience, particularly as they could be future landholders making land use decisions.
- We wanted to place the park in people's minds at a time of year when the park does not receive a great deal of attention.

In the end, GNP had achieved its' goals. We had initiated and implemented an outreach education program with key partners pursuing prairie conservation. We had fostered relationships with neighboring communities. We had individuals excited about visiting the park in upcoming seasons. Finally, and most importantly, we provided an entertaining, fun and free half day of programming to children that challenged and inspired them about prairie values. And based on student's feedback, they knew who we represented, what our individual tasks as organizations were, and why prairies are important and worth preserving.

We look forward to further participation and a legacy of quality children's education in prairie conservation. We hope that this education will provide an emotional and ideological 'buffer' around remaining native prairie lands.

Prairie Conservation Action Plan (PCAP)
(Co-ordinator 2001, Participated in 2000 and 2001)

The PCAP is chaired in Saskatchewan by the Saskatchewan Stock Growers Association (SSGA) and is a partnership of over 20 organizations representing industry, federal and provincial government agencies, non-government organizations and academic institutions (see Saskatchewan Prairie Conservation Action Plan: an example of an effective partnership, contained in these proceedings). The PCAP vision is to sustain the native prairie in a healthy state in which natural and human values are respected.

The 5 goals of the PCAP are:

- To sustain a healthy native prairie grazing resource
- To conserve the remaining native prairie
- To maintain Saskatchewan's native prairie biological diversity
- To promote the sustainable use of native prairie to enhance the quality of life
- To promote education and develop communication programs

The PCAP delivers the *Cows, Fish, Cattle Dogs and Kids!!!* Game Show in Saskatchewan and assumed responsibility for coordinating the 2001 Eco-Extravaganza.

These activities are tied to PCAP's fifth goal regarding promoting education and communication programs.

Cows, Fish, Cattle Dogs and Kids!!! is a fun, interactive game show about riparian areas for students in grades 4 to 6. The game show teaches students about riparian areas and decision-making related to ranch management and cows. It also illustrates

how ranchers, farmers, and urban dwellers need to work cooperatively to maintain these important "green zones".

The Game Show was originally developed by Brad Davis, an elementary school teacher from Alberta, who has a strong interest in environmental education. It was designed to be used at Agri-Ed demonstrations and schools and has been adapted for use in Saskatchewan. Rave reviews are consistently received from teachers and hosting organizations about its effectiveness in promoting environmental stewardship to youth audiences. Students enjoy the interactive learning process. Little to no preparation is necessary and teachers are encouraged to simply enjoy the show and learn along with their students.

Students were divided into two teams of cattle dogs - the smartest animals on the ranch. A member of the Eco-Extravaganza crew provided the audience with instruction on team cheers and other cues, and introduced Game Show host, "Alexis Troutbek" who was played by another crew member. The Game Show host provided additional information on the rules of the game, including the six question categories (Cows, Fish, Wildlife, Vegetation, Water and Mother Nature & You) which correspond to the sides of a large foam die.

One student from each team is selected to be the lead cattle dog. These students wear the "Cattle Dog Hat" and roll the die to determine the question category. "Lead cattle dogs" were then read a question from the appropriate category and consulted with his or her team members to select the best multiple choice or true/false answer. When teams answered correctly, their cow icon

was “moovved” along a huge game board which provided a visual representation of a riparian area, complete with a meandering stream, rangeland, farmland and a city. As cows are “moovved” along the game board, fish and wildlife icons are placed on the board to signify that a healthy riparian area had been maintained. Play alternated between different teams and different students were selected to be lead cattle dogs for each new question. Cow puppets, “Buford the Bull” and “Beauteous Bovine Brown” were played by other members of the Eco-Extravaganza crew and assisted the lead cattle dogs in consulting with their team members. The game show took about 30 minutes to complete.

PCAP also delivered some of the concurrent sessions for students in some of the larger schools. A free period often had to be incorporated into the timetable in the larger schools as we didn’t have enough concurrent sessions and presenters to fully occupy the morning. In such cases, PCAP led K to 1 students in prairie versions of classic games such as *Simon Says* or *Duck Duck Goose* which were adapted by the SBOIC. PCAP facilitated discussion sessions among older students (grade 5 and 6) on careers.

**Saskatchewan Burrowing Owl
Interpretive Centre** (Participated in 2000 and 2001)

The four pillars of the Saskatchewan Burrowing Owl Interpretive Centre (SBOIC) are education, eco-tourism, conservation and stewardship. The Centre was created in 1996 through the joint partnership of the Moose Jaw Exhibition Company Ltd., Nature Saskatchewan, and Saskatchewan Environment and Resource Management.

The SBOIC is located on the Moose Jaw Exhibition grounds next to their racetrack, where wild owls have historically nested. Throughout the summer months the SBOIC provides an eco-tourism opportunity that is unlike any other. During a trip to the Centre, visitors can walk through a giant man-made burrow, view the wild owls in the racetrack’s infield, observe up-close our 12 non-releasable owls and explore our newly planted native prairie plot that is home to a non-releasable ferruginous hawk. During the fall, winter, and spring the staff of the SBOIC are busy delivering our *Owls On Tour* program. This program brings a live owl and a handler into classrooms across Saskatchewan to deliver an interactive program of songs, stories, and skits that inform the students about burrowing owls and their habitat. In 2000, *Owls On Tour* was delivered to nearly 9,000 Saskatchewan students.

We at the SBOIC have been fortunate to participate in Eco-Extravaganza in 2000 and 2001. The majority of owls that remain in the province live and hunt in pastures managed by ranchers and landowners. Often, the children of these land managers attend rural schools that can neither afford various field trips, nor have many guest presenters to their schools. It is very important to us at the SBOIC to visit these children, because of their connectedness to the land, and participating in the Eco-Extravaganza allows us to do so.

Throughout the morning two SBOIC staff with owls, Luna and Scamper, offered 30-minute presentations in individual classrooms. Children learned about owl behaviour, adaptations, migration, as well as some of the factors that have led to the

decline of the burrowing owl population in Saskatchewan. In addition to our *Owls On Tour* presentations we also aided with Eco-Extravaganza programming for K and Grade 1 & 2 students, creating and delivering “Prairie Simon Says” as well as “Fox...Fox...Owl”- an adaptation of the ever-popular Duck... Duck... Goose. All of the programs we participated in were fun and educational, with many of the activities based on games and songs the children were already knowledgeable about.

Saskatchewan Wetland Conservation Corporation (Participated in 2000 and 2001)

The Saskatchewan Wetland Conservation Corporation (SWCC) is a crown corporation that works primarily with landowners in Saskatchewan’s agricultural sector, encouraging good stewardship of streambanks, wetlands and native prairie habitat. The mission of the corporation is to lead and co-ordinate the province’s conservation initiatives to ensure the sustainability and biodiversity of the prairie environment for people and wildlife. SWCC established and delivers the Streambank Stewardship Program and the Native Prairie Stewardship Program. Both programs work with landowners on riparian and native habitat conservation. SWCC was involved with the Eco-Extravaganza in 2000 and 2001 by involving school children in an interactive Project WET game about water quality called *Macroinvertebrate Mayhem*. The delivery of *Macroinvertebrate Mayhem* falls under SWCC’s mandate in helping increase awareness and promote rural communities to take an active role in environmental stewardship.

Macroinvertebrate Mayhem educates school children on the characteristics and importance of healthy riparian areas and good water quality. The first part of the activity involves discussion with the children to familiarize them with indicators of a healthy aquatic ecosystem; specifically, that the species of bugs found in the water are excellent indicators of water quality. The children learn to distinguish between pollution-tolerant species, and pollution-intolerant species, according to the taxonomic Order in which they belong. We then identify several environmental stressors or sources of pollution that may affect the water quality of a stream and macro invertebrate population.

Then, the children are divided into several groups, which are assigned one macroinvertebrate. The children role-play that specific macroinvertebrate. The SWCC representative usually asked the teacher to join her in playing the role of an environmental stressor or source of pollution. An initial population count of individual macroinvertebrates is done, and then a few rounds of the game are played. The activity is essentially a game of tag with the “environmental stressors” being “it”. The macroinvertebrate population is recorded after a few rounds of the game are played. The students then compare the bug numbers and stream environment at the beginning of the game to the environment at the end of the game.

Wrap up of *Macroinvertebrate Mayhem* consists of students’ providing insight into the quality of the stream throughout the game, using the level of biodiversity and visual assessment. Finally, the children observe preserved specimens of the

macroinvertebrates identified throughout the game and then have question time.

Ducks Unlimited Canada (Participated in 2001)

The Missouri Coteau is a very important program delivery area for Ducks Unlimited Canada (DUC). The rolling grasslands and shallow wetlands of the Missouri Coteau represent some of the best remaining waterfowl habitat in the Canadian prairies. Each spring thousands of waterfowl are drawn to the numerous wetlands that dot the prairie. The rolling hills of the Coteau have made wetland drainage difficult, and its rocky soils have slowed the rate of cultivation. The combination of intact wetlands and remaining grassland serves to form one of the continent's premier regions for waterfowl.

One of DUC's habitat goals in the Missouri Coteau is to ensure that the existing native prairie is not lost. In order to achieve this goal, future landowners in the Coteau need to understand the value of wetlands and wildlife habitat. An effective mechanism to help achieve this is through a youth education program. The 'Eco-Extravaganza' tour was an effective way for the DUC Southern Saskatchewan Field Office, based out of Regina, to partner with other wildlife agencies to provide educational programming for grades kindergarten to six students. The focus was on native prairie ecosystems and their conservation and management.

DUC's activity was called *Wildlife Habitat Relay*. The first objective of this activity was to get students to associate various wildlife species with their individual habitat requirements. Secondly, students learned the

incredible diversity of species which depend (directly or indirectly) on wetlands for their survival.

Students were divided into two teams and placed behind a starting line. Habitats, which in this case were pictures of habitats (grassland, forest, wetland, stream) taped to buckets, were set up at the other end of the room. DUC animal cards were spread out on tables set up about halfway between the starting line and the buckets. Once the start signal was given, one student on each team raced to the cards, chose one, and then placed it in the correct 'habitat' before racing back to their team to release the next person. The first team to have all its members finished won the game, depending on how many cards were placed in the correct habitat. For the most part, the team that placed the most cards in the correct habitat usually won, not the team that was the fastest. After the race was over, the DUC representative went through the habitats with the entire class to discuss which animals were placed in the correct habitat, and why.

The Nature Conservancy of Canada (Participated in 2001)

The mandate of the Nature Conservancy of Canada (NCC) is to protect and preserve Canada's threatened natural habitats through land securement, including donations, purchase, bequests, and conservation easements. The NCC's primary goal for the Eco-Extravaganza was to emphasize the importance of native prairie habitats to prairie shorebirds. The NCC's activity, *Bird Quest: Prairie Shorebirds*, introduced the basic biology of prairie shorebirds to the students, and raised awareness of the

importance of the Missouri Coteau area of Saskatchewan to the endangered Piping Plover

The basic characteristics of shorebirds were introduced to the students, including shorebird migration in North America and their basic requirements during migration. Then we briefly discussed the types of habitat for shorebirds in Saskatchewan, loss of that habitat, and how it affects shorebird populations in Saskatchewan. Two students of different sizes dressed up in Piping Plover and Killdeer costumes, consisting of neck-bands, beaks with rubber bands, appropriately coloured sweatpants, and coloured foot-covers. By doing this, the students could easily identify the differences between the Piping Plover (small, with one neck band, orange bill, legs, and feet) and Killdeer (larger, with two neck bands, grey bill, legs and feet). A Piping Plover and a Killdeer specimen also helped the students to discuss the similarities and differences between these two shorebirds. We also compared different types of bird feet (shorebird, eagle, pelican and snowy owl) and discussed reasons for foot differences. A specimen of a Long-billed Curlew was also shown to them, since the Long-billed Curlew occupies different types of habitat and feeds on different food items than the Piping Plover and Killdeer. At the end of each section, there were five minutes for student questions. Based on observations and conversations with the students, none of these students had heard of, or seen a Piping Plover. The students appeared to have a strong understanding of conservation, but lacked awareness on shorebirds and the endangered Piping Plovers that are living in their area. Several students submitted colored drawings of killdeer and Piping Plovers after

our visit. This activity was very successful in teaching students about these two species and how to distinguish them from each other.

EVENING TOWN HALL MEETINGS

Two town hall meetings were held each week during the delivery of the Eco-Extravaganza for a total of four meetings. In addition to Eco-Extravaganza partners, representatives from Saskatchewan Agriculture and Food and the Saskatchewan Stock Growers Association delivered presentations on extension programs and personal experiences with stewardship programs, respectively. Evening meetings were held in the schools we attended earlier in the day to optimize efficiency. Partner agencies set up displays and distributed literature on their programs and representatives were available to discuss programs with landowners before and after the presentations by Partner organizations. Representatives from the various organizations were introduced by the PCAP Coordinator and delivered a brief slide presentation or talk on their involvement with stewardship or educational programming.

Townhall meetings held in Assiniboia and Coronach during the first week of the Eco-Extravaganza delivery were poorly attended due to inadequate promotion and competition from at least two other special events that were scheduled in Assiniboia for the same evening. Approximately 40 landowners attended meetings which were held in Radville and Crane Valley during the second week of the Eco-Extravaganza. Increased attendance is attributable to having more time to promote these meetings

through flyers that were mailed to landowners and posted in communities and telephone invitations to landowners that were involved in stewardship programs delivered by SWCC. We were pleased with the attendance during the second week of the Eco-Extravaganza as one of the most effective communications tools will be the “coffee row” discussions that will occur among landowners after the meetings. The evening meetings provided the opportunity for us to inform the attendees of stewardship and educational programs that are delivered by the PCAP and its Partner organizations and to refer landowners to appropriate program contacts for additional information.

As well, the evenings provided a forum for us to thank landowners and ranchers as a group for their role in conserving and managing the native prairie resource.

PLANNING FOR 2002 AND BEYOND

Planning is underway for the Eco-Extravaganza 2002. Target areas are likely to include additional schools in the Missouri Coteau and possibly the Frenchman River Watershed. Planning is being initiated earlier than in 2000 and 2001, so that schools within the proposed target areas can be identified. We are using directories provided by Saskatchewan Education to facilitate planning. We hope to confirm arrangements with schools before Christmas so we can focus on improving promotional activities associated with the town hall meetings for landowners in early January. Delivery partners have agreed that program delivery will again occur during a two or possibly three week period during January and February.

SPONSORS

We would like to acknowledge the following organizations for their assistance:

Grasslands National Park (Initiator; Coordinator 2000; Participated in 2000 and 2001)

Prairie Conservation Action Plan (Coordinator 2001, Participated in 2000 and 2001)

Saskatchewan Burrowing Owl

Interpretive Centre (Participated in 2000 and 2001 and assisted with planning in 2001)

Saskatchewan Wetland Conservation Corporation (Participated in 2000 and 2001, assisted with development and distribution of promotional materials for town hall meetings, and wrap-up activities)

The Nature Conservancy of Canada (Participated in 2001)

Ducks Unlimited Canada (Participated in 2001)

Saskatchewan Agriculture and Food (Assisted with promotion and delivery of town hall meetings)

Saskatchewan Stock Growers Association (Assisted with planning and delivery of town hall meetings)

Environment Canada's Habitat Stewardship Program - Funding support for the delivery of the 2001 Eco-Extravaganza

Appendix 1: ECO-EXTRAVANGANZA - Draft Program

TIME	PARTNER	PROGRAM	DESCRIPTION	AUDIENCE	GROUP BREAKDOWN
9:00 GYM	Prairie Conservation Action Plan (PCAP)	Introduction	Meet the partners	All	All
9:05 GYM	Grasslands National Park (GNP)	Endangered Species and Spaces: a look at native prairie	A multi-media presentation on the role that GNP plays in protecting one of the rarest ecosystems in North America	All	All
9:35 GYM	PCAP	Cows, Fish, Cattle Dogs and Kids!!!	A fun, interactive game show on riparian (streambank) areas and their management	All	All
10:00, 10:30, 11:00, 11:30 GYM	Saskatchewan Wetland Conservation Corporation (SWCC)	Macroinverte- brate Mayhem	An active Project WET game on water quality and riparian and wetland conservation	To be determined in consultation with the school	To be determined in consultation with the school
10:00, 10:30, 11:00, 11:30 CLASSROOM #1	Nature Conservancy of Canada (NCC)	Bird Quest: Prairie Shorebirds	A hands-on activity to familiarize students with prairie shorebirds and their habitats	To be determined in consultation with the school	To be determined in consultation with the school
10:00, 10:30, 11:00, 11:30 CLASSROOM #2 & #3 - 2 simultaneous presentations will be offered for the larger schools visited January 22-26	Saskatchewan Burrowing Owl Interpretive Centre (SBOIC)	Owls on Tour	Meet imprinted owls Luna and Scamper and learn about Burrowing Owls and their habitat	To be determined in consultation with the school	To be determined in consultation with the school

Eco-Extravaganza
Presentation Checklist & Confirmation
Fax to Karyn Scalise - PCAP - 306- 525-5852

- ☐ Contact Person! - Please have the contact person designated for your school read and sign this form. We will use the home phone number only in the case of last minute delays or emergencies!
- ☐ Directions!- along with this confirmation form, please fax us a map showing us how to get to your school from the highway. Also indicate where we should park our 3 vehicles and which entrance to use to get to the gym.
- ☐ The gymnasium - this is where we will all assemble at 9:00 a.m.
- ☐ Small table/cart for our slide projector - (set up in the gym)
- ☐ 3 or 4 Classrooms- Please move the desks aside so the students can sit on the floor. I'll confirm the number of additional classrooms required when I call to arrange details.
- ☐ VCR- Please have a VCR setup in one of the classrooms. We will supply age appropriate videos for students to watch while they are waiting for presentations. This primarily applies to the larger schools we will be visiting during the week of January 22 - 26.
- ☐ I will contact you to organize how we will divide the classes for the individual presentations by SBOIC, SWCC and NCC
- ☐ Please ensure that children are wearing name tags and are not wearing ball caps. The brims of the hats can appear as beaks to the owls... making them a little unsure of these predators!
- ☐ We are planning a fun, exciting and BUSY morning! If the children are used to specific bathroom break times, please make us aware of this as well!

*I agree to the above requirements and will ensure that they will be in place at _____
School on _____ by 8:30 am.*

Signature: _____

Name

Home Phone

School Phone

Appendix 3: Eco-Extravaganza - Schedule of school visits

SCHOOL	DATE	CONTACT	# kids	#classes
Rockglen (BORDERLAND)	Mon. Jan 22	Don Eklund - Principal Marina Thomson 476-2220 - school 476-2720 - fax	97	K-8; 1-12; 2-14; 3-9; 4-22; 5-13; 6-19
Assiniboia Ele (4-8) (REDCOAT)	Tues. Jan 23	Al Kessler - Principal 642-5981 - school 642-4009 - fax	116 - 4&5s 162-185 with 6s	4-3 (69); 5- 2 (47); 6-2 (46) + 1 (23).
Bengough (BORDERLAND)	Wed. Jan 24	Maurice Koszman - Principal 268-2172 - school 268-2811 - fax	88	K-11; 1-12; 2-9; 3-14; 4-17; 5-9; 6-16
Coronach (BORDERLAND)	Thurs. Jan 25	Phillip Gleim - Principal Allan Ausum - V Principal 267-2210 - school 267-3235 - fax	172	K-20; 1-22; 2-24; 3-22; 4-19; 5-35; 6-30
Assiniboia 7 th Ave (K-3) (REDCOAT)	Fri. Jan 26	Patricia Leatherdale - Principal 642-3566 - school 642-4438 - fax	160	K-1 (19 or 20); 1-2 (37); 2-2 (45); 3-2 (39)
Radville - St. Olivier School (RADVILLE)	Mon. Feb 5	Lorne Weigel - Principal 869-3221 - school	147	K-21; 1-28; 2-21; 3-20; 4-19; 5-15; 6-23
Crane Valley (REDCOAT)	Tues. Feb 6 (with Spring Valley & Viceroy)	Heather Hobbs - Principal 475-2756 - school 475-2566 - fax	32 (54)	K-6; 1-3; 2-4; 3-5; 4-8; 5-1; 6-5
Spring Valley (Artesian School) (REDCOAT)	Tues. Feb 6 at Crane Valley	Thomas Meyer - Principal 475-2804 - school 475-2822 - fax	8 (54)	1 or 2 in each grade with no gr 4.
Viceroy (REDCOAT)	Tues. Feb 6 at Crane	Donna Morris - Principal 268-4562 - school	14	K-1; 1-0; 2-3; 3-2; 4-1; 5-4; 6-3

	Valley	268-2113 - fax	(54)	
Ogema (PRAIRIEVIEW)	Feb 7 (with Pangman)	Cathy Webb - Principal 459-2500 - school 459-2241 - fax	38 (78)	K-5; 1-6; 2-3; 3-6; 4-9; 5-5; 6-4
Pangman (PRAIRIEVIEW)	Feb 7 at Ogema	Judy Schwindt - Principal 442-2088 - school	40 (78)	K-6; 1-7; 2-5; 3-5; 4-5; 5-6; 6-6
Gladmar (RADVILLE)	Feb 8 (with Oungre)	Deborah Melle - Principal Dana Lloyd 969-4832 - school 969-4400 - fax	61 (91)	K-7; 1&2-20; 3&4-14; 5&6 - 20
Oungre - Lyndale School (RADVILLE)	Feb 8 at Gladmar	Scott Bansley Karen Knox 456-2662 - school	30 (91)	K-5; 1-1; 2-2; 3-3; 4-3; 5-9; 6-7
Willowbunch (BORDERLAND)	36564	Marc Cheriyan 473-2350 - school 473-2430 - fax	50	K-8; 1-4; 2-6; 3-7; 4-8; 5-6; 6-11

Appendix 4: Eco-Extravaganza - Sample timetable for large school (147 students)

ECO-EXTRAVANGANZA - Schedule of Presentations for St. Olivier School, Radville - Monday, February 5

TIME	LOCATION	PARTNER	PROGRAM	DESCRIPTION
9:00 - All grades	GYM	Prairie Conservation Action Plan (PCAP)	Introduction	Meet the partners
9:05 - All grades	GYM	Grasslands National Park (GNP)	Endangered Species and Spaces: a look at native prairie	A multi-media presentation on the role that GNP plays in protecting one of the rarest ecosystems in North America
9:35 - All grades	GYM	Prairie Conservation Action Plan (PCAP)	Cows, Fish, Cattle Dogs and Kids!!!	A fun, interactive game show on riparian (streambank) areas and their management
10:00 - Grade 2 10:30 - Grade 5 & 6 11:00 - Grade 4 11:30 - Grade 3	GYM	Saskatchewan Wetland Conservation Corporation (SWCC)	Macroinvertebrate Mayhem	An active Project WET game on water quality and riparian and wetland conservation
10:00 - Grade 3 10:30 - Grade 2 11:00 - Grade 5 11:30 - Grade 4	CLASSROOM #1	Nature Conservancy of Canada (NCC)	Bird Quest: Prairie Shorebirds	A hands-on activity to familiarize students with prairie shorebirds and their habitats
10:00 - Grade 4 10:30 - Grade 3 11:00 - Grade 2 11:30 - Grade 5	CLASSROOM #2	Saskatchewan Burrowing Owl Interpretive Centre (SBOIC)	Owls on Tour	Meet imprinted owls Luna and Scamper and learn about Burrowing Owls and their habitat
10:00 - Grade 6 10:30 - Grade K 11:00 - Grade 1 11:30 - Grade K & 1	CLASSROOM #3	Saskatchewan Burrowing Owl Interpretive Centre (SBOIC) Prairie Conservation Action Plan (PCAP)	Owls on Tour Prairie Simon Says and Duck, Duck, Goose	Meet imprinted owls Luna and Scamper and learn about Burrowing Owls and their habitat A colouring activity will be offered to Grade K at 11:00 and Grade 1 at 10:30 with free time at 10:00 for both Prairie versions of these old classics
10:00 - Grade 5 10:30 - Grade 4	CLASSROOM #4	Ducks Unlimited Canada	Wildlife Habitat Relay	A relay game to familiarize students with wildlife

11:00 - Grade 3 11:30 - Grade 2				species and the habitat types in which they are found
11:00 - Grade 6 11:30 - Grade 6	CLASSROOM #5		Career Chat Video Session	A discussion on careers, with an emphasis on those in the conservation field An age appropriate video on prairie conservation will be provided
12:00 - All grades	GYM	All Partners	Wrap-up	Thank teachers and students; distribute materials

pendix 4: Eco-Extravaganza - Sample timetable for small school (54 students)

**ECO-EXTRAVANGANZA - Schedule of Presentations for Crane Valley, Artesian (Spring Valley) and Viceroy Schools at Crane Valley Tuesd
February 6**

TIME	LOCATION	PARTNER	PROGRAM	DESCRIPTION
0.375	GYM	Prairie Conservation Action Plan (PCAP)	Introduction	Meet the partners
0.3784722222	GYM	Grasslands National Park (GNP)	Endangered Species and Spaces: a look at native prairie	A multi-media presentation on the role that GNP plays in protecting one of the rarest ecosystems in North America
0.39930555556	GYM	Prairie Conservation Action Plan (PCAP)	Cows, Fish, Cattle Dogs and Kids!!!	A fun, interactive game show on riparian (streambank) areas and their management
10:00 - Grade 4, 5 & 6	GYM	Saskatchewan Wetland Conservation Corporation (SWCC)	Macroinvertebrate Mayhem	An active Project WET game on water quality and riparian and wetland conservation
10:30 - Grade K, 1, 2 & 3	CLASSROOM #1	Nature Conservancy of Canada (NCC)	Bird Quest: Prairie Shorebirds	A hands-on activity to familiarize students with prairie shorebirds and their habitats
10:00 - Grade K, 1, 2 & 3 11:00 - Grade 4, 5, 6	CLASSROOM #2	Saskatchewan Burrowing Owl Interpretive Centre (SBOIC)	Owls on Tour	Meet imprinted owls Luna and Scamper and learn about Burrowing Owls and their habitat
10:30 - Grade 4, 5, & 6 11:00 - Grade K, 1, 2 & 3	GYM	Ducks Unlimited Canada (DUC)	Wildlife Habitat Relay	A relay game to familiarize students with wildlife species and the habitat types in which they are found
12:00 - All grades	GYM	All Partners	Wrap-up	Thank teachers and students; distribute materials

Eco-Extravaganza Teacher Evaluation

Thank you for your participation in the Eco-Extravaganza. We would appreciate it if you would fill out this evaluation to let us know if you and your students enjoyed it and to help us improve programming. Please circle the correct response and/or provide your comments to the questions below.

1. Did you find the Eco-Extravaganza worthwhile? Yes No
2. What did you like best about the Eco-Extravaganza?
3. Which aspects of the Eco-Extravaganza need improvement?
4. The Eco-Extravaganza is: Too long Too short Just the right length
5. Are there any other topics that should be included in the Eco-Extravaganza? Please list.
6. Other comments?

We would greatly appreciate feedback from your students on the Eco-Extravaganza. We welcome letters, poetry, artwork or any other medium in which your students would like to express themselves.

Name of School: _____ Grade: _____

Name (optional): _____

Please send evaluations and student comments to “Eco-Extravaganza” at the address listed above. Thanks again for your participation and support.



Saskatchewan Prairie Conservation Action Plan

The ECO-Extravaganza is Coming to YOUR Community

The Prairie Conservation Action Plan (PCAP) and Partner organizations including Saskatchewan Wetland Conservation Corporation, Grasslands National Park, Nature Conservancy of Canada, the Saskatchewan Burrowing Owl Interpretive Centre and Ducks Unlimited Canada will be delivering the Eco-Extravaganza to 14 schools in Saskatchewan's Missouri Coteau this winter. Environment Canada's Habitat Stewardship Program is a major sponsor of this event. Our goal is to provide educational programming to grade K-6 students on native prairie ecosystems and their conservation and management. Presentations will be delivered mornings at the following schools:

Jan. 22 - Rockglen	Feb. 6 - Crane Valley with Artesian
Jan. 23 - Assiniboia Elementary	(Spring Valley) and Viceroy participating
Jan. 24 - Bengough	Feb. 7 - Ogema with Pangman participating
Jan. 25 - Coronach	Feb. 8 - Gladmar with Lyndale (Oungre)
Jan. 26 - Assiniboia 7 th Avenue	participating
Feb. 5 - St. Olivier School, Radville	Feb. 9 - Willowbunch

In addition to the school visits, PCAP and its Partners are also hosting 4 public information meetings with the theme "CAN CONSERVATION AND AGRICULTURE CO-EXIST?"

Whether you're a farmer, rancher, teacher, birder or conservationist, the Prairie Conservation Action Plan (PCAP) and its partners invite you to attend evening public information meetings at one of the four locations highlighted above in **bold type**. Landowners and representatives of agencies working in south central Saskatchewan will be available to discuss:

**Sustainable land-use management
Technical and financial assistance
Stewardship programs**

**Educational resources
Conservation easements
Ecotourism**

Doors open at 6:30 p.m. and presentations begin at 7:00 pm. Coffee and donuts available. In addition to the organizations involved with the Eco-Extravaganza, you'll also hear from the Saskatchewan Stock Growers Association, Grazing and Pasture Technology Program, Saskatchewan Environment and Resource Management, Saskatchewan Agriculture and Food, and the Saskatchewan Prairie Conservation Action Plan.

**For more information and to
register, contact
Karyn Scalise at 352-0472,
Heather Felskie at 692-8710 or
Tom Harrison at 731-4404.**
There is no cost associated with
these meetings and they are for
information purposes only.



**Environment
Canada**

**Environnement
Canada**



Saskatchewan Prairie Conservation Action Plan
CAN CONSERVATION AND
AGRICULTURE CO-EXIST?

Whether you're a farmer, rancher, teacher, birder or conservationist, the Prairie Conservation Action Plan (PCAP) and their Partners invite you to attend public information meetings at one of the four following communities:

Assiniboia Elementary School on Jan.23
Coronach School on Jan. 25
Radville St. Olivier School on Feb. 5
Crane Valley School on Feb. 6

Landowners and representatives of agencies working in south central Saskatchewan will be available to discuss:

Sustainable land-use management	Educational resources
Technical and financial assistance	Conservation easements
Stewardship programs	Ecotourism

Doors open at 6:30 and Presentations begin at 7:00 pm. Coffee and donuts available. You'll hear from the Saskatchewan Stock Growers Association, Ducks Unlimited Canada, Saskatchewan Wetland Conservation Corporation, Nature Conservancy of Canada, Saskatchewan Burrowing Owl Interpretive Centre, Grasslands National Park, Grazing and Pasture Technology Program, Saskatchewan Environment and Resource Management, Saskatchewan Agriculture and Food, and the Saskatchewan Prairie Conservation Action Plan..

For more information and to register, contact:

Karyn Scalise at 352-0472,
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Tom Harrison at 731-4404.

There is no cost associated with these meetings and they are for information purposes only.



THE (SUB)URBANISATION OF PRAIRIE TOWNS: ISSUES OF IDENTITY, PLACE AND STRUCTURE

Beverly A. Sandalack , MLandArch, PhD CSLA MCIP

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BACKGROUND

In recent decades, concern with local and regional identity has been prominent, as part of a widespread international critique of urban forms that emerged as products of the modern era and the globalisation of capital. Where identity was once largely a product of the unique interaction between local culture and traditions with environmental constraints, the visual qualities and spatial structure of places is now strongly influenced by external political and

economic forces, and as a result many places now tend to look more and more alike. As Michael Hough observed, "the question of regional character has become a question of choice and, therefore, of design rather than of necessity" (1990:2).

Canadian prairie towns are distinct, expressing a unique culture and way of life, and are the product of a particular geography and historic processes. They evolved over a relatively short period of time in response to specific needs and as a manifestation of an anticipated future.



Figure 1. The town of Indian Head, Saskatchewan, typical of Prairie railway towns, is legible as a grain handling centre, as a component of the railway system, as a dense and leafy settlement on the otherwise sparsely inhabited prairies. (postcard by United Specialties Ltd., Saskatchewan 89246-D, photo by Jim Reichert).

But where these towns originally were formed and responded to specific and directed forces,

they are now part of the larger and more coarsely-grained international community. Over the past few decades, the determinants that shaped prairie settlement at the turn of the century, such as the need for regularly spaced grain handling and service centres, have changed. Transportation methods have shifted from rail to automobile and freight truck, and the network of railways is in decline. Concurrently, competition and the mechanization of agricultural practices have favoured large corporate agribusiness over the family farm, and the prairie economy has undergone a major structural transformation.

Although the function of the prairie town has changed, it remains an integral and vital part of the Canadian west. People continue to be attracted to the small town, as it is believed that these centres offer both a lifestyle and a physical environment that is distinct from that of the city. In the towns that do survive, a characteristic identity and way of life is in danger of being overwhelmed by the inexorable homogenizing processes of globalisation. Towns that were previously individual and unique are becoming standardized in their appearance and function, resembling anonymous city fringe belts and suburbs more than small prairie settlements, and are failing to support the distinct social and cultural life of prairie communities.

The history and morphology of prairie towns has been reviewed previously by several authors (Reps 1979, Hudson 1985, Holtz 1987, Sandalack 1998), who considered the distinctiveness of prairie towns and their transformations. This paper considers several of the factors contributing to the suburbanisation of prairie towns and focuses on specific issues of identity and urban structure. It proposes that the wide-spread adoption of suburban standards has contributed to a lesser quality of urban form and urban life. It takes the position that these standards are particularly inappropriate in the prairie town context, and concludes with some general strategies for addressing the issues. Urban form is considered at various scales – the town scale, the scale of the neighbourhood, and the scale of the street. These are inter-related and are elements of more complex town process and form.

URBAN STRUCTURE

At one time it was immediately evident the role that a prairie town played in its region. The major features, structures and thoroughfares all related to its functional purpose. On the flat prairies, the grain elevators were the first structures to be seen from a distance, signaling clearly the town's function as an agricultural service centre and emphasising its location on the rail lines, and signifying refuge and the presence of other people in the otherwise empty land. The potentially disorienting vastness of the prairies was made human and tolerable by those visual landmarks.



Figure 2 “The prairie landscape is a landscape of extreme dimensions, described as ‘a great simplicity’, and it calls for extreme, yet simple, forms. Two seem particularly suited: the low, spreading structure, submitting to the prairie; and the vertical, opposing its dominating horizontality. Only the grain elevator really belongs - its height, firm lines, and strong colours harmonising with the bland prairie and parkland and taking full advantage of the abundant sunlight. It is a self-assured form, confident of its function” (Rees 1969:32) (photo of Vulcan, Alberta by the author 1993).

From the railway station and grain elevators, one could easily locate services such as hotels, banks and stores. The street patterns were legible, and the size and organisation of the buildings were harmonised. In the prairie railway town, the social and cultural life were traditionally focused in the physical centre

which typically consisted of the railway station, the post office and the business district. The mainstreet and the adjacent commercial streets constituted the heart of the town, and were more than just streets and services and spaces - they were places, and were a measure of a town's success and prosperity.

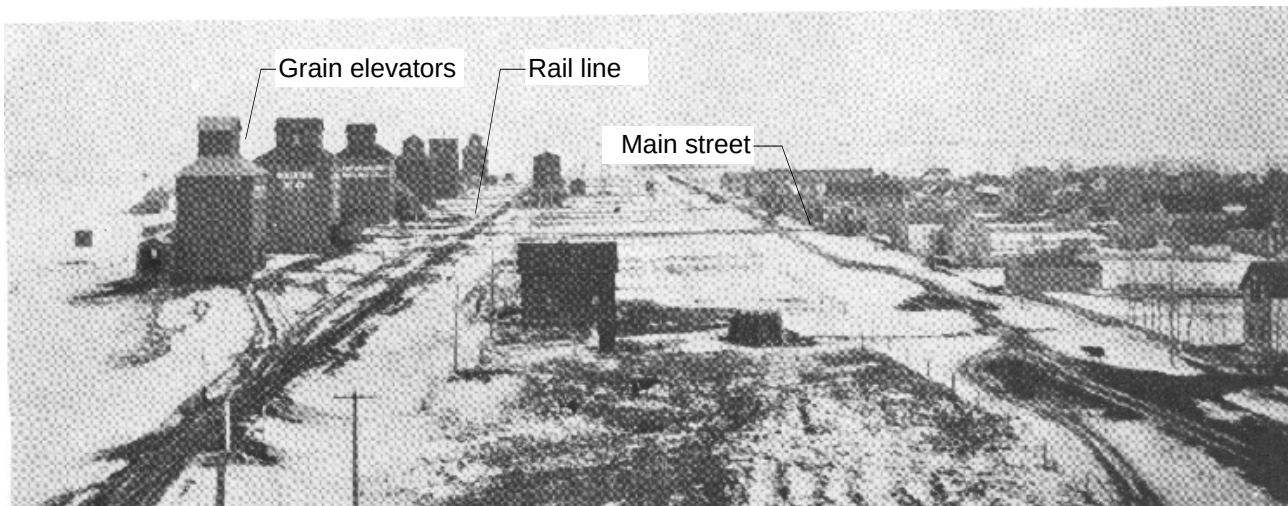


Figure 3. Grain handling and transportation structures (the grain elevators, railway station and rail line) and commercial activity (Main Street) formed a legible physical structure of the town. This example is from Winkler, Manitoba c. 1930 (photo from Winkler Home Coming Committee 1982:95).

Over time, the emphasis shifted from rail to automobile transportation, and the railways experienced a general decline. Although

several other institutions and their physical centres have been affected by government decentralisation and rationalisation programs

(such as the post office and schools), the decline of the railway is perhaps the most profound and symbolic. As road systems developed, and then as the government phased out direct subsidies

for passenger service and reduced rail freight services, meanwhile subsidizing highway and automobile travel, the railway stations become obsolete.



Figure 4. The railway station in Virden, Manitoba has been vacant for many years. The original station in Olds, Alberta (a similar structure to Virden's) was replaced by a concrete block shed. The railway garden in Olds was bulldozed and in 1967 a strip mall (poignantly named "Garden Park Plaza") and parking lot were built in its place. (photos by the author 1991)

Grain elevators are also vanishing from the prairie landscape - from 1982 to 1992 the number of country grain elevators in the Canadian prairies fell from 2,934 to 1,498 (Paavo 1993:13), and in Alberta where there were over 500 elevators standing five years ago, less than 100 remain today.

As a result of the reduction of rail services, and as numerous grain elevators were demolished, the railway lands in many town centres have become derelict, and most of the railway stations, formerly a focus of social interaction, have either been demolished, relocated or are vacant. The land along the tracks is often empty, or is used for parking or as a space for snow dumping, creating what "lost space" – space that has no functional or visual purpose.

The impact of this transformation is important to local and regional contexts. The presence of grain elevators gave the prairies structure and provided one of the only ways of orienting oneself. Towns were identified by the number and colour of the elevators, and were otherwise largely invisible on the flat plains. Without the elevators, the towns disappear into the horizon. The elevators gave structure and order to the towns, which now have few differentiating forms. Most towns are now clusters of houses and commercial buildings, and there are few

visual clues as to the reason for their presence or location.

MAIN STREET VS THE MALL

Prairie towns, while certainly not all alike, have a recognizable vernacular that is expressive of the traditional materials and ways of building. This is particularly true of the main streets. Timber frame construction, building right up to the property line, set back doorways, large storefront windows, false fronts to present the largest facade for advertising - these are all expressive of the social and cultural context, of the environmental conditions, of the light, and of the culture - the way of doing and being that is easily recognized as being of the prairies.

There were a limited number of building materials and techniques, and there were consistent ways of doing things, so that the streets hung together as cohesive townscapes. However, there was enough variety from town to town in terms of local variations in building materials and local businesses so that each town had a distinct identity. And, as other materials became available and as traditional construction techniques evolved or new ones were imported, various eras became identifiable through the historic record of built form. Although there was change, it was gradual and related to what came before, and as the streets and public spaces

provided an underlying unifying structure, there was continuity.

Many historic downtown commercial centres have in been losing business in recent decades to highway strip malls or to out of town shopping centres which are better positioned to capture the

transient automobile traffic. This has resulted in local economic loss, a decline in social vitality in the town centres, and in corporate homogeneity replacing local individuality and character. This issue has to date received significant professional and public attention.



Figure 5. Main Street in Olds, Alberta Street (circa 1950 photo by D. Becker) is recognisably of a prairie town – the false fronted buildings facing right up to the property line, the local businesses and the angle parking are typical and characteristic. Highway strips (upper right), malls (lower left) (both in Olds, Alberta, photos by the author 1991) and out of town shopping centres (lower right) (from Town of Steinbach, Manitoba brochure ‘City of the Future’ 1990), are forms more appropriate to city suburbs.

Attempts to address the economic decline of main street businesses began in the 1970's, most notably and successfully by the federal and provincial Mainstreet programs. Efforts to breathe life back into the Historic Business Districts in the form of various revitalization programs institutionalized the concern for the decline of the small town. Streetscape projects became popular in the design professions and were sanctioned by government funding programs, and downtown revitalization became a business of its own (see Nicolai and Sandalack 1995 and Sandalack 1998 for a review of these programs and a discussion of their effects).

ROAD LAYOUT AND NEIGHBOURHOOD STRUCTURE

Although the original railway grid plan can be criticized for its own autocratic system and for its unresponsiveness to local variations of topography, it defined the form of the prairie town, and is a historical expression of the development of the west (as well as a convenient and effective method of subdividing and selling land). It is also an urban form that is legible, permeable and, if attention is paid to issues of scale and variety, it often contributes to a high quality structure and way of life.

This continuous town fabric has in recent decades been threatened by new residential, commercial and industrial areas which have been laid out according to generic models of urban development. Towns which have experienced development since the 1950s are now composed of a gridded core surrounded by newer neighbourhoods of *culs de sacs*, crescents

and collector roads. The result is a jarring discontinuity - in street layout, building density, building setback, and even sidewalk dimension and species of street tree - as the new developments have been imposed with little regard for their compatibility with the existing fabric.



Figure 6. Town development in the case of Olds, Alberta up to the middle 1960's conformed to the subdivision pattern aligned with the railway grid. The government road allowances contained the town, and the railway station, grain elevators and Main Street formed a cohesive town centre. By 1995 the town consisted of the original railway grid but now with several developments of varying densities and configurations surrounding it. As the town expanded beyond the highway grid, new subdivision patterns followed generic engineering models for suburbs, rather than grafting on to the established streets. Drawings by the author 1998.

The shift in road layout and streetscape appears as fractures in the town form. Discontinuity of street alignment and changes in building density have resulted in parts of the town becoming segregated from each other. Town planners and

residents should determine a more coherent vision of town form. Ideas of road alignment and articulation should be expressed in the Municipal Plan, so that new areas can be grafted onto the old, rather than existing in isolation.

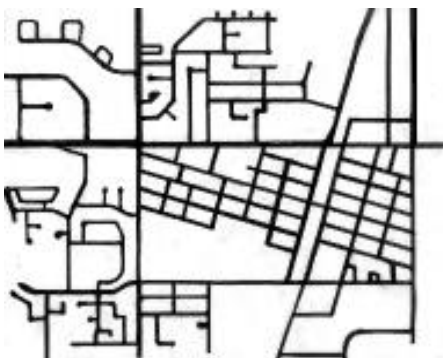


Figure 7. This diagram of streets emphasises the lack of continuity (drawing by the author). The photo shows the break in continuity and the adoption of suburban development models (photo from unknown source).

STREET STANDARDS

In the course of this evolution, changes occurred at the scale of the street. As the town expanded, new street morphologies were tacked onto the old historic town fabric. Where the town had been comprised of narrower streets with treed boulevards and small setbacks, the newer developments consisted of wider streets, wider sidewalks, no treed boulevards, and houses set back further from the sidewalks. Traditional back lanes are usually omitted, and

large garages, rather than front porches, dominate the street facades, further affecting the social and public function of the street. Later evolutions do away with sidewalks and street trees. The responsibility for street trees, once assumed by the town, has over time been downloaded to the developer or the homeowner, and the continuity and quality of the urban forest has suffered. (This issue is currently being investigated in current research by the author.)



Figure 8. Three streetscapes - all with sixty-six foot rights-of-way - representing three phases of residential development in Olds, Alberta. In the historic grid (l.h.s.) there is a clear definition between public and private space, the sidewalk is an important public component, and trees are a structural element. In subsequent development (middle) street trees have been eliminated, the human scale has declined, and the sidewalk is a much less comfortable place for walking. In the newest developments (r.h.s.), the street is most important as a device for moving and storing cars. The definition of private and public has become ambiguous, and trees are no longer considered as an important structural element. (photos by A. Nicolai 1994)

The sense of being inside or outside a place has also been modified through changes in subdivision design. The earlier grid, with the smaller setbacks and treed boulevards, helped to create a feeling of being inside a continuous town. The newer subdivisions, with the emphasis on the individual lot, and the lack of unifying elements such as street trees, transfer the feeling of 'insideness' to the house. The end product is a suburb – a low density self-contained neighbourhood - rather than a continuous town.

STRATEGIES FOR THE FUTURE

Change and transformation are part of settlement evolution. When they build on and reinforce qualities and patterns that are considered to be

distinctive and supportive of a high quality urban form and urban life, then change is positive. However, when town transformation results in a loss of identity and a decline in urban quality, then those changes need to be questioned. What do we do as technology changes, and when railway stations, or grain elevators, or mills, or mines become obsolete? What do we do with our landmarks when they are no longer viable and have become part of history? Do we tear them down, turn them into museums, or into themed restaurants or other tourist attractions, or do we find some adaptive reuse with an appropriate function? Or do we design for these changes in the urban structure and make sure that this system of landmarks is replaced by contemporary forms that are as powerful and necessary?

If the social and cultural role that the railway station and grain elevators played had been better understood, then what their loss meant would have been better anticipated. Perhaps then their imminent demise would have been more strongly and more successfully protested, or, failing a reprieve, their replacements could have been developed to a higher quality. For example, rather than destroying the elegant and symbolic railway station and replacing this public transportation centre with cheap and transient bus depots (often temporarily located in various gas stations or cafes), the railway station could have been adapted to serve bus traffic or other public uses. In addition, a more graceful decline of the railway could have been accommodated, finding public use for the land, and allowing the area to become woven into the fabric of the town, rather than leaving the gaping hole where its centre and heart used to be.

During the course of this research, the destruction of grain elevators has continued. Town and regional dynamics involve life cycles whereby buildings go through birth, life and death, and give way to something else. Clearly the end of an era of grain handling is coming to an end, and these structures are largely obsolete. Several examples should be retained as markers and as evidence of an important period of local, regional and national history, and towns that still have functioning grain elevators in their centres should formalise a commitment to keeping them as part of their infrastructure. In addition, the impact on the visual identity of the towns and on the region should be examined. This is problematic though, as while many other building forms (such as railway stations) lend themselves more readily to adaptive re-use, grain elevators, once redundant, have not been found to have other uses. Careful guidance of the process may help to ensure that some of the landmarks are meaningfully preserved, or are replaced with other forms relevant to the contemporary context.

The prairie town was originally a grid organized around the railway station and grain elevators. As they became obsolete, the centre lost its force; the open-endedness of the grid has allowed sprawl and the establishment of many mini-centres which compete for business. Establishing a new functional centre could serve as a magnet to keep the town from dispersing, and could help to link the newer and smaller magnets into a more cohesive whole. This issue also concerns the highway strip as a missed opportunity -- in its capacity as travel corridor to communicate regional and local identity, and in its capacity as an entry point to create a notable gateway into the town. Its function in a prairie town is very different from a suburb.

The appearance of new suburban forms corresponds to changes in land developmental processes, and changes in cultural values. Land subdivision patterns have also influenced town form and identity. When land was developed on a lot by lot basis, there was incremental growth, and greater variety within the neighbourhood. There was also a tendency for greater social stability, as individuals would make a greater commitment to an area. When large parcels of land are subdivided, developed and sold by one developer, the emphasis is on real estate as a commodity, rather than town building. There is also less variety from lot to lot, and a tendency for residents to view house purchase as an economic transaction more than a commitment to a place.

Development processes should be appropriate to small towns. What is current and convenient in city suburbs is not directly applicable to small towns, and standards should be developed and practices adopted that would seek to maintain the quality of urban form that is part of town life.

Distinct identity (whether of buildings, streets, towns or of ways of life) is a product of the maintenance of continuity, where each town or part of a town is continuous with its past as well as with its future (Lynch in Trancik 1986,

Hough 1990). This is particularly true in prairie towns, whose small size and brief history make them especially vulnerable to insensitive intervention. What might be minor actions in a city have major consequences in small places. Small town planning requires different attitudes, methods and practices. Each place should be understood in detail, and the important elements and attributes should be identified. A town plan should include documentation of the historical evolution of the place, and record what is distinctive and of value. This should include analysis of the overall spatial structure, as well as details such as street profiles. This background would then lead to development of locally relevant, place-specific policies and practices, that are grounded in the desire to maintain a particular identity and quality of life.

The loss of the identity of the Canadian prairie town represents the loss of an important piece of Canada's cultural heritage, and more significantly, the loss of a way of life. Unless there is a conscious decision to retain that way of life (together with the physical infrastructure of buildings and spaces that expresses and enhances it), and to make design, planning and economic decisions subordinate to it, these towns will vanish (Nicolai and Sandalack 1995). Although they may still appear on a map, their identity and culture will have been taken over by suburban aesthetics and values. By understanding what it is that distinguishes the Canadian prairie town and its way of life, it will be possible to design and plan in order to support that way of life and reinforce its identity.

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