Patterns of Change

Proceedings of the 9th Prairie Conservation & Endangered Species Conference

Winnipeg 2010

9th Prairie Conservation & Endangered Species Conference

Winnipeg, Manitoba • February 25-27, 2010

About the cover image – In keeping with the conference theme, *Patterns of Change*, crafty women from across the Prairies created twenty-five 18” x 18” quilt squares. These were assembled and quilted, and the result is a magnificently charming work of collaborative art.

Photo taken by Dean Berezanski *Cover design by Tommy Allen*

Patterns of Change

Learning from our past to manage our present and conserve our future

Proceedings of the
9th Prairie Conservation and Endangered Species Conference

February 25 to 27, 2010 – Winnipeg, Manitoba

Edited by
Donna Danyluk

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Welcome to the Proceedings of the 9th Prairie and Endangered Species Conference

On behalf of the Conference Steering Committee, we are pleased to provide you with the Proceedings of the 9th Prairie Conservation and Endangered Species Conference which was held in Winnipeg from February 25 to 27, 2010. The theme of the conference was *Patterns of Change: Learning from our past to manage our present and conserve our future*. In choosing a theme for the conference, the Steering Committee wanted to ensure that lessons learned and insight gained from past conferences would continue to inform and guide those practices used today in managing our remaining prairie resources, and that they would ultimately help ensure sound conservation of these resources in the face of future growing pressures from a new global society.

A recurring theme emerged from the various plenary, workshop and poster sessions presented during the conference, namely that of public education as a critically important, but often under-utilized tool to conserve the various habitat types that make up the prairie landscape. This is a tool that we often forget to use as we busy ourselves with improving our knowledge of prairie ecosystems for better conservation and management. While we succeed at sharing our knowledge among colleagues and managers, we must challenge ourselves to translate our findings into words and images that will touch the general public and motivate them to speak out and demand for stronger and more accelerated conservation of prairie ecosystems. We must take up this challenge as we move forward towards the next conference in 2013. How nice it would be to have a session during that conference that outlines the successes we have achieved on a comprehensive public education agenda.

These Proceedings contains papers with detailed information from many of the plenary, workshop and poster sessions presented at the conference. For those authors who were unable to provide a manuscript, an abstract of their presentation along with their name and affiliation is provided should readers wish to obtain further information on their topics.

In closing we would like to express our gratitude to the many sponsors who helped make this conference a success. It simply would have not been possible without their generous support. We would also like to recognize the members of the Steering Committee, the various sub-committees and the numerous volunteer who gave so freely of their time. We hope that the resounding success of the conference has been a satisfying return on their investment!

We hope you enjoy the Proceedings.

Proceedings Committee: Ron Bazin, Jim Duncan, Janet Moore, Christine Tymchak, Peggy Westhorpe

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History of the Conference

The Prairie Conservation and Endangered Species Conference is a forum to discuss the latest issues, information, research and trends in prairie landscape and species conservation. The conference is held every three years in a Canadian Prairie Province.

The first Prairie Conservation and Endangered Species Conference (PCESC) was held in 1986 in Edmonton, Alberta. Following its success, the decision was made to repeat this conference every three years, and that it should be held in each of the three Prairie Provinces in turn. The locations and themes of the conferences have been:

1986 – Edmonton: Endangered Species

1989 – Regina: Implementing the Prairie Conservation Action Plan

1992 – Brandon: Partnerships between Agriculture and Wildlife

1995 – Lethbridge: Ecosystem Management for Conservation

1998 – Saskatoon: Connection between Prairie Ecosystem Conservation and Economic, Social and Ethical Forces of Society

2001 – Winnipeg: Sharing Common Ground

2004 – Calgary: Keeping the Wild in the West

2007 – Regina: Homes on the Range – Conservation in Working Prairie Landscapes

Published Proceedings

8th PCESC – Proceedings of the 8th Prairie Conservation and Endangered Species Conference and Workshop, March 2007, Regina, SK. Homes on the Range: Conservation in Working Prairie Landscapes. Edited by Robert Warnock, David Gauthier, Josef Schmutz, Allen Patkau, Patrick Fargey and Michael Schellenberg. 2008. Saskatchewan Prairie Conservation Action Plan. Published by Canadian Plains Research Center, University of Regina, 3737 Wascana Pkwy, Regina, SK S4S 0A2.

7th PCESC – Proceedings of the Seventh Prairie Conservation and Endangered Species Workshop, February 2004, Calgary, AB. Natural History Occasional Paper No. 26. Edited by Garry C. Trottier, Elizabeth Anderson and Mark Steinhilber. 2004. (Available on CD). Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

6th PCESC – Proceedings of the Sixth Prairie Conservation and Endangered Species Workshop, February 2001, Winnipeg, MB. Edited by Dana Blouin. 2001. (Available on CD). Published by Manitoba Habitat Heritage Corporation, 200-1555 St. James Street, Winnipeg MB R3H 1B5.

5th PCESC – Proceedings of the Fifth Prairie Conservation and Endangered Species Workshop, February 1998, Saskatoon, SK. Natural History Occasional Paper No. 24. Edited by Jeffery Thorpe, Taylor Steeves and Mike Gollop. 1999. (Available on CD). Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

4th PCESC – Proceedings of the Fourth Prairie Conservation and Endangered Species Workshop, February 1995, Lethbridge, AB. Natural History Occasional Paper No. 23. Edited by Walter D. Willms and John F. Dormaar. 1996. Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

3rd PCESC – Proceedings of the Third Prairie Conservation and Endangered Species Workshop, February 1992, Brandon, MB. Natural History Occasional Paper No. 19. Edited by Geoffrey L. Holroyd, H. Loney Dickson, Mona Regnier and Hugh C. Smith. 1993. (Out of Print). Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

2nd PCESC – Proceedings of the Second Endangered Species and Prairie Conservation Workshop, January 1989, Regina, SK. Natural History Occasional Paper No. 15. Edited by Geoffrey L. Holroyd, Gordon Burns and Hugh C. Smith. 1991. (Out of Print). Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

1st PCESC – Proceedings of the Workshop on Endangered Species in the Prairie Provinces, January 1986, Edmonton, AB. Natural History Occasional Paper No. 9. Edited by Geoffrey L. Holroyd, W.B. McGillivray, Philip H.R. Stepney, David M. Ealey, Garry C. Trottier and Kevin E. Eberhart. 1987. (Out of Print). Published by the Provincial Museum of Alberta, 12845-102 Ave., Edmonton, AB T5N 0M6.

The Prairie Conservation Award

The Prairie Conservation Award is granted to a deserving recipient from each of the three Prairie Provinces once every three years in recognition of significant long-term contributions to native habitat or species at risk conservation. Individuals from any walk of life, organizations or Aboriginal groups can be nominated for this award.

Five criteria are used in the evaluation of nominations for the Prairie Conservation Award:

1. Relationship of achievements to the conservation or understanding of native habitat or endangered species within the Prairies Ecozone.
2. Demonstration of exceptional commitment or innovation (above and beyond normal livelihood expectations).
3. Demonstration of enduring commitment.
4. Significance of the accomplishment in terms of results.
5. Extent to which granting of an award to this nominee will help native habitat conservation and endangered species efforts within the Prairies Ecozone.

The Prairie Conservation Awards were presented at the 9th Prairie Conservation and Endangered Species Conference in Winnipeg, Manitoba on Friday, February 26, 2010. The 2010 recipients of the award were Dr. Robert E. Jones from Manitoba, Pat Fargey from Saskatchewan and the Dylan and Colleen Biggs Family from Alberta (see pages xii-xiv).

Past Recipients of the Prairie Conservation Award

	ALBERTA	SASKATCHEWAN	MANITOBA
1986 – Edmonton		Award Created in 1989	
1989 – Regina	Dianne Pachal and Vivian Pharis	Dr. Stuart Houston	
1992 – Brandon	Cliff Wallis	Donald Hooper	
1995 – Lethbridge	Francis and Bonnie Gardner	Dale Hjertaas	Local Government District of Stuartburn
1998 – Saskatoon	Cheryl Bradley	Miles Anderson	Manitoba Naturalists Society
2001 – Winnipeg	Ian Dyson	Greg Riemer	Rick Wowchuk
2004 – Calgary	Dawn Dickinson	Dr. David Gauthier	Tony and Debbie McMechan
2007 – Regina	Barry Adams and Richard Quinlan	Lorne Scott	Marilyn Latta
2010 – Winnipeg	Dylan and Colleen Biggs Family	Pat Fargey	Dr. Robert E. Jones

Robert E. Jones – 2010 Manitoba Recipient
Prairie Conservation Award

Excerpt from nomination by Christie Borkowsky:

I would like to nominate Dr. Robert E. Jones for the Manitoba Prairie Conservation Award offered by the Prairie Conservation and Endangered Species Conference in February 2010. Dr. Jones, readily known as Bob to colleagues, friends and acquaintances, spent the better part of his career in Manitoba, working for Manitoba Conservation (formerly the Department of Natural Resources). During his 25-year career with the Province, he was involved with many programs and projects, from common waterfowl to endangered species and their habitat.

I first met Bob when I was hired as a summer assistant at the Manitoba Tall Grass Prairie Preserve. At the time, Bob chaired the Management Committee for the Manitoba Tall Grass Prairie Preserve and represented Manitoba Conservation on the Preserve's Local Advisory Committee (LAC). He was instrumental in developing the work plans that would lead to long-term monitoring projects for protected species at the Preserve and helping the LAC secure funding for the establishment of the Preserve's Prairie Shore Interpretive Trail.

What makes Bob so deserving of the Prairie Conservation Award is that his commitment and involvement with conservation projects has not diminished since his retirement in 1998. He continues to band fledgling falcons for the Manitoba Peregrine Falcon Recovery Program and helps with the Manitoba Piping Plover Recovery Program. He has maintained strong ties to Delta Marsh with his participation at the annual Delta Marsh Birding Festival and contribution to the Delta Marsh History Initiative. Bob established Manitoba's first Monitoring Avian Productivity and Survivorship Program (MAPS) banding station at the Manitoba Tall Grass Prairie Preserve. This international program, coordinated by the Institute for Bird Populations, monitors species across North, Central and South America. Despite his official retirement, he has maintained his commitment to the Preserve and the banding program, with twice monthly visits to band prairie birds during the summer season.

Bob is also a member of the Science Advisory Committee for the Nature Conservancy of Canada – Manitoba Region, providing insight on the quality of natural areas from wetland to prairie habitats and the multitude of species that occur in Manitoba. Recently, he has volunteered his time for the Manitoba Chimney Swift Initiative, watching for this threatened species at possible nesting sites across the province. Bob is always willing to help out, offer advice and share his knowledge with others. He is a long-serving and active member of the Portage Natural History Group in Portage la Prairie. While his sons were growing up, Bob was involved with the Scouts program for many years, for which he led numerous hikes and camping trips and, along the way, instilled an interest in nature to another generation of youth.

During his many visits to the Preserve for the MAPS program, Bob has shared many stories about the various projects and programs he has worked on over the years. I have learned that Bob is one of those unique individuals that found his passion for nature early on and developed it into a long and fulfilling career. Through his quiet nature, Bob has inspired and mentored many others, and I feel most fortunate to have had the opportunity to not only work for, but also work with, Bob for the past 16 years. For the man who continues to answer the phone simply as "Jones here", I cannot think of a better tribute, or of another more deserving individual than Dr. Robert E. Jones for the Prairie Conservation Award.

Pat Fargey – 2010 Saskatchewan Recipient
Prairie Conservation Award

Excerpt from nomination by 13 of Pat's colleagues:

We respectfully submit our nomination of Pat Fargey for the 2010 Prairie Conservation Award. We assembled a nomination team of individuals from Alberta, Saskatchewan, Manitoba and Montana because diverse input from government and non-government agencies was needed to truly reflect Pat Fargey's profound and far-reaching contributions to prairie conservation.

Pat Fargey has been an inspirational leader who has led recovery teams of some of our country's most endangered species. Through his vision and tenacity, strategies and innovative actions have been developed to yield real solutions to the recovery challenges of imperilled species. The results of Pat Fargey's accomplishments speak for themselves. For example, we believe that the reintroduction of bison to Grasslands National Park, the reintroduction of Black-footed Ferrets to Canada, and the down-listing of Swift Foxes by COSEWIC would not have been possible without Pat Fargey's involvement. At a time when the identification, designation and application of critical habitat is still in its infancy in Canada, Pat has made precedent-setting advancements for Swift Fox and Sage Grouse which will also yield increased habitat protection for numerous other prairie species.

Over the last two decades, national and international conservation reviews have called for an increasing shift from species to ecosystem planning, but few researchers, managers, or agencies have been able to make this transition convincingly. Pat Fargey has truly struck this balance by also spearheading multi-species, landscape or ecosystem initiatives on provincial, national or continental levels. Indeed, how many of us have contributed as he has to biodiversity protection that spans from aquatic invertebrates to songbirds to bison? As a trusted leader who is primarily known for his courage and integrity, he has a unique ability to consult, network, and broker agreements where others cannot. As illustrated by the many anecdotes that we collected for the nomination, he has a rare and enviable ability to not only garner the respect of conservation professionals but also of local landowners.

Such dedication is not without sacrifice. Pat Fargey is often seen working on weekends or into the late hours of the night to meet yet another crucial deadline with profound implications for species or ecosystem recovery. His tenure of more than a decade on numerous committees shows that he stays the course even when the going gets tough. And what does Pat do when success is achieved? He humbly retreats into the background, gives credit to others, and downplays his own accomplishments. After two decades of tireless dedication, the time has come for Pat Fargey to finally receive the credit that he deserves. Such recognition from his peers and your committee will only fuel his fire to create even greater successes for prairie conservation in the years to come.

Dylan & Colleen Biggs Family – 2010 Alberta Recipient
Prairie Conservation Award

Excerpt from nomination by Don Ruzicka:

It is a pleasure to nominate Dylan and Colleen Biggs and their four daughters, Jocelyn, Julia, Maria and Hanna for the 2010 Prairie Conservation Award for Alberta. Their ranch is located in the Special Areas between Coronation and Hanna. I have known the Biggs family for thirteen years and have visited their ranch (called TK Ranch) and viewed their land ethic many times.

TK Ranch is an organic 12,000 acre cow-calf, feeder-to-finish operation located in the endangered semi-arid Northern Fescue Grasslands of east-central Alberta. For more than 50 years, TK Ranch has managed the native grasslands that encompass their ranch in a manner that enhances wildlife and species diversity. The ranch is a contiguous block of land approximately 13 kms long and 4 kms wide. It has several large Ducks Unlimited projects and many excluded dugouts and burrow pits that provide valuable riparian habitat for birds, amphibians and mammals. While most of TK Ranch is undisturbed native prairie, it also has the occasional poplar and willow bluff to provide varied habitat for many species.

Dylan and Colleen Biggs of TK Ranch are very committed to the conservation and enhancement of the wild prairie. They firmly believe that both ranchers and the ecosystem benefit from well-managed grazing practices.

Dylan and Colleen Biggs of TK Ranch have been involved in the conservation of fragile prairie ecosystems for decades. In 1992, Colleen Biggs was involved in the Alberta Breeding Bird Survey and found 111 species of birds on TK Ranch. This prompted the Alberta Government to do a further survey that increased the number of bird species found there to 140. The Biggs commitment to the preservation of wild prairie is best represented by the number of species found on TK Ranch that are considered at risk, that may be at risk, or that are considered sensitive by the Alberta government's Department of Sustainable Resource Development.

The Biggs family have worked hard and have connected all of the dots in realizing how crucial it is to steward the increasingly sensitive prairie ecosystem. Personally, I have not witnessed this degree of intimacy with the land on any other farm or ranch. It has become a way of life for them. For them, it simply is the right thing to do.

TK Ranch has included stewardship in marketing their beef, bringing an awareness of the importance of conservation to consumers, retailers and chefs. They are leading by example as well as making a profit, and are starting to receive the attention of other farmers and ranchers.

The subject of prairie conservation and endangered species needs people like the Biggs family who take an active role in spreading awareness. As you may conclude, they are at the top of my list for being worthy candidates to receive this award.

PLENARY SESSIONS

PLENARY 1 – PATTERNS OF GLOBAL CHANGE

Perceptions of the Aspen Parkland, 1690-1890: Relating Story to Science

Nancy P. Sather
Minnesota Department of Natural Resources

Abstract – Ecologists often use the time-transgressive 19th century records of public land surveyors as a baseline for understanding natural ecosystems. In the southeastern portion of the Aspen Parkland, these records postdate written landscape descriptions by decades to well over a century. I illustrate the use of anecdotal historical narratives to illuminate our understanding of recent presettlement environmental history in this transitional ecoregion. I also explore some of the challenges of using historical narratives and provide a bibliography of selected primary and secondary sources for the Aspen Parkland.

On August 12, 1691, a youthful Henry Kelsey, journeying inland from Hudson's Bay to locate an "Inland Country of Good Report" for the Hudson's Bay Company, came to a place where

> Ye ground begins to grow heathy and barren in fields of about half a Mile over Just as if they had been Artificially made with fine groves of Poplo growing round ym (Ronaghan 1993: 91).

On August 20, he and his Native guides

> Pitcht to de outtermost Edge of ye woods this Plain affords Nothing but short Round sticky grass & Buffillo & a great sort of a Bear wch is Bigger than any white Bear and is neither White nor Black But silver hair'd like our English Rabbit (Ronaghan 1993: 91).

In these words we find what is believed to be the first description of the Aspen Parkland.

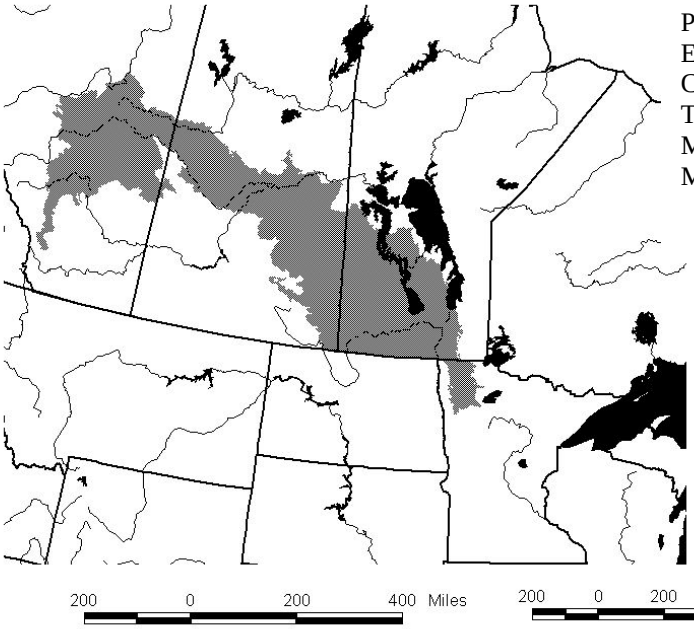
Five questions used by journalists can be applied to any use of historical narratives: who, what, where, when and why? These questions apply equally to the original narrator, to those who have analyzed and interpreted the materials, and to ourselves, if we are end users. Truth is in the eye of the beholder. With respect to historical documents, we need to understand the social and cultural context and the perspectives of the writers. We need some certainty that the writer could recognize the features identified in the account, and we need to be able to locate the described area. With respect to the work of our contemporaries who have analyzed the material, we need to know the motivation of the study and the purpose and methods of the analysis. With respect to ourselves, we must be able to interpret the narrative, including discerning locations from old (or missing) place names and translating antiquated names of animals and plants. For this purpose, other historical documents, Native place names, more recent survey data and paleoecological proxies provide valuable links between narrative descriptions and our present understanding of natural systems.

Kelsey's account illustrates how our potential use of a document depends on the relationship between our objectives and the certainty with which we can answer the above five questions. At the time of Kelsey's visit, the Hudson's Bay Company had previously restricted its trade activities to the Hudson Bay area. His was a first encounter. He entered uncharted territory with a company of Cree, and left us a story-map in lieu of a bird's-eye view grounded in European geographical referents. Ronaghan (1993) summarizes attempts by a series of researchers to determine the exact route of Kelsey's travels. His close reading (90-91) suggests that the "barren ground" with "fine groves of poplo" was somewhere near Usherville, Saskatchewan, and the "outtermost edge of ye woods" was near the confluence of the Lillian and Assiniboine Rivers between Preeceville and Sturgis. Given the general nature of Kelsey's description, what may be more important than the exact location of the account is the date. As early as 1691, vegetation that physiognomically characterizes what we conceive as Aspen Parkland was present in the general area between the Saskatchewan and Assiniboine Rivers.

The Aspen Parkland, in which we meet today, is an ecoregion whose definition and geographic boundaries appear to remain inconsistently interpreted. Delineation of a single North American Aspen Parkland ecoregion is clouded by 20th century land-use patterns overlain on a natural northwest-to-southeast shift from mixed grass to tall grass prairie. Winnipeg is at the locus of two hundred years of European influence on land use, whereas portions of the Parkland away from travel corridors were most impacted by conversion to European land uses after the 1870s (see D. Young's paper on page 11 of these Proceedings).

Bird (1961) recognized that the Aspen Parkland ecoregion extended into northwestern Minnesota. I compiled a reference map for this meeting by joining the Tallgrass Aspen Parkland Province of Minnesota (Minnesota Department of Natural Resources 2010) with the following Canadian Ecological Provinces (Marshall and Schut 1999): Aspen Parkland, Boreal Transition, Interlake Plain, Lake Manitoba Plain, and islands of Midboreal Uplands that are wholly included within the former polygons. The purpose of this map is not to provide a new interpretation of Aspen Parkland boundaries, but to serve as a frame of reference for this talk, especially with respect to the relationship of sites in southern Manitoba and northwestern Minnesota. As is always the case, ecologists and managers need to remind ourselves that lines on maps are human constructs that approximate transition zones on the ground, zones we are painfully aware will shift rapidly over the next century. I would personally argue that ecological units are a better frame of reference for our common conservation mission than political boundaries.

A generalized map of the Aspen Parkland.



This map combines the Tallgrass Aspen Parkland Province from the Minnesota Ecological Classification System with Canadian Aspen Parkland, Boreal Transition, Interlake Plain, and Lake Manitoba Plain, with inclusions of Midboreal Uplands.

Produced by Nancy Sather,
Minnesota County Biological Survey,
February 2010

Our readings today are from the low-hanging fruit of historical natural resource descriptions. They serve to introduce readers unfamiliar with the sources to some of the most readily available, detailed or colourful accounts. Numerous scholars across a range of environmental and social sciences have used historical documents to corroborate, clarify, or enliven interpretation of scientific data. A selection of these secondary sources is presented in the bibliography to enable the new researcher to break into the literature easily.

The most frequent uses of historical narratives have been analyses of passages relating to fire, bison, climate and hydrology. Key sources include: Nelson and England (1971), Higgins (1986), Shaw (1995), and Rannie (2001). In a recent paper on evidence of anthropogenic burning, Boyd's (2002) analysis of the relationship of grass phytoliths to anthropogenic burning illustrates the breadth of academic disciplines that draw on historical accounts to corroborate material evidence. Hamilton et al. (2006) provide a recent review of the relationship between bison, people and vegetation on the Northeastern Plains. Blair and Rannie's 1994 "Wading to Pembina" is a useful entry-point for a historical perspective on Red River flooding. Rannie (2001: 24-25) used accounts from the Red River Settlement, Brandon House, Fort Pelly, and

Pembina to generate graphs of fire seasonality and frequency.

Bibliographies in the above papers will lead the reader to the majority of analytical studies that use historical documents relating to the northern Great Plains and Prairie Provinces. Appendices in Severson and Sieg's (2006) *The Nature of Eastern North Dakota: Pre-1880 Historical Ecology* extend the geographical coverage of narratives to the upper Red River Valley, including some, but not all, of the historic accounts of fire and bison in the upper Minnesota River Valley.

Content analysis searches for key words or phrases, parsing them into quantifiable data. Marschner's (1974) base map of Minnesota's presettlement landscape is based on manual extraction of bearing tree data and line descriptions from Minnesota Public Land Survey records. Beginning in the 1980s, a variety of University of Minnesota and Minnesota DNR projects re-extracted the data to generate GIS covers of bearing trees and landscape types interpreted from the line notes (Almendinger 1997). Hanuta (2006) used content analysis to derive quantifiable GIS attributes of vegetation from southern Manitoba Dominion Land Survey records and Parish River Lot Surveys. She published a popular article on the resulting map in *Manitoba History* (Hanuta 2008).

Other uses for historical narratives include their obvious potential for interpretive programming, their references to phenology, and their incidental references to the distribution and abundance of species. Ferreting around in brief passages can be fun and fruitful. Consider several brief passages on the distribution and abundance of tree species in riparian forests. Hackberry (*Celtis occidentalis*) is today common in southern Minnesota but diminishes northward and is sufficiently rare in Manitoba to warrant tracking by the Conservation Data Centre. French trader La Vérendrye's 1738 observations of *Bois inconnu* at Fort Reine (near Portage la Prairie, Manitoba) are especially interesting because they illustrate both the challenge of interpreting obsolete nomenclature and the persistence of the species for over 250 years. He reports:

> …le bord des Rivieres plante de bois et les bois communs sont des chenes blancs, ormes, frenes, <u>*bois inconnu*</u>, bois blancs et bouleaux. Tout le reste est prairies, ou il se trouve de Iles de bois de chenes et pruniers. (Burpee 1927: 485)

His editor, Lawrence Burpee, translates the passage:

> Trees grow only on the banks of the rivers, and the prevailing kinds are white oak, elm, ash, <u>some unknown trees</u>, bass and birch. All the rest is prairie, with here and there clumps of oak and wild plum. (Burpee 1927: 485)

The underlining is mine and highlights the question: who was ignorant? Was La Vérendrye unable to identify one of the species he saw (the customary interpretation), or could it be that Burpee was unaware of an old vernacular name? In this case, 20th century botanist Frere Marie-Victorin resolves the issue in his description of Hackberry, listing *bois inconnu* in his synonymy and further explaining:

> La désignation étrange de "Bois inconnu", qui est encore en usage dans la région de Montréal, est très ancienne; elle est mentionnée par le voyageur-botaniste André Michaux (1795).
>
> (Marie-Victorin)

The journal of Northwest Company trader Alexander Henry the Younger, who traded at Park River and Pembina from 1800 to 1808 (and later in Saskatchewan and Alberta), is one of the most valuable historical accounts available to researchers for several reasons. Henry regularly described the appearance of the landscape, the availability of fish and game, and natural events such as fire and phenology. He dates his entries. Although it is sometimes difficult to decipher his location, the copious footnotes in the Coues edition (1897, reprinted 1965), generally supply geographic information, as well as identities of organisms whose old names may be puzzling. The Gough edition (Gough 1988), which claims to be a more faithful transcription, includes meteorological observations omitted by Coues, but provides fewer footnotes with respect to geography and natural history.

Henry maintained a series of sub-posts, which he visited with some regularity, thus providing descriptions for forays into the Pembina Mountains ("Hair Hills") and the valley of the Souris, the Forks of the Assiniboine, and the Red River Valley southward beyond its confluence with the Red Lake River. He also made trips to Red Lake, Minnesota, and to the Missouri River to visit the Mandan Villages.

Like La Vérendrye, Henry comments on the presence of Hackberry:

> Desmarais making snow shoes. *Bois inconnu* is the best wood we have and would prefer it to Birch or any other wood I know of. It is light and bends remarkably well. We find none of this wood in the North of this place, but the further south we go the more plentiful it is.
>
> (Gough 1988: 97)

> We came opposite to the Grande Fourche or enterance of the Riviere du Lac Rouge which come in here from the eastward and is about the same breadth as the Red River, which still keeps its Southern direction; they both appear very crooked. The soil banks and muddy beach are the

> same as below, and so is the large woods, with the addition of Bois inconnu and the Prickly Ash of which there is an abundance here.
>
> (Gough 1988: 87)

The geographic distribution described in the above account is supported by the distribution of bearing trees (Almendinger 1997) seventy years later. The six locations of Hackberry bearing trees in northwestern Minnesota illustrate this distribution, with concentrations along the Red River upstream of Henry's location, especially in the forest at the confluence of the Red and Red Lake Rivers. Similarly, Henry's comments about the dirth of *bois blanc* (basswood) for flooring are borne out by the bearing tree records, which show considerable oak along the Red River near Henry's Park River post, but concentrations of basswood more to the south of Henry's location.

What was the condition of riparian forests along the Red River in 1800? Henry's observations suggest that these forests may not have been as untrammelled as plant ecologists might imagine:

> Bears make prodigious ravages in the brush and willows; the plum trees are torn to pieces, and every tree that bears fruit has shared the same fate; the tops of the oaks are also very roughly handled, broken, and torn down to get the acorns. The havoc they commit is astonishing; their dung lies about in the woods as plentiful as that of the buffalo in the meadow. (Coues 1897: 101)

The frame of reference for Henry's comment about the buffalo dung is provided by his previous observations at the mouth of Riviere Gratias (the Morris River).

> The ravages of buffaloes at this place are astonishing to a person unaccustomed to these meadows. The beach, once a soft black mud into which a man would sink knee-deep, is now made hard as pavement by the numerous herds coming to drink. The willows are entirely trampled and torn to pieces; even the bark of the smaller trees is rubbed off in many places. The grass on the first bank of the river is entirely worn away. Numerous paths, some of which are a foot deep in the hard turf, come from the plains to the brink of the river, and the vast quantity of dung gives this place the appearance of a cattle yard. (Coues 1897: 64)

These comments appear to support the hypothesis by credence to Campbell et al. (1994) that the demise of bison, which predated fire suppression associated with settlement, may account for an increase in aspen during the interim. Appendix 7 in Severson and Sieg (2006: 289-296) includes full quotations for all of Henry's reported bison sightings, along with those of others whose descriptions bear on eastern North Dakota.

Contemplation of the relationship between fire and the balance of woody and graminoid dominance is not new. In March 1798, on his trip to the Mandans, David Thompson made the following analysis near the Red River in the vicinity of the present international boundary:

> In the more northern parts, where Pine Woods have been destroyed by fire, Aspins, Poplars and Alders have sprung up, and taken place of the pines. Along the Great Plains, there are many places where large groves of Aspins have been burnt, the charred stumps remaining' and no further production of Trees have taken place, the grass of the Plains covers them: and from this cause the Great Plains are constantly increasing in length and breadth, ad the deer give place to the Bison. But the mercy of Providence has given a productive power to the roots of the grass of the Plains and of the Meadows, on which the firs has no effect. The fire passes in flame and smoke, what was a lovely green is now a deep black: the Rains descend, and this odious colour disappears, and is replaced by a still brighter green; if these grasses had not this wonderful productive power on which fire has no effects, these Great Plains would, many centuries ago, have been without Man, Bird, or Beast. (Tyrrell 1916: 248)

During the mid-19th century, the Red River Valley was a lively commercial supply route for the Red River Settlements (Gilman et al. 1979). Travelers included the Metis draymen guiding high-wheeled and creaky ox-carts, business entrepreneurs, educators, and government officials on business for both countries. Among the travelers were journalists, adventurers, gold-seekers and scientists. Although Lake Agassiz was first formally named and acclaimed by Warren Upham in 1895, he was not the first to recognize its strandlines. With a huge fetch to make waves, and a complex history associated with expansions and retractions of the glacier, Lake Agassiz left a legacy of beach lines, each reflecting a lower level of the lake.

As early as 1846, Hudson's Bay trader Robert Clouston, on a business trip between Red River and St. Paul, speculated on the origin of the ridges:

> From this eminence a fine view of the country was obtained: to the south our view fell upon an apparently level plain bounded on the east by one of those extraordinary ridges of land which

> the eye no sooner rests upon, than the idea forms in the mind, that it must at one time have been the bank of an immense lake – breaks or gulleys are found in them, as if the water had forced a passage for itself. (Clouston 1846: 3)

Henry Hind, returning to Toronto from the Canadian Red River Exploring Expedition, commented on their lacustrine origin and their potential as a transportation route:

> The ancient Lake Ridge…extends in an un-broken line, except where the river from the higher level in the rear has cut channel through it, from near Lake Winnipeg, far beyond the international boundary…it forms a beautiful dry gravel road wherever traversed, and suffers only from the drawback of being the favourite haunt of numerous badgers, whose holes on the flank…are dangerous to horses; it is, apparently, perfectly level for a hundred miles…; it may yet form an admirable means of communication through the country, and it marks the limit of good land on the east of Red River. (Hind 1860: 160-161).

Many of Minnesota's largest protected prairies lie near the former oxcart trails. My own use of historical documents that describe natural history has been in the arena of interpretation, largely in a rural context. For example, on behalf of the Minnesota Native Plant Society, other ecologists and I developed a suite of Minnesota Native Plant Society field trips to the Aspen Parkland that combined historical narratives with natural history. By providing participants travelling in a caravan of personal vehicles with road maps, early township survey maps, plant lists and historical documents, we engaged them in rediscovery of the topographic landmarks that guided 19th century travelers from the crossing of the Middle River to the crossing of the Red Lake River, and from there to the Sandhill River, visiting all the natural areas that still exist along the route. The route passes directly through the Glacial Ridge Project, one of the largest prairie restoration projects in the U.S. At a location that is very likely somewhere within this project area, Hind's returning Canadian Red River Exploring Expedition paused on a high prairie to view the spectacle of a fire:

> In the afternoon we arrived at a part of the prairie where the fire had run; as far as the eye could see westward the country looked brown, or black, and desolate. The strong northwesterly wind which had been blowing during the day drove the smoke from the burning prairies beyond Red River, in the form of a massive wall towards us; a sight more marvelously grand, and at the same time gloomy and imposing, could scarcely be conceived. (Hind 1860: 259)

Tips for Conducting Your Own Research

Use of historical documents for conservation biology, resource management, and interpretation needs to be undertaken with caution on a case-by-case basis. Despite the availability of automated search tools, direct evaluation of returned sources and an understanding of the context within which the document was written are necessary antecedents to use of the data. Depending on the apparent veracity of the source, the precision with which the account can be pegged in time and space, and the nature of the content, historical documents may be useful to estimate the frequency of events, quantify species within given areas, confirm presence of species, confirm range limits if the narrator makes them explicit, corroborate life history events, and explore phenology.

Egan and Howell's (2001) *The Historical Ecology Handbook* is a valuable source of information on the wide range of cultural, biological, and proxy evidence that can be used to reconstruct historical environments. Chapter 3 (Edmonds 2001) provides step-by-step guidance to get you started using historical documents.

The secondary references mentioned in this paper include bibliographies that can serve as your portal to the majority of published primary and secondary literature useful for locating and interpreting historical narratives at a regional scale. Local libraries and historical societies often hold personal diaries and papers of settlers or clergy that may contain useful material. Librarians generally only catalog the natural history content of historical documents if plants and animals constitute a substantive part of the content. In some cases, searching for a geographical location with the words "description and travel" may turn up results. Because the international boundary was superimposed on Rupert's Land and Assiniboia, it is wise to search both American and Canadian sources. The Hudson's Bay Company Archives at the Archives of Manitoba are catalogued online, with a handy interactive map to locate posts. Microfilms of post records may be obtained by interlibrary loan. The actual documents may also be available in digital format online. The list of references at the end of this paper includes not only works cited and consulted for this conference, but a partial list of primary and secondary materials that may not be familiar to many readers (see Appendix). Most of these focus on the Red River Valley and its environs. Microfilm holdings of the Minnesota Historical Society are available through interlibrary loan, whereas printed materials are not. Copies can be obtained of most materials in the Society's collections.

The web sources listed below will lead you to an ever-increasing body of digitized Canadian and U.S. historical

documents. They also serve as an entry point for locating copyright-free artwork and historical photographs. This is especially true of the Glenbow Archives in Calgary, which also maintains a catalog of Canadian Pacific Railway (CPR) land sales. When using search engines, try alternative searches using old names, current names, and likely misspellings (e.g., "aspin" for aspen). Another useful hint is to try alternative terms to narrow a search, but note that most engines allow only two levels of search (i.e., one search within a search).

American Memory (Library of Congress): http://memory.loc.gov/ammem/index.html

Archives of Manitoba: http://www.gov.mb.ca/chc/archives/

Champlain Society Digital Collection: http://link.library.utoronto.ca/champlain/search.cfm?lang=eng

Early Canadiana Online: http://canadiana.org/ECO

Glenbow Archives: http://www.glenbow.org/collections/search/

Hudson's Bay Company Archives: http://www.gov.mb.ca/chc/archives/hbca/

Peel's Prairie Provinces (Peel Library, University of Alberta): http://peel.library.ualberta.ca/index.html

Saskatchewan Archives Board: http://www.saskarchives.com

The 19th Century in Print (special online collection of Library of Congress): http://memory.loc.gov/ammem/ndlpcoop/moahtml/snchome.html

Travel and Exploration Narratives and Guidebooks (University of Pennsylvania Library): http://gethelp.library.upenn.edu/guides/hist/travelnarratives.html

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Is Progress the Enemy of Conservation? John Deere and the Meadowlark

David Young

Abstract – The human activities which endanger species at risk are impelled by three closely intertwined ideological forces: Liberal Democracy, Social Progress, and Economic Growth. Efforts to preserve or protect species at risk must occur within the context of these widely accepted and highly valued ideologies, and effective design and execution of such measures requires an understanding of the historical context of the ideas, their current manifestation, and the directions in which they seem likely to carry us.

The presentation begins by noting that the advent of the modern world in Western Canada occurred almost exactly 200 years ago at the forks of the Red and Assiniboine Rivers, virtually the site of the present conference. The ideological notions which engendered Lord Selkirk's initiative marked a departure from the era of fur trading and exploration. The seeds of the industrial revolution were planted in prairie soil. Before the end of that century they would set in motion the political, economic and technological changes that have affected the western landscape and ecosystem, and would produce the widely accepted and valued social, aesthetic and economic rewards which we enjoy today. These (largely positive) impacts on the human condition are contrasted with their impact on indigenous species. This contrast creates a dilemma for those concerned with the politics of ecological integrity. The presentation concludes with some observations concerning the probable directions of social and economic change in the immediate future, and some notions and ideas which might be useful to future strategies.

The stated objective of this conference is "Learning from our past to manage our present and conserve our future". Obviously, our past, our present and our future must be understood within the paradigm defined by the community that we have created and in which we live, and in accord with the guidelines and values that we, as a broad community, have chosen. So all we have to do is understand our community, its past, its present and its future, and of course, its value systems, its limitations, its economy and its social organization, etc. We may not have quite enough time this morning to totally dominate this subject, so I have set myself a simpler task; I shall attempt to break a trail into this wilderness.

I think of the upper story as a forest of budget constraints and competing demands for resources, with a tangled understory made up of thickets of varying heavily nuanced and sometimes competing ideologies. More conventionally, one might say that the matters which you are about to address, the issues which arise from efforts to protect endangered species, occur within a social, economic and political context. In the next half hour I propose to explore briefly the ideologies which have informed and impelled the development of that context. I said I would *try* to break a trail; I shall try to do that without getting lost and without losing the rest of you. Here we go!

It began here, within a few hundred meters of this building, in 1812, almost two hundred years ago, with the arrival of the Selkirk Settlers. The event was not an accident. These were not a few wandering Scots who casually fetched up at the forks of the Red and Assiniboine Rivers and decided to try their luck at farming. It was the culmination of a project invented by a visionary, a man influenced by radical new notions of social progress, liberal democracy and economic growth. Thomas Douglas, the youngest son in a family of minor aristocracy, had been taken to Paris in his late teens by an uncle who sought to improve his education. The boy who was to become Lord Selkirk found himself in the midst of the intellectual ferment of the early stages of the French Revolution. He attended lectures and he and his uncle even dined with de Condorcet, perhaps the most influential of the *progressistes* – the advocate of such notions as free education for everyone, of equal opportunity for all (even women), and of democratic government. It was de Condorcet who inspired Malthus to write his famous essay denying the possibility of progress. Douglas and his uncle also associated with another visitor to Paris, another student of the revolution, Thomas Paine, who was soon to write his most famous work, *The Rights of Man*. The boy and his uncle returned to Edinburgh, where local Scots and visitors, including Thomas Paine, were discussing and

advocating the ideas which they believed should shape future society and governance.

The industrial revolution was well underway. The enclosure movement, designed to improve agricultural productivity in the highlands, was pushing peasants from the lands they had occupied for centuries. Thomas Douglas was deeply troubled. As a third son he could do no more than observe and perhaps record his thoughts. Shortly after his two older brothers died, he became Lord Selkirk. He began tinkering with the notion of establishing self-governing colonies of displaced Scottish crofters in the new world. He bought into the Hudson's Bay Company and organized a project to establish a colony on the Red River.

The idea of establishing a self-governing agricultural settlement at the Forks was, at best, half baked. The recruited families came partly because of somewhat extravagant promises of support and partly because they had little choice. Driven from their traditional crofts, theirs was a very meagre subsistence in Scotland. The notions of democracy and progress were Selkirk's, not theirs.

They came ill-equipped. Their tools were poor. The seeds they brought were adapted to a cooler climate with a longer growing season. Their clothing was inadequate for prairie winters. And they brought few relevant skills. From the beginning they relied, for mere survival, on the skills and generosity of local people, the descendants of those who had lived here for thousands of years. The Anishinabeg, the Innunu and the Metis taught them to find food in the rivers, on the prairies, in river-bottom forests, and in woodlands to the east. They would never have survived on the meagre output from their agricultural efforts. People who had raised corn here hundreds of years earlier knew that food won by grubbing through the roots of Big Bluestem and Prairie Cordgrass with crude hand tools could only be a meagre supplement to country food. For the settlers, even with the harvest from the rivers and forests, survival was a challenge from year to year. Most of the hours of every day were dedicated to finding and preparing food. The remaining hours were used to find fuel and to repair their tiny stock of housing and tools. They had little communication with the rest of world, and very little time to contemplate events that were so very far away from this harsh land where they struggled for survival.

For the first five or six decades after their arrival, they had little impact on the environment. A few more fish were taken from the river, a few more animals were harvested, a few acres of prairie soil were turned, but no species were threatened by the presence of this small group. If the settlement had failed in those early years, it would have left little impact on the environment. The Burrowing Owl and the Black-footed Ferret would have remained safe and secure.

But elsewhere in the world, the revolution was gaining momentum. The ideas of Liberty, Equality, and Fraternity had been established in France. Three decades earlier a new nation had been created on this continent. Organized along democratic lines and focused on the needs of farmers and honest mechanics, the United States was beginning to look to the west and to future expansion.

On the great central plains of Canada, the land still belonged to the buffalo, and in those first decades, the people of the Red River would learn to combine their agricultural ideas with the lifestyles and the technologies of local people. It might be argued that we should have learned more from that experience, that we should have recognized the wisdom and value of the attitudes to the environment that the First Nations had learned during the millennia that they had occupied these lands. Perhaps we learned a little, but there were also other forces at work shaping the values of the community that we would establish here. There were those ideas of democracy and equality coming from Europe and the new United States of America.

Then, in 1837, just 25 years after our settlers arrived, John Deere invented the steel plough. It was a crude device; a single shearing blade to cut and turn the soil, and two wooden handles to guide it. The whole implement weighed only about fifty kilos. One draft animal could pull it and one man could control it. But it could slice through tough prairie sod and ready the soil for planting. It would take a decade or two, but the industrial revolution was coming to the great central plains. This was the second force. The ideas of equality and democracy required a growing population of independent people; Jefferson's farmers and honest mechanics. Progress required economic growth. Technology would provide the means to achieve growth and increasing prosperity.

I was reminded of John Deere and his plough on a fine spring morning a few years ago. I was driving west from the fringes of the boreal forest just east of here, and out onto the sudden expanse of the prairies – farm land to the horizon and for a thousand kilometres beyond. I was reminiscing about the signs and sounds of spring on the prairies sixty or seventy years ago – less than one human lifetime. Bluebirds came every spring, and they always nested in the same woodpecker hole in a decadent aspen in a poplar bluff that surrounded a pothole near my house. (Indigo Buntings, but we called them bluebirds.) And when we walked along the dirt road between our farm and the neighbours', there were meadowlarks on the fence posts – bright yellow breasts and that startling, black, V-shaped

collar, and their unforgettable mating call. There were a lot of fence posts and there were a lot of meadowlarks.

But as I approached Steinbach, I had to shift my attention to traffic. At the first stop light, just on the edge of the city, an enormous tractor occupied almost two lanes of the highway. There were twelve huge drive wheels, three on every axle, each tire almost half a metre wide and more than two metres tall. In the field, it would be hitched to a cultivator, maybe sixty feet wide, and behind the cultivator would be an air seeder, opening the soil and depositing seed and fertilizer with perfect precision, completing seedbed preparation and seeding in a single operation.

A man with a steel plough and a horse, working throughout the spring, could turn maybe three or four acres of prairie sod into a field of wheat. How many minutes would it take the farmer and his new tractor to seed three or four acres? In a hundred and fifty years or so, John Deere had come a long way.

To use that new rig efficiently, the farmer needs large fields and long, straight lines. Turning wastes time and fuel. Poplar bluffs have been bulldozed and potholes have been drained. Fence lines have been cleared to make way. Efficiency is an imperative. The farmer is competing with other producers, all over North America. And Europe. And Asia. His first economic goal is to survive, his second is to earn a decent income for his family. He has just confronted himself with an added personal investment of a half million dollars. Every year there are casualties among farmers who have pursued the same strategy and through bad luck, or maybe insufficient efficiency, have *not* survived. He is competing in a global economy which demands cheap food, and cheap food requires efficient producers.

The goals of the modern farmer are not much different from those of the Selkirk Settlers, but he lives in a very different world. The Settlers were isolated from the outside world and learned the techniques of survival from their neighbours in their small community. The new John Deere is steered around the field by a computer linked to a GPS device and a memory card describing the field. The farmer is working in an industry controlled by global interest rates, global markets and prices.

The landscape outside this building would probably be unrecognizable to the Selkirk Settlers. The complex social, economic, political and technological world of the modern farmer would surely have been unimaginable.

The changes didn't come overnight; it was a long way from the steel plough to the giant John Deere. First there was a need for infrastructure; railroads to bring people and carry away the produce, roads, and villages to supply the settlers with services. In 1905, in Winnipeg, a farm tractor exhibition was organized, probably the first in this hemisphere. In the same year, the Provinces of Alberta and Saskatchewan were being created and readied for settlers. Only a few million acres of prairie had been lost to the plough and the barbed wire fence, but a stream of people were being attracted and most of them were looking for land and prosperity. The people would bring the ideas and the energy, and the tractors would conquer the grasslands. It would take about fifty years.

The settlers did not always bring any great reverence for the landscape or the ecosystems. The prairies were there to be cultivated; the trees were there to be cut to make houses and winter fuel. Wildlife was often only a nuisance or even a threat. Man would have dominion over the beasts of the field and the birds of the air. Civilization would come to the prairies.

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Our first objective this morning is to seek lessons from the past. Can we shift our focus for a moment and see these changes in agricultural technology from the point of view of the meadowlark? The first tool of the first farmer was probably a pointed stick. It was not a long way from the pointed stick to the wooden plough. Hitching a draft animal to a wooden plough was a technological advance. The tractor was a revolution. Fossil fuels replaced farm-grown fuels – hay and oats. Efficiency increased enormously, and new industries were created to supply fuel and machinery. Inter-regional trade grew quickly to move the fuel and machines to the farmers, and to move his vastly increased product to local and distant markets. From the point of view of the meadowlark, the available acres began to shrink. But, at least for the first fifty years, there were still fence rows and potholes and poplar bluffs, rich in the seeds and fruits of native plants and introduced exotics. In the next fifty years, bigger tractors, pesticides and herbicides and the inexorable demands for efficiency would drastically reduce these refuges.

And yet, as the years passed and farmers and ranchers began to see the impact of their enterprises on the land and what we now call "the environment", they became concerned. Farmers were, and are, close to the land they manage. When the duck population drops, or the mule deer disappear from a district, the farmers are often the first to notice. As the decades have passed, recognition of the responsibilities of stewardship has grown stronger. Global markets are a demanding taskmaster, and technological efficiency is necessary for survival, but there is another gentler force present in the farm community.

Now, from our point of view, everything the farmers have done (well, almost everything) has been to our enormous benefit. *Our*. I speak now as member of our community. Forget about the meadowlark. The farmers have reduced the cost of food. They have freed most of us to devote our time and energies to other pursuits – to improving human health, to building toys for adults and children, to creating entertainment, to providing education. The surpluses of time and energy made available by efficient food production have even made possible the allocation of a bit of money to hire the services of people charged with preserving the environment. The road to affluence begins with freedom from the struggle to find enough food to sustain ourselves. In this community, here on the prairies, we have made that journey in just 200 years, most of it in a little more than 100 years, and for us, it has been the agricultural industry, the farmers, who have made it possible.

There is no shortage of people who will take credit for the development of this prosperous and peaceful community in which we live. There are entrepreneurs who have built successful industries to supply markets in which demand is created by people who can feed themselves on 10 % of their income. There are intellectuals, paid with public funds, who carry out significant research and guide students in their studies. There are artists creating and performing for admiring audiences. These people, and all the rest of us, in business, in the professions and in other walks of life, can legitimately claim a share of the credit for the creation and support of our community, and of course, we make claim to a right to manage and govern our affairs. But let us keep in mind that the settlers of 200 years ago spent every hour of every day struggling to acquire the bare necessities of existence – a simple diet, some shelter and a bit of clothing. Two hundred years later, the same amount of labour produces a lot more. There is a surplus adequate to pay for the affluence that we enjoy, and it has been made possible by freeing most of us from the task of finding or producing food.

Meanwhile, the farmers – descendants, for the most part, of poor and usually landless people from various parts of rural Europe – continue to pursue the technical and economic efficiency which is necessary to a prosperous community. They are the first engine of progress. Lord Selkirk would surely be proud of them. But some of the things they have to do are not so good for the Indigo Bunting and the meadowlark.

Of course, agriculture is not the only engine of growth and it is not the only cause of the transformation of the landscape. Forest industries have been harvesting trees now for a hundred and fifty years or so. More recently the fossil fuel industries, particularly oil and gas, have intruded on the landscape and wind turbines are coming. These industries and others contribute to our prosperity, but it is our pursuit of that objective – *prosperity* – and all of the benefits that come with it, that brings us here today. Prosperity is paying our travel costs and covering our expense accounts. Prosperity is paying for accommodation and meals. Prosperity has paid for our education and meets the costs of our medical care. It pays wages and salaries and pensions. It provides us with the freedom to choose our goals and objectives. It finances the opportunity to try to preserve threatened species and threatened spaces. *And it threatens the spaces and species we hope to protect.* This is our world. We have designed it to suit ourselves. It creates challenges and it offers opportunities.

Now, perhaps before we begin to consider the tasks ahead of us in these next two days, we should pause for a moment to recognize the presence of the large, hairy creature at the back of the room. *The climate is changing*. I have avoided taking that into account in my reflections this morning. My excuse? I have no idea in what form, or at what speed, the change will occur. Steady or sporadic? Modest and manageable, or drastic? Disastrous? Catastrophic? A few things seem certain: it is occurring and it will continue to develop. It will almost certainly affect us adversely. We will react. How? How soon? I have no idea. We could spend much of the next two days speculating about climate change and about the effect that it will have on our community and on the species with which we are concerned. In the end we would accomplish very little. We simply don't have enough information yet. Perhaps five years from now it will be the main topic of a conference such as this.

With that matter set aside, at least for the moment, let's get back to our task. Obviously it would take days to begin to assess the nature and complexities of the world in which we work. There is, for example, the matter of the current international economic crisis; not as significant perhaps as climate change, but still pervasive enough to occupy much of our time. It is a temptation that I think we should resist. In the short run, what will be, will be. Instead we should begin, I think, by recognizing the fundamental values of our community. First, we have a democratic system of governance and decision making. Second, there is an almost universal acceptance of the idea of progress – movement toward a future that is, in some way, better than the past or the present. And third, there is a general and widespread agreement that progress in any form requires a prosperous and expanding economy to maintain the status quo and provide the resources for future improvements.

For most of us in this room, preservation of species and spaces is a priority. But we must accept, I think, that while the value of such goals and activities is widely accepted in our community, it is not, for most members of the community, a top priority. Prosperity comes first. Prosperity, the Economy, and Economic Growth. Preservation of the environment is, for many, *a cost of doing business*. For others, *it is a priority, after the needs of the economy are met.* For the community-at-large there are two sets of priorities: those that are necessary for continued prosperity and future growth, and those that can be acquired with the surplus wealth that accumulates in a prosperous society. The costs of preservation and conservation are seen not as contributors to a prosperous society, but as consumers of the wealth and resources that are available in a free and prosperous community. Those of us who work to preserve and protect the environment are seen not as *producers* of wealth, but as *consumers* of the surplus. Even for farmers, the cost of their role as stewards of the land is a tax on their efficiency and their ability to compete. (When we invent programs to assist them financially with those costs, we are moving toward recognition of our responsibility to share the costs of progress and prosperity.)

As consumers of wealth, we must compete for a share of the surplus, the disposable income of the community. At worst we must compete for attention and resources with the producers of SUVs, power sleds and holidays in Hawaii. At best, we may aspire to compete with the producers of services generally deemed to be essential; education, for example, health care, and infrastructure maintenance. I doubt though, that there is a majority in our community who would accord our objectives equality with these essential services. More realistically, we should probably hope to compete for resources with charitable donations and foreign aid.

Personally, I confess that I find these conclusions somewhat disagreeable. I don't entirely buy into the notion that man shall have dominion, and I question the prudence of permitting the demands of economic and technical efficiency to overwhelm the health of the environment. I mention this bias because I suspect it may be held by some others in this room. But we must recognize, I think, that we are, in our community, a small minority, and we live in a fairly smoothly functioning democracy where the views of minorities are heard, but not always heeded. The oil sands *will* be developed, and the lands of the great central plain *will* remain allocated, for the most part, to agricultural and industrial use. Candidly, I may doubt that this is the best of all possible worlds, but I try to remember that it is also necessary to attend to our business.

So if this is our present situation, if this is where we find ourselves this morning, what can we expect of the future, particularly of the next five or ten years? First, the basic values of the community will not change very much no matter what may happen to the global economy. The goals of freedom, prosperity, and growth will prevail. There will no doubt be challenges created by global events, and the community will rise to meet them within that framework. Technology will continue to create change and impose challenges for resource managers. These are forces and trends we cannot change.

When I think of technological change, I irreverently imagine a young man – a defender perhaps of the Black-footed Ferret – standing bravely and bare-handed in front of one of those giant green tractors. Heroic, no doubt, but he would not likely have much impact on the forward thrust of technological change. It will be more fruitful, I think, to study our community, and to find those values, beliefs and attitudes that we can turn to our advantage.

At a morning devotional service conducted by an Ojibwa elder I heard reference to "…the people who walk on four legs, and the people who walk on six legs, the people who swim in the water, and the people who fly in the air, and to the people who slide upon the ground with no legs". The words are not casually chosen. "The people" accords to other species equality with our own species, or something close to equality. It is certainly a long way from "man shall have dominion". Judging by our actions, the values of our community seem to lie somewhere between the two extremes. While we don't quite recognize other species as having rights equal to our own, we do enshrine in law some protection for them, and our laws and our allocation of resources seem to reflect, perhaps imperfectly or even inadequately, the attitudes of the community.

There was a session yesterday addressing "Social Marketing – How to get people to act for species at risk". This seems to me to address one of the things we can learn from understanding our place in the community. We must compete as *suppliers*, or at least as potential suppliers, offering services. Perhaps more importantly, we must portray ourselves as suppliers of *essential services*, services at least equal to highways and bridges, if not health and education. This is not to say that we should not also compete with those who provide toys and luxuries; that market absorbs huge cash flows. The mavens of marketing may seem far removed from the good people who adopt rivers, but there are some very successful conservation organizations using their services very effectively.

As we look to the future, to the next five or ten years, we can be quite sure that the mollusks in freshwater streams won't change very much, although they may

decline in numbers. The consumer marketplace, however, can be expected to be the scene of turbulent and rapid change. SUVs are out, hybrids are in and electric cars are coming. Styles, fads, whims and fancies change, and suppliers, with good research into basic attitudes and skilful advertising, create markets for an enormous range of goods and services. Where there is change, there is opportunity.

In the public sector of the economy, change is slower, and the levers that guide change are somewhat different, but change can be effected here as well. Resources can be diverted to meet changing public attitudes. Suddenly, in the past few weeks, government has noticed that the welfare of women and children in some parts of the world is not satisfactory, and policies and programs have been announced to address the new-found problem. Would it be cynical to suggest that survey research discovered that this concern was of importance to some segment of our society, and that government might hope to win votes by attending to the matter? In fact, standing barehanded in front of an advancing tractor won't accomplish much, but careful work to shape public opinion can, in the long run, be effective.

Now before I conclude, let me make a disclaimer. I have used John Deere and the meadowlark as symbols of the conflict between our goals as a community and the imperatives of habitat conservation. Of course, the meadowlark is not a seriously threatened species, at least at this time, and John Deere is representative of only one aspect of agriculture. The big tractor, the oil fields, and all the other manifestations of the machinery of growth represent what we demand of the farmers and other producers – the wealth that we want for ourselves. They must balance our demands for cheap food and high industrial efficiency with their need to remain competitive, and with the needs of other species. They are on the front line. They deserve our respect and support.

The problems that will be addressed here, in the next two days, are not caused by the people with no legs who slide on the ground, or by the people who walk on four legs, or the people who fly in the air. They are caused by the people who walk on two legs. Many of us in this room arrived here through the study of one aspect or another of biology or ecology. The threats to the species we study and seek to protect are created by the people who walk on two legs. That species, I submit, must be a central focus of activity during the next five or ten years.

I look forward to the next two days, and I thank you for your attention.

Prairie Conservation Action Plan: Progress and Conservation Lessons Learned after Two Decades

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Abstract – Two decades after the release of the original Prairie Conservation Action Plan (PCAP), what progress have we made toward conserving prairie grasslands and endangered species while maintaining the economic stability and productivity of these grasslands in Canada? Soon after the World Conservation Strategy was released, we produced our own conservation plan with the motto "Think Globally, Act Locally". The stated purpose of the plan was "to influence policy and attitudes so as to conserve the biological diversity found in the Canadian prairies". I reflect on the nine conferences and the progress that we have made, or have not made, on the conservation of native prairie and endangered species. During this time we have down-listed Peregrine Falcons, reintroduced Black-footed Ferrets and de-listed Baird's Sparrow. But we have listed far more species than we have recovered. We have produced numerous recovery strategies and various plans, and have watched thousands of gas and oil wells drilled, many kilometres of pipelines installed and thousands of acres of native prairie cultivated. Have we accomplished our goals? PCAP stated that we needed a commitment by westerners, cooperative action, and ongoing monitoring of progress. We need a reality check on our state of prairie conservation, our economy, agricultural policy and, most recently, even our climate.

With the passage of a quarter century of workshops and conferences dedicated to endangered species and prairie conservation, we ask: what have we accomplished and where do we go from here? These were the questions posed for me to address at this 9th Prairie Conservation and Endangered Species Conference. Obviously, prairie conservation is more than 25 years old. Our predecessors accomplished much before the first conference was held in 1986. They laid the groundwork for what we have accomplished since then. The Prairie Conservation Action Plan (PCAP) was published in 1988 just before the second conference (WWFC 1988). Not every conservation action that has occurred in the past 25 years can claim to be the result of these conferences and PCAP. But conferences have continued uninterrupted since 1986, a linkage of gatherings with published proceedings every three years that gives us a record of our progress. This article is an overview of the progress in prairie conservation over the past 24 years. First, I will document some of the history surrounding the origin of this series of conferences.

The Origin of the Prairie Conservation and Endangered Species Conferences

In today's environment of planning and strategy development, and often top-down, hierarchical programming, the Prairie Conservation and Endangered Species Conference stands out as a grassroots example of a successful string of events that has no structured organization behind it, no master plan, but with a 24-year record of nine successful gatherings.

When the first workshop was held in 1986 (the first seven were called workshops rather than conferences), Canada did not have any recovery teams nor a federal endangered species act. COSEWIC had existed for less than 10 years. Recovery efforts for listed species were initiated over the phone and by snail mail with no direct team coordination or communication. The working sessions at the first workshop were defacto recovery team meetings, the first for many species. By the second workshop in 1989, some species experts remained in Regina and held team meetings in anticipation of the formal designation of recovery teams by the federal-provincial-territorial wildlife directors.

This series of conferences did not evolve from any organizational or planning effort but from fortuitous circumstances. In 1985, I had just been made a first-level manager (head of the Threatened Species section) in the Canadian Wildlife Service (CWS), Environment Canada, and was also President-Elect of the Edmonton Natural History Club (ENHC). Pat Clayton, president of the Federation of Alberta Naturalists (FAN) called me to ask if ENHC would host the annual meeting of FAN in January 1986. I agreed, and she asked that I organize an evening speaker or topic. As I learned more about threatened species conservation from CWS staff, I realized that many species had never been the subject of a workshop or expert gathering. As I called provincial and university experts on threatened species, it became apparent that a workshop was needed. Soon I had a Friday evening speaker to open the workshop, concurrent sessions for Saturday and a half day on Sunday.

At this point, Garry Trottier, also of CWS, suggested that we should discuss habitat as well as species issues. So he organized a full day on Friday focused on prairie habitats. The first Prairie Conservation and Endangered Species workshop/conference was born.

As the program evolved, the requirements for space increased. Phil Stepney, then Director of the Provincial Museum of Alberta (now Royal Alberta Museum) immediately agreed to host the workshop. As the number of concurrent sessions increased, so did the number of additional rooms. Phil and I toured the museum and found laboratories that could be emptied for all the sessions. Dave Ealey, current president of FAN, became chair of the local organizing committee. ENHC organized volunteers to handle registrations, audio-visual and the myriad of other tasks, while I helped to organize the program.

By the end of the weekend, the success of the meeting could be felt in the concluding session and in the animated faces in the audience. Steve Herrero, as the rapporteur, gave the gathering a thumbs-up, and Monte Hummel, President of World Wildlife Fund Canada (WWFC), raved about the workshop. Steve suggested that the workshop should be repeated. As I stood up to close the meeting, I realized that I had the opportunity to call a next meeting but had not discussed the options with anyone. I looked into the audience and recognized two smiling faces, decided three years was long enough to wait, and announced that the next meeting would be in Regina in 1989, organized by Dale Hjertaas and Lorne Scott. And so it was – the series of conferences was born.

The Origin of the First Prairie Conservation Action Plan (PCAP)

When I called Monte Hummel in late 1985 to ask him to give a plenary talk at the first workshop, he readily agreed. WWFC was about to launch a series of regional conservation initiatives with the first planned elsewhere, but by the end of our phone call he proposed that WWFC's first conservation initiative be based in the prairies. At the 1986 event, he announced the start of a three-year program called Wild West, and we released a joint promotional poster featuring a Swift Fox and the caption "Lets Keep Some Wild in the West". Conservation of the biological diversity found on the Canadian prairies was the primary objective of the Wild West program.

The Wild West program funded over 90 demonstration projects for the recovery of endangered species, involved over 500 landowners in cooperative projects, and increased public awareness of what can be done to conserve prairie wildlife and habitats.

A major product of that initiative was the publication of the first *Prairie Conservation Action Plan: Lets Leave Some Wild in the West*, which was released to the public at the 1989 Workshop in Regina (WWFC 1988). This plan (PCAP) was the result of three years of work by a committee of Wild West that I chaired and Dave Leman coordinated while he was a graduate student at the University of Calgary (co-supervised by Steve Herrero and myself). The committee had representatives from all three provincial wildlife agencies and the federal Canadian Wildlife Service. The document was reviewed by a wide variety of stakeholder groups, landowners, universities and government agencies (WWFC 1988, Leman 1990). I mention these details to show that this plan was not developed in isolation, but as a multi-disciplinary effort. PCAP was released with much fanfare in each provincial capital by Monte Hummel, together with either the premier or the provincial wildlife or environment minister.

Each province established a committee to enact PCAP. It had a five-year planning horizon, and all three Prairie Provinces have produced subsequent five-year plans. In addition, from 1989-1992, the Alberta wildlife minister Don Sparrow and Monte Hummel initiated a three-year follow-up to Wild West called Prairie for Tomorrow. This provincial program funded many conservation and educational activities.

So what progress have we made on the original PCAP? The plan was developed after the publication of the World Conservation Strategy (WCS) (IUCN 1980). The WCS has three simple global objectives:

1. Maintain essential ecological processes and life-support systems;
2. Preserve biological diversity;
3. Ensure sustainable use of species and ecosystems.

Conservation of the Canadian prairies was consistent with these objectives. With the saying "Think globally, act locally", PCAP was drafted and published with great hopes. It had 10 goals:

1. Identify the remaining native prairie and parkland.
2. Protect at least one large representative area in each of the four major prairie ecoregions.
3. Establish across the three Prairie Provinces a system of protected native prairie ecosystems, and, where possible, connecting corridors. This system should include representative samples of each habitat sub-region.

4. Protect threatened ecosystems and habitats by preparing and implementing habitat management and restoration plans.
5. Protect and enhance the populations of prairie species designated nationally or provincially as vulnerable, threatened, endangered or extirpated, by implementing recovery and management plans.
6. Ensure that no additional species become threatened, endangered or extirpated.
7. Encourage governments to incorporate conservation of native prairie more explicitly into their programs.
8. Encourage balanced use of private lands that allows sustained use of the land while maintaining and enhancing the native biological diversity of the prairies.
9. Promote public awareness of the values and importance of prairie wildlife and wild places.
10. Promote research relevant to prairie conservation.

Each goal then has actions detailed in PCAP which are reviewed next.

Goal 1 describes actions to complete and make available inventories of native prairie and parkland. Such inventories now exist and are available from a variety of sources. These inventories confirm what was determined in PCAP – less than 20% of prairie Canada is still native and less than 1% of the tall grass prairie remains.

Goal 2 identifies 12 actions for the establishment of large reserves in all three provinces. Only two of these have been realized: the establishment of Grasslands National Park on September 23, 1989 (Fargey 2000) and the Suffield National Wildlife Area declared by Order in Council on June 19, 2003. The Suffield area was established as a National Park in 1922 to provide wintering habitat for diminishing pronghorn populations. Subsequent to the recovery of the species, the area was withdrawn as a park in 1938. The new NWA is much smaller than the original national park (Department of National Defence 2003) but its establishment provides a sound basis for continued protection. Grasslands National Park continues to gain landholdings on a willing seller / willing buyer basis.

Goal 3 was supported in 1984 when Saskatchewan established the Wildlife Habitat Protection Act, progresssive legislation that protects 3.4 million acres of wetlands and uplands in the agricultural region. However, a planned sale of 1.6 million acres of Crown land puts some of this wildlife habitat at risk in 2009, according to Nature Saskatchewan (Scott 2009). Otherwise, Goal 3 seems to have been lost. Of nine actions recommended in PCAP, little progress is obvious. With no implementation strategy to gather support and resources, the establishment of a system of connected representative samples of each habitat sub-region is not going to happen.

Goal 4 recommends planning to protect habitats, but with limited funds and with proposals to sell off public lands, planning is headed in the opposite direction to prairie conservation. The construction of gas wells, pipelines and service roads in PRFA pastures and in native prairie in all three provinces is contrary to the goals of PCAP.

Goal 5 focuses on implementing plans to save species at risk. Previous federal and provincial legislation does include protection of most species under each jurisdiction. The federal *Species At Risk Act* (SARA) was proclaimed in 2004. The act has provisions for protection of residences and critical habitat of all listed endangered and threatened species. However, even though the act is six years old at the time of this conference, progress to complete all the recovery strategies, action plans, management plans, and identification of critical habitat that is dictated by the act has been slow (Anonymous 2009). This report states that the Banff Springs Snail is the only species in Canada for which all of the provisions of the act have been implemented. A great deal of effort is currently going into drafting these documents but, with limited staff, the progress is indeed at a snail's pace and implementation has been limited.

Goal 6 states that we should ensure that no additional species become at risk. This goal has seen some spectacular successes in the area of reintroductions of extirpated species. In October 2009, Black-footed Ferrets were released into colonies of Black-tailed Prairie Dogs in Grasslands National Park and two adjacent private ranches. In 1986, this release was just a dream (Laing 1988) and the initial recovery team was not able to advance the reintroduction program.

Swift Fox populations have increased and the species has been removed from the extirpated list of COSEWIC. Twenty years ago, only two experimental releases of foxes had occurred, spearheaded by the captive breeding efforts of the late Miles and Beryl Smeeton (Reynolds 1987). The latest survey of Swift Fox in 2005 produced an estimate of 647 foxes in Alberta and Saskatchewan and 515 in northern Montana due to their expansion south (Moehrenschlager and Moehrenschlager 2006).

Plains Bison were released into the west block of Grasslands National Park in May 2006 after a major fencing program was completed under the leadership of park

biologist Pat Fargey. This herd is successfully reproducing and growing (W. Olson, pers. commun.)

Peregrine Falcons have increased in the past 20 years. The breeding facility in Wainwright, Alberta was closed in 1996 after a 25-year captive breeding and release program. The species is now set to be downlisted to Special Concern (COSEWIC 2007).

Other species such as American White Pelican have gone from threatened (Brechtel 1987) to an abundant species, another success story. However, most worrisome is the long and growing list of declining prairie mammals, birds, reptiles, amphibians, invertebrates and plants that are now listed by COSEWIC, and the many that are up for review for listing. In 1988 PCAP listed 18 vertebrates and 3 plants species that were listed by COSEWIC; in 2009, COSEWIC listed 35 species of vertebrates and 24 of plants (Table 1). New additions to the list include Common Nighthawk and Chestnut-collared Longspur, species that were common until recently. Also, we are no longer only listing species that are at the northern edge of their range; many species that have extensive ranges in Canada but whose populations are in decline are being listed.

Table 1. The number of species that occur in the three Prairie Provinces and were listed by COSEWIC in 2009 is far greater than were listed in 1988 for all taxa.

	Mammals		Birds		Herptiles		Invertebrates		Vascular Plants	
	1988	2009	1988	2009	1988	2009	1988	2009	1988	2009
Extirpated	2	2	0	1	0	0	0	0	0	0
Endangered	0	2	6	7	0	2	0	9	1	5
Threatened	2	3	3	8	0	1	0	0	0	9
Rare/Special Concern	2	1	3	6	0	2	0	4	2	10
Total	6	8	12	22	0	5	0	13	3	24

Goal 7 is more elusive to evaluate. Governments have many detailed programs, and determining if they explicitly incorporate conservation of native prairie is difficult. The Ecological Goods and Services (EGS) initiatives of government agriculture departments fit into this PCAP goal. On its website, Agriculture and Agri-Food Canada states that it "recognizes the contributions of farmers and rural landowners in protecting and enhancing the environment" (AAFC 2007). It describes two programs that incorporate the concept of EGS: the National Environmental Farm Planning Initiative and the National Farm Stewardship Program. The development of beneficial management practices (BMPs) by agriculture and wildlife agencies is another step in the right direction, but their benefits will only be realized when they are implemented. BMPs are important to the sustainability of the agriculture and agri-food industry and the long-term health of the environment, including prairie wildlife and their habitats in Canada. AAFC is working with provincial governments to develop a framework for policies that are good for agriculture and that provide environmental benefits for all Canadians.

Alternative Land Use Services (ALUS) is a producer-driven initiative that has been adopted in all three Prairie Provinces as well as elsewhere (MacArthur 2010). In Manitoba, the program pays $25 per acre per year to landowners who maintain or reclaim land, which provides environmental and societal benefits including reduced soil erosion and stream siltation, improved water quality, and wildlife habitat protection. While not a lot of money, it pays the equivalent of taxes on land that otherwise is a liability for the landowner (Winters 2007). This program was initiated by producers and is supported by provincial and federal governments, at least in its trial phases. The program appears to fully support the goals of PCAP.

Goal 8 presents actions to encourage private landowners to conserve native prairie. Non-government conservation organizations have implemented actions to support landowners' decisions to maintain native wildlife and habitats. Programs such as Operation Burrowing Owl and Shrubs for Shrikes of Nature Saskatchewan, Operation Grassland Community of the Alberta Fish and Game Association, the MULTISAR program of Alberta Sustainable Resource Development and several programs of Ducks Unlimited Canada have extension activities to help landowners develop environmental farm plans that incorporate the needs of species at risk and other wildlife while improving or at least maintaining the profitability of the land.

However, as the number of cattle producers declines in Canada, ranchers claim that they are an endangered species. On February 16, 2010, Statistics Canada reported that the number of cattle farms fell below 100,000 in Canada, the lowest number since 1931 (Martello et al. 2010). While the decline is not directly a prairie conservation issue, the poor economic condition of cattle ranches is a concern, especially as this is reflected in the number of family farms. For example, the net

farm income for beef cattle farm operators declined 19.9% from 2005 to 2006, the latest year for which statistics are available (Chartrand and Beaulieu 2009). Grazing of native prairie by cattle is a conservation benefit. If ranchers are forced to do something else with their prairie lands, then we would have a conservation concern. Around Calgary and other cities, native prairie is being bought and developed into residential properties. As acreage residences are created, much native land is lost to asphalt and Kentucky Bluegrass. Alternatively, conservation lands away from urban centers can be purchased at rock-bottom prices if funds are available to groups such as the Nature Conservancy of Canada.

Farm Credit Canada (2010) reported that 60% of producers and agri-business operators were considering the environment in their business practices, an encouraging percentage (Ewins 2010). One catchy phrase in the report was that a triple bottom line approach of "people, profit and planet" will benefit all three. Part of this greening trend is minimizing the environmental impact of agricultural operations, which will ultimately benefit prairie conservation.

Goal 9 is targeted at increasing public awareness. Progress on this goal is difficult to evaluate. Funding for educational interpretive programs varies by institutions, government jurisdiction, etc. One recent positive example occurred in Edmonton with the announcement of new funding for expansion of the John Janzen Nature Center; on the other hand, the expansion or relocation of the Royal Alberta Museum is perpetually postponed. Non-government environmental organizations have some positive examples, such as the success of the Saskatchewan Burrowing Owl Interpretive Center (SBOIC) in Moose Jaw, including their Owls on Tour program (Felskie 2001), and the Owls and Cows program of the SBOIC and Saskatchewan's Prairie Conservation Action Plan Committee, which has a goal of exposing every elementary school child in southern Saskatchewan to the program at least once. Another positive development is the commitment to extension programming by Parks Canada Agency. They are encouraging staff to develop community and school programs to make the Canadian public more aware of their natural heritage that is protected in our national parks. In Val Marie, the Prairie Learning Center holds educational events using Grasslands National Park as its resource and backdrop. But in cities, celebrations of Wildlife Week and Environment Week are on the wane and an increasingly urban populace with electronic addictions increases the challenge of providing a connection to landscape and endangered species.

Even in the rural landscape, the observations of Gilbert Proulx near Mankota, Saskatchewan (see page 128 of these Proceedings) tell a disturbing story of environmental abuse and lack of understanding of basic biology. Landowners, presumably driven by the goal of protecting their crops from foraging Richardson's Ground Squirrels, are misapplying strychnine and rodenticide bait stations. As a result, they are poisoning predators and non-target species that would otherwise help in the control of pest species, or are innocent bystanders. More education about a balanced approach to pest management is needed to prevent such occurrences.

Goal 10 is to promote research on prairie conservation. Many research projects have been conducted in the past 25 years which cannot all be reviewed here. Our research with the CWS has led to the discovery of wintering grounds of Burrowing Owls, their winter ecology, winter survival and, most recently, migration routes (Holroyd et al. 2010). Together with Jason Duxbury, we presented the hypothesis that some Burrowing Owls disperse long distances from one year to the next. An example of this dispersal is the reappearance of this species in southwestern Manitoba after an absence of many years. Clearly these owls are not a local population, but have immigrated from somewhere else. Other examples of single-species research abound. But as a researcher, I also have to ask myself: are there more owls as the result of my studies? Most of my studies have been targeted at learning more about the species' basic biology. More research should be targeted at specific conservation applications if we are to truly help the species at risk that we study.

To achieve this, we would have to complete the implementation of the specific actions from PCAP. Currently, there is no prairie-wide committee to identify research priorities, there are no guidelines for research priorities, and there are no research stations designated for grassland research and long-term monitoring (as exist in the U.S.). Although there are a few exceptions, most research projects are independent, short term, and not interlinked in any ecosystem or food chain project. The example of the Boreal program in the Yukon demonstrated what can be accomplished by a team effort (Krebs et al. 2001) – the sum of the individual projects was far greater than the individual accomplishment of each project.

Discussion

Overall we have implemented less than half of the actions recommended in PCAP – a grade below 50 %. And remember, the goals of PCAP were for five years. This brief evaluation is after 20 years. Each province has had subsequent 5-year Action Plans, but we have not been able to achieve these goals, albeit ambitious ones. Perhaps the original goals were too ambitious?

Did we aim for the stars and land on the moon, rather than aim for the fence and hit the dirt?

Besides conservation of prairie wildlife and habitats, we face frequent daily reminders of many more warnings of our fate on this planet. Most notably in the past 25 years is the attention given to climate change, not even on the agenda of the early conferences. Many awesome new books have been written in the past quarter century that have given us sober reminders of the causes of the demise of past societies, such as *Collapse*: *How Societies Choose to Fail or Succeed* (Diamond 2005). Several books have followed on the theme of Rachel Carson's *Silent Spring*, describing the decline in bird populations in North America, such as *Restoring North America's Birds* (Askins 2000), *Silence of the Songbirds* (Stutchbury 2007), *Where Have All the Birds Gone?* (Terborgh 1989), and more locally and most recently *Grass, Sky, Song: Promise and Peril in the World of Grassland Birds* (Herriot 2009).

So why are we not making more progress? You and I are convinced more needs to be done. Why else would we travel in February to Winnipeg, or Regina or Saskatoon, Lethbridge, Brandon, Calgary or Edmonton for these conferences? We cannot be accused of fleeing to some exotic locale to discuss our conservation issues.

One suggestion is that we must take a longer term view and create a different set of goals. Although I hate to state this (you will see why later), we need another plan, but this time an implementation plan with funding. The first conference and action plan were two decades ago. I now have colleagues in our office that were very young when the action plan was published. If all of them, and their peers, had grown up with a strong environmental ethic, society would be on the road to finding and implementing solutions to all environmental problems.

John Livingston (1981) stated this philosophy in *The Fallacy of Wildlife Conservation*, where he argues that all the logical arguments to conserve wildlife ultimately fail. Did we choose careers as wildlife biologists to become rich, or for religious reasons, or for any of the logical reasons that we try to put forward to society to conserve wildlife? Livingston stated "In the broadest sense, wildlife preservation is a catastrophic, heartbreaking disaster"; pretty harsh words regardless of the time frame. His thesis is that all logical arguments to conserve wildlife ultimately fail to convince anyone but the already converted. And we are converted because of our own personal experiences with wildlife. Are you promoting wildlife conservation because of some logical reason? Or are you active because you enjoy wildlife and believe intrinsically in the need for wildlife to exist and prosper?

If you ever visit Tucson, Arizona take a day – a full day – and explore the Sonoran Desert Museum. It is not a traditional institution of stuffed animals, but a zoo of native plants and animals set in the native Sonoran desert. In his book *Pebbles in Your Shoes*, Carr (1982) describes the underlying philosophy of this unique facility. If you have a pebble in your shoe, you pay attention to it, stop and admire it as you remove it. Maybe not admire it, but at least it gets your attention. The museum is designed to get the visitor to stop and look at all the native desert organisms. They do not house exotic animals; no elephants or giraffes here. Rather, they have a hummingbird house of native species, native cactus galore, desert mammals, both large and small, all showing the huge diversity of this part of the planet in an effort to get the visitor to stop and appreciate the variety of life around them. These pebbles can grow, just as if they were tossed into a pond, creating ripples that radiate outwards.

In *The Tipping Point*, Gladwell (2000) describes how little things can make a difference. He gives examples of events that have changed major directions of society; such events can also occur at the local, even personal, level. For example, on the Edmonton Christmas Bird Count in 1989, we had a city-wide public contest through our daily newspaper, *The Edmonton Journal*. First prize was a spring day of birdwatching with me at Beaverhill Lake, with lunch provided by the Westin Hotel, cooked on site by their staff. (And no, second prize was *not* two days birdwatching with me, as some colleagues suggested!) The weather on the chosen day was cold, wet and windy. The couple that won the prize were not birdwatchers, but they came anyway. We saw lots of birds and had a delicious lunch, and at the end of the day, I thought that was that. But little did I know the tipping point that was created for that couple on that day. The woman came up to me a few years later, reminded me who she was, and described how that day had changed their lives. They sold their condo in the city and bought an acreage which was now loaded with bird feeders. She quit her job, volunteered and then worked for a wildlife rehabilitation facility, and was one exam away from qualifying as a master rehabilitator. That day had changed their lives and she wanted to say thanks. A pebble in their shoe became a tipping point in their lives.

How many of us had such tipping points early in our lives? For me, it was the sight of a European Robin from a hospital window while recovering from surgery to remove tuberculosis-infected glands from my neck at the age of seven. Stutchbury (2007) describes how childhood observations of birds at her family cottage led to her career as a biologist and university professor. Other environmentalists have similar stories of childhood experiences. We should have more opportunities for

children to experience nature, to find a pebble in their shoe and create a personal tipping point in their lives.

At the 1986 conference, Dr Walter Moser, a retired botany professor from the University of Alberta, told the story of his project to save an Austrian woods from ski development. Town council was to vote on a re-zoning of the woods to allow the trees to be cut for a ski run. Rather than tackle the developer head-on, he took the local schoolchildren on trips to the woodlot. They wrote stories and poems about their experiences, and made drawings of what they saw. Dr. Moser then took those papers and published a book on the children's views of the woodlot and gave a copy to every school child. How could the town councillors vote to cut the forest when their own children were so attached to, and proud of, their book and the woodlot? They didn't, and the trees were saved.

Dr. Moser's presentation had an important conclusion. He described society and science as two wheels travelling though time (see Fig. 1 on page 42, Conference Wrap-up in these Proceedings). When two wheels going in the same direction touch, they grate against each other; the back of the lead wheel goes up while the front of the following wheel comes down. He argued that we need communicators, who function as a third wheel suspended between the two wheels. The three wheels then move in synchrony. The middle wheel represents communication between the scientist and the public, and provides the grease, or understanding, between the two sectors of our society, and all moves smoothly.

Have we lost our communicators? When I was a child, there were many live-in nature schools or camps, a place where students arrived on Monday and left on Friday after a week of immersion in nature. Do we still have those? Yes, but not many, especially when compared to the growing population of youngsters that grow up in cities with little or no connection to nature. We need children to grow up with binoculars as well as hockey sticks, and fewer violent computer games!

What else has slowed our progress in wildlife conservation, in my view? One issue is regulation and planning. When I was a teenager, a friend called and asked if I was available on the weekend; a shipment of Canada Geese was arriving in Toronto. A reintroduction of this extirpated species was to occur at Centre Island and they needed help to haul and open the cages. There was no fanfare, and I'm not sure what paperwork was needed but back then it would have been minimal, so we conducted one of the fastest and most successful reintroductions in Canada. Some would say that we overdid it. Near Long Point, when local farmer Brown expressed concern that his few geese might be shot, we produced a "Do Not Shoot Canada Geese" pamphlet and distributed them to motels and restaurants where hunters would gather. Farmer Brown's geese prospered, with no administrative paperwork.

Since the mid-1980s I have been lucky enough to be involved in the Peregrine Falcon recovery program (Holroyd 2003). A recovery plan was published halfway through the reintroduction effort (Erickson et al. 1988), not before reintroduction could begin. Now, 20 years later, we have never managed to finalize a second recovery plan as the format and content of plans has changed too frequently. Nevertheless, the recovery has been a success due to the effort of many committed agencies that pulled together without a published plan. The process to down-list peregrines began after the 2000 national peregrine survey but is still not complete after a decade of paperwork (COSEWIC 2007).

In October 2009, the Black-footed Ferret was released into Grasslands National Park and two adjacent private ranches. The recovery team met for five years to plan the releases. A huge paper exercise was needed to get permission from all levels of government and landowners before a small member of the weasel family could be returned to the Canadian prairies. This is a good news story, but not without its administrative paperwork delays and expenses.

As a final example, the Mountain Plover has been listed as endangered for over 20 years. Several recovery teams have met and are now disbanded; several recovery plans and strategies have been drafted and now gather dust. But I am not aware of one conservation action to benefit this species in Canada. We seem to be happy producing plans, but not implementing them. The need to develop too many plans becomes an excuse for inaction. When plans are finally drafted, then they are not funded and implemented. By that time, another plan is needed.

Granted, we need to know where we are going. If funds are to be spent, then there should be a plan of what will be funded and how. But if funds are not available, why create plan after plan? If there is no intention to implement a plan, then why draft it? I was once an eager drafter of plans, but after thirty years of drafting such plans, I realize the futility of most.

One positive example of planning was the North American Waterfowl Management Plan (NAWMP) signed by Canada and the U.S. in 1986 (NAWMP 1998). That plan was drafted by biologists and managers but was targeted at politicians and the treasuries of the U.S. and Canada. And it was successful, and is still funded and implemented by a collaboration of landowners, government and non-government agencies, and universities.

But the majority of plans have not and will not be funded directly. The recovery teams that develop the plans and then implement them do not have direct funding to allocate to priority activities. Each partner in the team accomplishes actions that are a priority to their agency. In this way, some actions do get accomplished. The plans can be quoted when applying for funds, but the plans are not funded directly. Ideally each plan would have a process to obtain direct funding to implement *all* of the actions in the plan.

If there was a major failing of PCAP, it was the lack of a funding plan to get it implemented. WWFC provided seed funds for four implementation committees to meet: one in each of the three Prairie Provinces, and one prairie-wide committee. The three provincial committees were formed by the provincial representatives of the Wild West committee, but the prairie-wide committee never met due to a change both in personnel and in perceived mandates in CWS. But none of the committees had a plan to get direct funding to implement their portion of PCAP.

Conclusion

The Prairie Conservation Action Plan, the series of 9 PCES conferences, and the three provincial implementation committees have been successful in bringing prairie conservation issues to the public forum and keeping them there. They have served as catalysts for action by many interested parties across the three provinces. There have been some spectacular results for individual species, especially in the reintroduction of extirpated species. But as the list of COSEWIC species gets longer, and prairie continues to be lost and fragmented, much remains to be done. The goals and actions of the original PCAP are still valid after 20 years and need to be pursued. A longer term view is needed to put more effort into education, especially environmental experiences for children, for they will inherit this world and will have to solve the problems that we leave behind. Finally, the relatively large tracts of prairie land that still exist in southern Alberta and Saskatchewan hold the last chance for prairie species, and every effort should be made to keep this land in its natural state. This will require a commitment by all levels of government, and by us, to make sure the original intentions of PCAP continue to be realized.

We need champions for conservation to keep working towards the goals of PCAP. We may not have reached the stars but we have landed on the moon, and need to continue our efforts to ensure prairie wildlife continue to exist. Think Globally, Act Locally.

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PLENARY SESSION 2 – DEALING WITH CHANGE

Conservation in the 21st Century

Brad Stelfox
ALCES Landscape & Land-Use Ltd.

Abstract – During the past century, the extent and integrity of North America's prairie ecosystems have been severely compromised. Future efforts to conserve what remains will require a new dialogue, one that helps stakeholders understand the fundamental existence value of these systems and the full suite of benefits (social, economic, ecological) that native grassland communities provide.

Drawing on data from Alberta's grassland ecosystems, the land-use drivers (agriculture, residential, transportation, energy, mining, recreation) that have shaped, and continue to shape, prairie ecosystems are discussed. Plausible future trajectories of these land uses will be identified, and their effects on prairie systems estimated.

Is there a lower limit on native grasslands that we do not wish to violate? Has that limit already been exceeded? The role of scientists and society in defining threshold values for the amount and quality of remaining grassland ecosystems remains elusive.

A case is made for a prairie conservation argument based on inherent existence value, maintenance of biodiversity, aesthetic appeal, water regulation (both quality and quantity) and storage of biotic carbon. The role of functioning grassland systems in a climate change future is stressed.

Most importantly, society must accept and understand the finite nature of grassland systems. We cannot continue to endorse growth trajectories for agriculture, mining, energy sector, transportation networks and urban sprawl, and expect native grassland systems to persist above minimum critical levels.

Niche Market Farming and Ecosystem Management

Don Ruzicka
Ruzicka Sunrise Farm

Abstract – Adapting to change has been the norm for our farm for the last 14 years. During this period, we have transitioned from a conventional way of farming to a niche market model. In an era where governments and agriculture have embraced global markets, our farm, located near Killam in east-central Alberta, has looked toward local markets to sell what we raise and grow.

This has led me to the conclusion that, as farmers, we have to understand and learn to manage ecosystems well. Conservation and stewardship are a few of the tools required to accomplish this task on the path to sustainability. I was fortunate to be able to learn about these tools by joining a watershed group. Our farm has benefited from the various partnerships that brought the message of awareness regarding watershed health to our community.

Another challenge has been to find consumers who support this way of farming. On the radar screen of many consumers, there is a growing concern regarding water quality and quantity, endangered species, local food, carbon sequestration, climate change, colony collapse disorder, biodiversity and many other issues. How do we entice these consumers to support conservation and stewardship? We have to feed them – not just great tasting, wholesome, healthy food, but also the importance of caring for the land.

We view the various species that frequent our farm as a barometer that let us know how well we are managing the land. Since 2004, we have noticed the arrival of species of concern, species at risk, as well as endangered species. If we can continue to attract and satisfy consumers, maintain and increase biodiversity, and make a living, it is indeed a win, win, win! In my presentation, I explain the journey that our farm is on, along with the many unexpected but necessary detours.

all photos by Marie Ruzicka

In many ways this highland cow is different from other cattle, just like niche market farming is different from other ways of farming. Most people would think that this cow cannot see very well, if at all. And, most would also believe that niche market farming wouldn't really make a difference to how one views the land. But this cow can see just as well as other cows. By changing from the industrial model of farming to a niche market way of farming has helped me to see and to understand the critical importance of managing ecosystems.

In this presentation, I will tell you about what we raise on our farm and the model that we use. I will explain what influenced our stewardship ethic, and introduce you to some of the people and partnerships that are the cornerstone of how conservation has been practiced. By adding stewardship as a value to everything that we raise, you will see some of the results that are happening on the land. Lastly, I will explain how important it is for consumers to support us with their food-purchasing dollar.

Marie and I learned many years ago that one cannot survive on an 800-acre farm growing grains and beef for the commodities market. Agriculture has become specialized, standardized, corporatized and industrialized. On our farm, this led to the draining of wetlands and clearing of bush over the years so that we could grow more grain and have more cattle. It seemed that the more efficient I became, the more damage I did to the land.

In our search to find another way, we took a course in Holistic Management in 1996 that taught us about the importance of farming in harmony with nature. It changed our life, how we farm and most of all, how we have come to view the land.

During the Holistic Management course there was a lot of talk about thinking outside the box. I also began to realize that just because you are changing or thinking outside the box, that doesn't mean you will be successful

or are on the right track. Will Rogers said it best: “Even if you are on the right track, you still have to move or you will get run over by the next train.”

We changed from a conventional way of farming to a grass-based, certified organic, niche way of farming. Our farmland is all certified organic with 600 acres seeded to grasses and legumes, along with 200 acres of native pasture, wetlands and bush. We raise a small herd of Angus, Galloway and Highland cows. They calve in sync with the seasons just like wildlife, in May and June. We also custom-graze cattle for other farmers and ranchers.

We raise chickens in shelters (below, upper left) that are moved ahead every morning to a fresh buffet of grasses, legumes, dandelions and insects. A self feeder of grain is provided in each shelter as well as a waterer. We also have a mobile turkey shelter (upper right) that is moved every morning, providing the same buffet as the chickens enjoy. The laying hens are also moved daily (lower left), and the egg yolks have a bright yellow glow that reveals the influence of eating forages.

One of the great joys that a pig has is to root, and our model allows them to do just that. The shelters (lower right) have two waterers and a grain self-feeder, and are moved ahead to fresh pasture twice a day. Pigs can’t sweat, so I provide a shower in each pen on hot days which makes for happy hogs. A rubber ball hangs from the roof of the shelter that they enjoy butting around. I’ve thought of using a football but as they are made of pigskin, I thought it best to avoid any undue suspicion as to what the future may hold.

The health benefits of poultry and livestock raised on pasture is that their meats have an increased amount of healthy omega # 3 fatty acids. All of the grain is purchased from off the farm, run through our poultry and hogs, and the land benefits from the manure. We direct market poultry, eggs, pork and beef from the farm gate. This allows us the opportunity to show our customers how and why we farm the way that we do.

The next influence on our farm and how it has evolved happened in 2001. A lady with a vision for a healthy watershed convinced a number of farmers and ranchers to start a watershed group in our county. We became reacquainted with the land in a way that made us realize that we are part of it, not above it.

This experience reminded me of the Amish culture. The Amish feel that they are a part of nature and when they damage the land, they compromise their relationship with their community as well as the Creator. When a salesman visits their community to see if they would be interested in some new technology or innovation, they listen to the

Movable animal shelters for (clockwise from upper left): chickens, turkeys, pigs, laying hens.

sales pitch. After he leaves, one of the elders of the community presents a question to the rest of the farmers. He asks, “How will this be good for our community or how will this affect our community?” They make their decisions based on the answers to this question. This way of thinking has influenced how our farm has evolved.

Three major partners brought the message of conservation to our watershed group. Cows and Fish (Alberta Riparian Habitat Management Society) taught us about the importance, health and function of riparian areas. Ducks Unlimited (DU) extolled the virtues of wetlands. PFRA taught us about water quality and quantity, soil conservation, and the importance of trees. By working closely with these organizations, the words “stewardship” and “conservation” crept into our vocabulary and our farm started to put forth a new face.

In addition, I happened to come across a few authors who also made me dig a little deeper into what influences a person to become concerned about stewardship. Edward O. Wilson, the world renowned biologist, tells us that we all have “Biophilia”, which means that we are hardwired to care for nature. However, we require some form of a catalyst to ignite the flame of stewardship. For me, Holistic Management was the initial catalyst that motivated me to start looking at the land in an entirely new way, and becoming involved in the watershed group was another important piece of the puzzle.

Aldo Leopold is another author that caught my attention when I read about his definition of a “Land Ethic.” He claims that it reflects the existence of an ecological conscience which in turn reflects a conviction of individual responsibility for the health of the land.

The awareness of the place in which we live and how we as farmers and ranchers can have a positive impact was continually reinforced by our watershed partners. They also started to teach us about the importance of biodiversity and how it contributes to sustainability. My land ethic started to take shape.

Here are some of the results of this influence. We have fenced our dugouts, creeks, wetlands and sloughs to keep cattle out of the water and to protect sensitive riparian areas. The undisturbed forages and trees surrounding the dugouts (below, left) stabilize the banks and filter the snow melt and water run-off.

We use a portable solar-powered water pumping system (below, right) to get water to the cattle. This is helping us to realize our goal of having the water that runs through our farm leave cleaner than when it entered. Wherever the cattle are, that’s where the water tank is. All of the manure and urine from the cattle is spread throughout the paddock as the cattle graze in a planned rotation throughout our pastures. The cattle realize better weight gains and have fewer health problems because they are drinking clean water. The average cost of fencing these dugouts was about $58 each. The investment in the solar pumping system has paid for itself, and then some, over the last 13 years.

Left: undisturbed vegetation surrounding fenced dugouts; right: portable solar-powered watering system.

Yogi Berra is one of my favourite contemporary philosophers. His quote "You can observe a lot by watching," is one that I have come to practice often. We noticed that after we fenced our 10 dugouts, dragonflies began to show up. Tall grasses, sedges and cattails surrounding the dugouts provide excellent habitat for them. In turn, dragonflies play an important role in our pest-control program, travelling back and forth from the pastures to the dugouts, eating grasshopper larvae as well as small grasshoppers and mosquitoes.

We partnered with DU on the wetland project shown below. I fenced the riparian area in 1997. Up until then, the cattle could drink wherever they wanted. There were no cattails, the creek banks were pugged and totally devoid of vegetation. Today, it is a great example of a wetland imitating an urban water treatment plant. The cattails and abundant vegetation within the fenced riparian areas are allowing the wetland to clean up the water as it passes through to the next user downstream.

Cows and Fish did a riparian health assessment of this area in 2001 – a report card that gives us an idea of the health of the riparian area. It scored 77%, which means it is "healthy but with problems". Five years later, in 2006, they returned to do another assessment, and the score was 84% ("healthy").

Eighty percent of all fish and wildlife spend all or part of their lifecycle in these sensitive areas. They are also convenience stores for migrating birds that need a place to rest and fuel up for their long journey. We graze these areas after mid-September, allowing a carryover of mature forages that provide a buffer to filter spring run-off and also provide wildlife habitat. The improved health over the five-year period was a direct result of the awareness that Cows and Fish, DU and PFRA brought to our watershed.

Left: DU wetland project; right: shelterbelt.

Although we have planted trees almost every year since moving to the farm, we made a major commitment to planting more trees in 2003. Since then, we have planted over 42,000 trees of 16 different varieties. We have planted two-row shelterbelts, one row of maple or ash and one row of berry bushes, around all five of our quarter sections. All of the trees are fenced off from livestock and cover a total area of about 55 acres.

The blossoms on shrubs such as choke cherry and wild rose (below) attract pollinating insects which in turn attract a variety of birds. If these birds decide to hang around for the summer and fall, they can snack on the fruits of the labour of various pollinators, such as choke cherries and rose hips. In turn, the bird droppings return nutrients back to the land.

Insects also pollinate the grasses and legumes in the pastures, as well as the plants in Marie's vegetable garden (below right). The garden reminds me often that every third bite of food we take depends on a pollinating insect. Albert Einstein claimed that if we lose our pollinating insects, we will have five years left before we run out of food.

Flowering shrubs attract the pollinators that much of our food supply depends upon.

Wildlife also use these treed corridors to move around our farm and to cross to neighbouring farms. The trees trap snow in the winter (below) and sequester carbon during the growing season. This translates into water in the spring which helps our pastures grow and also replenishes the aquifer.

Shelterbelt trees trap snow in winter.

Agriculture and Agri-Food Canada developed a plastic mulch program as a response to the Kyoto Accord goal to cut greenhouse gas emissions. Up until 2007, with every tree order they supplied plastic mulch to cover the ground in which the new tree seedlings are planted. The mulch cuts down on competition from weeds and conserves moisture. We source all of our trees through the PFRA shelterbelt program at no cost to us. In 2006 we planted six 1.2 acre plots of 16 different species of trees in 10 rows including conifers, deciduous trees and berry bushes – about 800 trees in each plot. These are wildlife habitat plantings and it is our hope that these new bushes will attract more biodiversity.

The county supplies the help to plant and, if needed, will also water them for the first time. It took a day and a half to plant these habitat plantings consisting of 5000 trees, and a day to put down one mile of plastic mulch. Within one week of planting the trees, Red Fescue and Cicer Milkvetch were seeded between the rows. Ground moles and gophers do not care for the roots of Cicer Milkvetch and wherever these plants are doing well, there are no moles or gophers.

Above, left to right: Planting trees; laying down plastic mulch; newly planted seedlings pulled through the mulch; four-year-old maple saplings.

Below left: Tree plantings after two years. Right: Red Fescue and Cicer Milkvetch planted between the rows discourage moles and gophers.

Erecting birdhouses was another goal for our farm, the purpose of which was to increase biodiversity. In 2001, I built 150 birdhouses and put 30 on each of our five quarter sections. The occupancy rate was 27% the first year and has risen steadily to 97% in 2009. This proves to me that "if you build it, they will come." We now have over 200 birdhouses.

Tree Swallow at nest box.

Some interesting things are happening regarding our commitment to providing homes for birds. When the grasshopper population got out of control in our area in 2002, we didn't have a problem on our farm. I noticed that a lot of our birdhouse residents were feasting on the larvae as well as the hoppers. As we all know, there are no free lunches and this is a great way for the birds to pay the rent for the housing.

Each morning when I move the chicken shelters, I notice the Tree Swallows fly around and pick up loose feathers. They take them to birdhouses or tree cavities and build nests for their young. A swallow is one of the most proficient insect eaters and feeds its young 10 to 20 times each hour. Swallows like flies in their diet so they are welcomed to help control the fly populations among our grazing cattle.

In 2009 we had about 160 houses occupied by swallows, averaging about 5 young each. Add a few dozen more that nested in tree cavities, and our farm has increased the swallow population by about a thousand birds.

Ever since moving to the farm, we have always had a few Mountain Bluebirds, but have noticed an increasing presence with the addition of the birdhouses. They consume terrestrial insects such as grasshoppers and grasshopper larvae.

For me, the adult bluebird below with her newly hatched family is an example of the powerful metaphor that nature provides regarding the importance of new life and caring. She had a total of 8 young ones with the first hatch and had another successful hatch later in the summer.

Mountain Bluebird and young in next box.

Meadowlarks disappeared from the farm in 1989. I never gave a lot of thought as to the cause. After completing the Holistic Management course in the spring of 1966, I started walking my native pasture and found an abundance of sage, yarrow and virtually no litter. I started putting some of the HM principles into place, such as resting some of the paddocks for a year, or refraining from grazing them until late fall. In the spring of 2000, after an 11-year absence, I heard my first meadowlark.

They returned because I started to manage our overgrazed pastures with a lot more care. Instead of grazing them like a golf course, I started resting them. This allowed the root system to develop and the canopy to grow and, in turn, created nesting habitat for meadowlarks *and* more productive pasture for the cattle.

One of the duties at which meadowlarks excel is consuming grasshoppers. Their cheerful song is the voice of the grasslands and enhances the spirit of the land. After 11 years of silence, it was a great feeling to give the farm back its most beautiful voice.

We welcome Red-tailed Hawks as their presence helps to keep the mice, vole and gopher populations under control. A mature mating pair usually raises two young and over the season they consume about 500 gophers. Great Horned Owls like to nest along our riparian woodlands and in areas with lots of shrubs. They also hunt mice, voles and pocket gophers.

Breeding pairs of Pileated Woodpeckers require a territory of about 100 acres of mature forest. They prefer dead and dying trees and enjoy a diet of ants and berries. We graze our native pasture and bush starting in mid-September. The lack of disturbance from grazing cattle in spring and summer creates an abundance of wild raspberries and saskatoons for their diet. They may also like the buffet that our shelterbelt berry bushes are providing. I used to cut dead standing trees for firewood. Since learning about their value to birds as a source of food and for nesting cavities, I now leave them standing.

We have a row of buffaloberry bushes in each of the six wildlife habitat plantings. The branches are covered with barbs, and since planting these bushes, we have noticed both Northern Shrikes and Loggerhead Shrikes showing up. They like to impale their prey on the barbs of the branches and also like grasshoppers in their diet.

Left: Dead standing trees are important wildlife habitat; right: buffaloberry shrubs provide thorns for shrikes.

You are probably noticing that many of the bird species I have mentioned like to eat grasshoppers and grasshopper eggs. Whenever we get into a drought situation, grasshoppers start to move in. We believe that the more birds we have that prefer grasshoppers on their menu, the better control we will have. E.O. Wilson maintains that the more species there are living in an ecosystem, the higher its productivity and the greater its stability to withstand drought and other forms of environmental stress.

Another important partnership and friend of our farm is Glen Hvenegarrd, Associate Professor of Geography and Environmental Studies at Augustana University in Camrose, which is about 50 minutes from our farm. In June 2004, Glen started coming to our farm to do annual surveys of the bird populations. He chose nine different areas on the farm that give a fairly good profile of the different ecosystems that are present. He does a ten-minute visual and audio study in each of the nine areas.

The first survey in 2004 yielded 40 species. Since then, the total number of species he has identified comes to 81 species. The highlight from the 2010 survey was a Marsh Wren, an indicator of a healthy wetland. Many of these species serve as a barometer that tells us how well we are managing our land and the various ecosystems. Glen has had a huge impact on how we have come to understand the land.

We usually hear a Sprague's Pipit in one of the 9 areas surveyed but have never seen one or even a nest. In 2010, we heard them in 5 areas but again, never saw them. A week after Glen did the survey, I stumbled upon two nests (see photo next page), and was able to solve the mystery as to why we had so many.

Because of a drought, our custom-grazed cattle had gone home early the previous summer. This resulted in more carryover of forage. By spring time, the dead grass, which had become a blanket of litter covering the ground, provided the Sprague's Pipit population with excellent nesting conditions. They are also fond of grasshoppers in their diet.

As our wetland continues to develop, more species of birds and waterfowl show up each year. Yellow-headed Blackbirds arrived in 2003 and have come back every spring since. Pelicans checked out the wetland in 2006 and are also repeat visitors. My understanding is that their presence is an indicator of a healthy wetland. Great Blue Herons also stand guard over the wetland and are often seen in the evenings along the shore or perched on the roof of our cabin.

Clockwise from upper left: nest with young Sprague's Pipits in pasture; American Badgers provide predator control; Yellow-headed Blackbird and American White Pelicans in wetland.

Gophers have become a major problem in pastures in many areas. Badgers are another important member of our gopher control program. There is no denying that the holes they dig do make a mess. However, these holes not only provide lunch for the badger, but also homes for Burrowing Owls and the Swift Fox. If badgers disappear from the landscape, strychnine may be one of the few remaining options for gopher control, which can have negative repercussions on wildlife.

Now you know a little bit about what our farm raises to sell to consumers and how the various partnerships have helped us to promote and maintain biodiversity by the way we manage the various ecosystems. I have also mentioned biodiversity many times. I never realized that, by making some adjustments and management changes, we would attract all of the various species that we have. Nor did I realize all of the services that they provide.

In 1997, Bob Costanza, an ecological economist from the University of Vermont, set an economic value on ecosystem services such as pollinating insects, nutrient cycling, etc. His estimate of the worth of these services was 33 trillion dollars annually, far larger than the human economy taken all together. These statistics shed a different light on the value of biodiversity. If we lose it, how much will it cost to get it back, and how much will it affect productivity while trying?

When I look back, it took:

- 11 years to bring the riparian area back to good health;
- 11 years to rebuild the habitat necessary to bring meadowlarks back;
- 6 years to go from 40 species of birds to 81;
- 9 years to go from 27% occupancy of our birdhouses to 97%.

If climate change is happening and drought is going to be the norm, I definitely would not be able to rebuild all of this in the same amount of time if I had to start over.

We have proven to ourselves that you can't purchase stewardship. The changes to our farm are a result of matching the farming model to the land rather than making the land match the model that I farmed with before. It's a cooperative, rather than competitive, way of farming. These stewardship efforts have been a lot of work and a major commitment, but I would have to say that this has been the easy part.

Our certified organic niche has been challenged by the major food chains. In the giant corporate grocery stores,

you can purchase foods that cost much less, have a convenience factor and are also certified organic. But are the farming practices from which they come sustainable? Do they speak about the value and benefits of conservation and stewardship? Demonstrating to consumers the importance of caring for the land is our # 1 challenge.

One advantage we have is that consumers are becoming more knowledgeable and concerned about issues such as climate change, local food, slow food, food security, water quality and quantity, carbon sequestration, peak oil, species at risk, biodiversity, sustainability, etc. Without their support, we simply cannot survive.

We have had to become less bashful and shy about our stewardship efforts, and more proactive. I will share a few examples of where this journey has taken us.

In order to market the food that we raise and grow, I have given a few presentations to church groups in Edmonton at their 100 Mile suppers. I always include an invitation to come for a tour of the farm. We also direct market to families who have formed Food Purchasing Cooperatives. Their priority is to source local food from farmers who are attempting to farm sustainably.

We feel that it is important to connect with groups like this. It presents us with an opportunity to explain that growing food and caring for the land has hidden costs. This has prompted us to work with some of our conservation partners and host days where people come to the farm and look at a different way of farming.

We partnered with PFRA and hosted a shelterbelt workshop in June 2009. The group toured the farm and viewed our various tree plantings, and we shared our mistakes as well as our successes.

We have built a dove-tail timber cabin, off the grid, that overlooks the wetland. It has become one of our favourite places on the farm. When people come for a tour or visit, this is the last place that we take them. If they choose to stay for a few days, we feel that there is a good chance that their biophilia will start to kick in. It is our hope that our farm can be a catalyst in helping them to develop the ecological conscience that Aldo Leopold described many years ago.

Left; PFRA shelterbelt workshop; right: off-the-grid cabin available for visitors to rent on our property.

The 60th anniversary of Aldo Leopold's book, *Sand County Almanac*, was in 2010. On the Leopold Centre website, I recently read about an 84-year old lady by the name of Lotus Miller. She learned about conservation from Leopold and was a student in his last class in 1949. She said that Leopold knew that if we were going to save wildlife we would need farmers on the land who understand these things. I believe that consumers, supporting farmers like Leopold describes, have the potential to make this happen.

Wes Jackson, another author that I hold in high esteem, calls industrial agriculture the "Failure of Success." Clearing wetlands will lead to growing more food, but in doing so, the ecosystem is destroyed. How many more can we sacrifice and will this lead to future generations not being able to feed themselves? Biodiversity gives spirit to the land, and I think we have discounted how much spirit that it gives to us, as a prairie people.

When managed well, the prairie ecosystem has the ability to sustain itself. If you get down on your knees and study a patch of native prairie, you will notice the abundant diversity. There are varieties of perennial grasses and legumes that continually renew themselves, provide fertility, accumulate ecological capital, control pests and diseases, and utilize water efficiently. I think that the prairie ecosystem is providing us with a diverse model of how we need to farm the land.

I enjoyed Trevor Herriot's latest book, *Grass, Sky, Song: Promise and Peril in the World of Grassland Birds*. He claims, and I quote, "that the survival of grassland birds depends not only on informed agricultural and governmental policies, but on our own individual choices

as consumers." I agree with all three, but I believe that consumers have the potential to make the most difference in the shortest amount of time.

When people ask me how they can help to affect change, I tell them to look at their grocery list. For starters, pick one item that you can purchase from a local farmer. Ask him or her how they farm the land, and if their values coincide with making the land more diverse and healthy, please support them.

Another challenge for farmers is that they need a way to become known to consumers. In summer 2009 we signed on with, and were inspected and certified by, Local Food Plus. They originated in Ontario and are certifying farms all across Canada. Their standards are:

- Employ sustainable production systems that reduce or eliminate synthetic pesticides and fertilizers and conserve soil and water;
- Provide healthy and humane care for livestock;
- Reduce on-farm energy consumption;
- Provide safe and fair working conditions for on-farm labour;
- Protect and enhance wildlife habitat and biodiversity;

This certification will help consumers find farmers who are committed to these five criteria.

I want to close with a quote from a very sage gentleman, Wendell Berry. Having met and visited with many of you over the last few days, I think that his quote will resonate well with you:

> *The care of the Earth is our most ancient and most worthy, and, after all, our most pleasing responsibility. To cherish what remains of it and to foster its renewal is our only hope.*
>
> ~Wendell Berry, Poet and Farmer

Blood Tribe First Nation: A Prairie Peoples' Commitment to Conservation

Paulette M. Fox
Natawawoahkaakii "Holy Walking Woman", Blood Tribe

Abstract – The prairie ecosystem has been a source of sustenance for millennia for diverse groups of First Nations peoples. The Blood Tribe (of the Blackfoot Confederacy) is known as the largest "reserve" in Canada; however, the traditional confederacy territory spans southeastern Saskatchewan, southern Alberta, extends into Montana and grips Wyoming. The ecosystemic diversity inherent to these regions contextualizes the dynamics of complex yet critical linkages inherent to the Blackfoot way of life over a vast landscape.

The Blood Tribe Land Management Environmental Protection division (established in 2003) is a result of grassroots-based guidance: elders and advisory groups in the community drive research in environmental aspects and participate in dialogues to continue to push the envelope in areas of climate change and biodiversity; youth partake as monitors of species at risk; students and technicians gather and input spatial and attribute data to support a baseline of water quality, target species, critical habitat and invasive species, among other things.

As the community faces challenges not unlike any other, it maintains a linguistic legacy linking the people to the landscape. Preserving the language is directly related to preserving the kinship between the people and the elements in nature. By extension, its relativity to conservation is both a blessing and a challenge.

Moving beyond boundaries and into trans-jurisdictional territory via *dialogue* is a current area of exploration. Dialogue fosters and facilitates a shift in perceptions, perspectives, and ultimately paradigms. It is arrived at by individuals interested in experiencing the cumulative effect of insight and illumination. At its essence, its purpose and intent is to embrace equanimity and equality. It takes time. It takes a shift in how we view time. It is time.

GUEST SPEAKER

Conservation and Tourism with Community Partners: Practices and Innovation in Experiential Tourism

Celes Davar
Earth Rhythms, Inc.

Abstract – *The Demand:* From local citizens, to local schools, to local conservation projects, and from travelers around the world, there is global hunger to take care of our planet – to find meaningful ways to make a difference. This is clearly visible in the volume and passion with which people view nature documentaries or take part in volunteer research adventures. Travelers are seeking out infectious stories of where and how they can make a difference. "Responsible tourism" and sustainable tourism all over the world is a response to this demand. Some of the most powerful beginnings and stories for making a difference come from those who work daily on the ground in research, conservation, and protection of species and spaces.

The Challenge: We live in times that require our creativity and capacity for developing new collaborative business and community models to get things done. Nowhere is this more critical than at local levels within our communities. We need to start looking at each other from our respective areas of expertise in Canada – conservation and science professionals as well as tourism professionals – and ask ourselves: how do we collaborate? Whether it is about climate change, water scarcity, food production, our wild spaces and species, or our practices of conservation, they need to be communicated through entirely new tools of "experience", communication (stories), and new collaborative initiatives.

The Obligation: At the heart of this new approach to collaboration between environmental scientists, resource conservation specialists and tourism operators, one thing is clear – we are past the point of working within our respective silos. We have an obligation to the citizens of our country to work together, engage them in our work, share our results in meaningful ways, and effect transformations in behaviour that enable ordinary people to become the champions of our emerging low-carbon economy.

The Opportunity: People love to travel. We have a tremendous opportunity to use this global passion for travel to craft new western Canadian travel experiences in which researchers and scientists are more accessible to ordinary citizens. This can be done through very simple techniques, by partnering with tourism operators who can provide the marketing and logistical shell and framework, with researchers and conservation specialists providing the programming. How we craft this partnership is the journey that needs to be assessed and developed. Assisting our researchers to open their research to be accessible, to tell their stories, and to be presented as part of a unique partnership with the tourism industry is the opportunity. We can then enable these powerful local stories to be transformed into personal actions, by travelers, as new ways to make a difference in their lives.

The Presentation: Using examples, rich media, stories, and provocative questions, Celes teases out this framework of collaboration and opportunity, helping to move us from the past tendency of presenting knowledge to a more active approach for our citizens and travelers to experience place, people, and ecosystems, helping to conserve our future.

CONFERENCE WRAP-UP

Moving Forward into a New Decade: Lessons Learned at this 9th PCES Conference

Geoffrey L. Holroyd
Environment Canada

The theme of this 9th Prairie Conservation and Endangered Species Conference was "Patterns of Change: Learning from our past to manage our present and conserve our future." The first day's speakers focused on patterns of change in our socio-economic and ecological environments, and on the second day we heard speakers on how to deal with change. The wide variety of stakeholders represented in the organizing committee and list of sponsors was evidence of the important role these conferences play in engaging a large cross-section of society. Producers, governments, aboriginal nations, universities and non-profit conservation organizations have all contributed to the success of this gathering.

A conclusion from the first day's sessions was that the only constant in the past has been change itself. We have ploughed most of the grasslands and cleared much of the aspen forest (Sather, page 2). This change has been driven by three intertwined forces – liberal democracy, social progress and economic growth – that began with Lord Selkirk's settlement, coincidently near the conference location at the forks of the Red and Assiniboine Rivers (Young, page 11).

The second day produced a number of tangible conclusions, unfortunately not all positive. We heard about creative initiatives to engage landowners, such as the MULTISAR program (Blouin, page 76), and to involve the public, such as experiential tourism (Davar, page 38). However, one disturbing story of misuse of poisons by some landowners and municipalities provided cause for concern whether any conservation message has reached some parts of society (Proulx, page 128).

In my opening presentation (Holroyd, page 17), I reviewed each goal of the original Prairie Conservation Action Plan (WWFC 1988) and conceded that we have not achieved many of them. The speakers at this conference provided fodder for supporting this conclusion. In 1986 we were shocked to learn that barely 1% of the original extent of tall grass prairie remains. Koper et al. (page 45) found that 37% of the native tall grass prairie that was present in 1987-88 was degraded or gone by 2006. I am not sure how many decimal places less than 1% are needed to describe the area of tall grass prairie left. That a third of the remaining prairie has disappeared after 25 years of conservation effort is discouraging to say the least. The status of butterflies and orchids that remain on the tall grass prairie is just as dire (Westwood, page 52). Species on mixed grass prairies are faring no better. In 1979, 13 of 21 grassland bird species for which we have adequate data were in decline on the prairies, but by 2007 *all* 21 species were in decline and 6 were listed by COSEWIC (Davis, page 52). Stelfox (page 26) questioned if the loss of native grasslands has already gone too far! Several speakers were unequivocal in their conclusion that prairie species, and the quantity and quality of prairie, are continuing to decline due to both direct and cumulative effects.

These declines are the product not only of local issues and attitudes, but also global economic pressures. Biofuels were named a few times as a new stressor on land use that has encouraged tilling of native prairie for otherwise marginal crops. Wetlands were once extensive in southern Manitoba but have been reduced from 11% to less than 0.1% of the land base in the Red River Valley (Goldsborough, page 62). In addition, we continue to lose wetlands as larger farming equipment makes small depressions inconvenient, and as drought leaves wetlands dry and available for cultivation. Ducks Unlimited, one organization concerned about the disappearance of wetlands, discussed the benefits of wetlands including flood and erosion control, carbon sequestration, air and water purification as well as wildlife habitat (Edwards, page 71). She suggested that wetland and water policies need to be changed to reflect these societal benefits. Venema (page 63) talked about "mal-adaptive drainage practices that have continued…unabated since initial European settlement – particularly natural wetland drainage, which reduces landscape heterogeneity and hydrologic buffering capacity, and is driven by production-oriented incentives…". Why, if wetland drainage is mal-adaptive, does it still continue? What market incentives need to be changed to save the last remaining wetlands? Stronger wetland protection is the subject of a recent technical analysis (Bartzen et al. 2010), and I suspect a similar case can be made for protection of uplands.

Advances in genetics are allowing us to realize the threats posed by the loss of genetic diversity, with declines in species at the edges of their range and threats

of hybridization with introduced species. There was little good news about the changes in prairie health. We may be approaching a tipping point for many species. We now see previously common species listed by COSEWIC as species at risk. While some species have been removed from the COSEWIC list in the past 25 years, far more have been listed since the first conference was held. We have done an excellent job of documenting the decline of prairie and prairie wildlife, but a less than stellar job of conserving the prairies.

The second day of the conference focused on current and future solutions to conservation issues on the prairies. The past 25 years of prairie conservation research has brought me into contact with many landowners, probably my best teachers during this time. They are the people who make the land-use decisions that affect most of the wildlife and habitat that this series of conferences encourages to conserve. What can we learn from these land managers to encourage prairie conservation? How do we combine this practical advice with the academic, bureaucratic and non-government perspectives that are a larger part of these conferences? Stewardship requires landowners and land managers to buy-in to the conservation message. As I shared coffee with one landowner in southern Saskatchewan, looking out his window at a pair of nesting Burrowing Owls, he asked me to explain the conservation message he had received in the mail, "Save Endangered Species Habitat". As a steward of a pair of endangered species, who or what are we saving his land from? To him, the message was an insult to his stewardship of his land; it neither acknowledged nor encouraged it. In my experience, many landowners actively care about the wildlife they observe, while others at least acknowledge the need to preserve biodiversity. But their actions are driven by market and financial needs, and government policies that support cheap food. Thus we need to find ways to support and reward stewardship activities by producers that benefit both wildlife and society in general.

To balance these demands on landowners, the move to quantify and compensate landowners through Ecological Goods and Services (EGS) programs was promoted as a way to encourage conservation action. While land-use decisions have conservation consequences, conserving wildlife and native prairie is only one of many issues that landowners must incorporate into their decision-making process. For example, how will demand for raw materials for biofuels affect native habitat (McCandless, page 73)? After considering on-farm socio-economic pressures, Unterschulz (page 65) concluded that environmental policies that maintain or increase EGS will slow productivity and reduce overall farm income. If this really is the future, then it is bleak. I have to hope that some EGS will contribute to farm productivity and if not, then compensation will be available to the landowner to maintain the EGS that benefit not only them, but all of society, as well as future generations.

A key land-use decision in prairie conservation is whether to cultivate native land, i.e., change the land use from grazing to crops. Armbruster (page 66) made the case that doing so degrades many EGS, impacting all of society, not just the individual landowner. Environmental Farm Plans under the federal Agricultural Policy Framework should provide one route to maintain and increase EGS while maintaining a viable agricultural economy (McFadyen, page 69). The costs to landowners and benefits to society of EGS need to be defined, therefore justifying compensation to the landowner for the net difference.

Within the spectrum of conservation tools is the development of Beneficial Management Practices (BMPs). Currently, the development of BMPs consists of interpretations of published literature and expert guesses about what is beneficial, particularly for wildlife where data is particularly sparse. BMPs must be flexible, and must be evaluated for their benefits and costs (Flaten, page 62). We should treat the health of the environment like human health: get the diagnosis right, then prescribe the right treatment. However, in the world of environmental health, many parameters interact. Getting the prescription right will be very difficult without experimentation. Having said that, I see little current experimentation to test the effectiveness of BMPs for wildlife conservation. More studies are needed to identify effective BMPs. Many landowners want to do the right thing while earning a living on the land, and they are looking for ideas how to create win-win land management activities.

One landowner family demonstrated the benefits they received from taking the initiative to improve the water quality and wildlife habitat on their farm while adapting to changing markets. The Ruzicka family (page 27) sells meat products to their customers while encouraging wildlife to return to their Alberta farm. They welcome and appreciate the arrival of endangered species, and do not fearmonger about government intervention because they are doing the right thing. This family has struck a balance between environmental and economic values that is benefiting all.

Another conclusion from this and earlier conferences is that planning by itself will not conserve prairie. Bureaucracies need plans to justify funding and action. Action committees and groups need plans to determine a common direction to their actions. Recently, IUCN (2008) produced a handbook on strategic planning that is a useful resource. But all too often, plans are treated as an end in themselves with no commitment to action, funding or resources. Some species have several provincial and

federal plans that are regularly re-written, with limited or no implementation of actions within the plans. In some ways, the 1988 Prairie Conservation Action Plan (PCAP) is an example. After the plan was published, no funding application was made nor resources specifically allocated for its implementation, with the exception of the 3-year Prairie for Tomorrow program in Alberta. PCAP did give rise to provincial committees that have continued to promote the implementation of the plan, as well as subsequent provincially derived plans. At the second conference, Monte Hummel cautioned that PCAP was just the beginning of conservation action, not the end result. He ended his paper "A plan means nothing if it is not followed through. So think of the PCAP as sexual foreplay; it only sets the stage for the real thing. I leave it with you." (Hummel 1989)

Several authors discussed how we need to better market the conservation message. Conservation of wildlife and their habitats will not be reason enough to change public policy. Conservation messages need to consider other relevant societal needs. One excellent example of the conservation message being accepted by landowners was provided by the Blood Tribe of the Blackfoot Confederacy in southern Alberta (Fox, page 37). The Swift Fox holds important cultural value to the Blood Tribe, and thus they supported and implemented the successful reintroduction of this once extirpated species back onto their land. The various environmental initiatives on their territory involved everyone, from elders to youth, on a variety of topics. Another example of creative marketing is the creation of experiential tourism in Manitoba (Davar, page 38). In this program, members of the public pay to join a researcher in field studies. They consequently gain a deeper understanding of conservation issues while funding both the interaction and in some cases the research itself. This program is somewhat similar to EarthWatch, which puts volunteers into research situations with funding coming from the volunteers. Experiential tourism allows people to learn about conservation issues firsthand, which will contribute to changing public opinion.

Stelfox (page 26) stressed the need for compelling, popularized science stories that will result in signals from the public to politicians for action. The public is inundated with messages about the needs of other sectors of society, but rarely does the prairie conservation crisis get media attention.

One opportunity for media coverage occurs every three years at this conference. Media packages should be compiled and local media contacted in the host city. Media contacts not only result in current articles, they also provide the media with a list of "who's who" for future stories. Many earlier conferences had a concurrent set of sessions consisting of lectures and stories about endangered species that were targeted at the public, media and especially teachers. These sessions provided an opportunity for anyone to learn the latest about particular species, and provided the basis for improved public understanding. At some conferences, in order to encourage the public and teachers to attend, these talks were free and did not require registration. I recommend future conferences consider these options.

While the need for better data was mentioned occasionally at this conference, as someone who has been involved in research and monitoring for 49 years, I can assure the reader that we will *always* need better data, better GIS and better models. But what we lack is action. While monitoring will continue to be better refined and more accurate, we have not made the same progress to promote conservation action. Dale (page 83) stressed the need to vigorously pursue conservation initiatives, and to not use the need for complete information as an excuse for inaction.

Research to better understand the past prairie environments has become more and more sophisticated. These studies provide insights into how we will have to adapt as the effects of climate change continue. While prairie habitat has always been dependent upon dynamic forces (fire, grazing, climate) to provide a mosaic of variable habitat for wildlife, cumulative human impacts on the small remnant prairies have resulted in less flexibility within the system to react to changes, human induced or otherwise. As a changing climate puts more stress on human endeavours, mechanisms to cope will directly affect native prairie and wildlife. There will be winners as well as losers. We should look for opportunities to obtain conservation benefits for native prairie during any turbulent times ahead. Change is often a time for opportunity and growth as well as a threat to the status quo.

In summary, the science is unequivocal: the prairies are going to hell in a handbasket (in other words, headed for disaster without effort or in great haste), and we seem incapable of making major changes in the direction of society in order to save the remaining prairie. I am not saying that we should not celebrate our successes. Like an investment portfolio in a declining market, one can celebrate the few stocks that are increasing, but the overall portfolio is in decline and no amount of celebration will change that. So what to do? McLachlan (page 104) provided food for thought by thinking outside the box. Involving indigenous youth (Swayze, page 109) and local stakeholders (Brook, page 114) hold promise for finding new ways to promote conservation action.

I return to the story told by Walter Moser in the second conference (Holroyd 1989) and noted in my plenary presentation (page 17). A graphic representation of his

ideas is shown in Figure 1. Science and society are rolling along together and wherever they touch, there is friction. The upward-moving surface of one wheel grinds against the downward-moving surface of the following wheel. A third smaller wheel is needed to make the transition from science to society and vice versa. Communicators, park naturalists, writers, musicians, media and others must fill this role. And I repeat the conclusion of John Livingston (1981) in *The Fallacy of Wildlife Conservation*: *logical arguments will not convince society to change its ways.* People need to experience nature, to have firsthand knowledge of wildlife, before they will factor wildlife needs into their daily decisions.

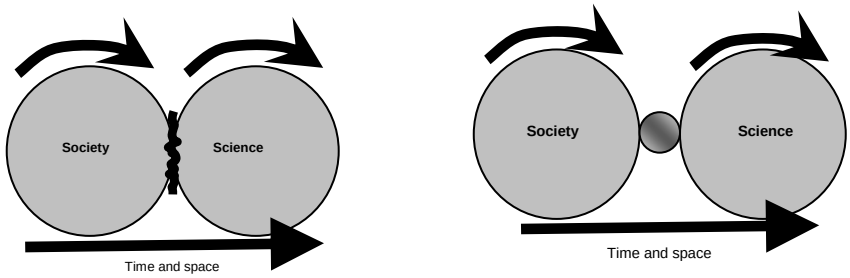

Figure 1. When science and society touch, friction results from lack of mutual understanding (left). When interpreters, communicators, poets, musicians, etc. work between science and society (right), they reduce or eliminate the friction as they communicate society's needs to science and sciences' discoveries to society.

The conference successfully presented the past and current status of the prairies, and the various solutions to conservation issues that are underway. Many speakers contributed to the dialogue about the loss of grassland habitats and species. However, what can be improved in the conference format? The first four conferences were actually workshops, while the last five have been a more typical conference format, with program time totally allotted to invited or submitted speakers. Earlier conferences included working sessions with speakers using the first half of the time, and the second half was a panel discussion that included the audience. The advantage of these sessions was that they brought new ideas and dialogue into the public arena. Using the framework of positive feedback, new ideas sparked by audience discussion were shared and improved by everyone. Workshop leaders were often able to document the new ideas from these discussions in an article for the proceedings. I have often heard that the best parts of conferences are discussions over meals and breaks, and sessions as described above are one way everyone can benefit from informal discussions. If we are to truly find new solutions to prairie conservation issues, we need to encourage new initiatives that involve everyone, not just those invited to speak.

And lastly, each of us needs to emphasize at every opportunity, to everyone everywhere and in every way, that every last remaining prairie grassland and wetland must be saved, and that the last remaining large pieces of prairie must be treated as if they are special. As special as if they took millions of years to make, and as special as something that can never be replaced. Try buying something like that at your local mall!

Think globally, act locally. See you at the 10th conference in Alberta in 2013.

Acknowledgements

I thank the organizing committee for producing a successful conference and for the opportunity to present this summary. In particular I thank Diane Kunec and the many volunteer scribes who took notes during the various sessions, and made the notes available to me to compile this article. I thank H.E. Trefry for constructive comments on earlier drafts of this article.

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WORKSHOP SESSIONS

WORKSHOP 1 – ECOLOGICAL CHANGES

Moderators: Cary Hamel, *Nature Conservancy of Canada – Manitoba Region*
Kristin Tuchscherer, *City of Winnipeg*

Workshop Summary

This workshop aimed to highlight the status of various aspects of prairie health by providing a snapshot of the current status of some of the ecological communities, species guilds and keystone species that comprise the Prairies Ecozone. The presentations highlighted changes in tall and mixed grass prairie, prairie herptiles, grassland birds, and prairie lepidopterans. Four main themes were brought forth throughout the course of the presentations – the overall decline in prairie habitats and species, the importance of management across the Prairies Ecozone, the need for data and information to make management decisions and the necessity of public awareness, knowledge and stewardship involvement.

Nicola Koper (page 45) examined changes in quantity and quality of patches of tall grass prairie over the past two decades. Overall there has been a decline in quality of tall grass prairie, although prairies managed by non-government organizations have increased in quality. Her research indicates that the quantity of prairie is declining: 23% of the prairie patches re-visited have been converted, 14% have been passively degraded, while 63% of prairie patches remain. Also of note, 66% of the remaining prairies are small, and from her research, small prairies are most likely to be converted. Additionally, many patches of tall grass prairie have declined to the extent that they require active management as they are no longer functioning ecologically. She also highlighted that the prairie ecozone has the most habitat conversion but the least protection.

A presentation by Stephen Davis (page 52) provided the status of both mixed grass prairie and grassland birds. Like tall grass prairie, mixed grass prairie has also declined and is being degraded. He also noted that there may be classification errors leading to gaps in the data, so there may be less mixed grass prairie than what the scientific community currently thinks. Grassland birds have declined greatly and their populations are at high risk for extirpation. He emphasized the importance of protecting guilds of avian species rather than focusing on species-specific management. He also emphasized that the status of grassland birds, while known to the scientific community, is not common knowledge in the general public. Promotion of this issue to the public may be key to slowing down this decline in grassland bird populations. Finally, he pointed out that the effects on grassland birds of new energy developments across the prairies are as yet unknown.

Discussion from Richard Westwood's presentation (page 52) highlighted the challenges in managing tall grass prairie patches. In his research at Manitoba's Tall Grass Prairie Preserve, management techniques that positively affect the Western Prairie Fringed-orchid can place two lepidopteran species at risk for extirpation – the Poweshiek Skipperling and the Dakota Skipper. The use of fire, haying and grazing as management techniques has different effects on these species. For example, managing the fire-tolerant Western Prairie Fringed-orchid along with the fire-intolerant skippers is a challenge. Essentially, heterogeneous management is key to species protection.

Finally, Andrew Didiuk (page 53) discussed prairie herptiles by stressing the lack of information about the status of reptiles and amphibians across the prairies. He mentioned that while there is sufficient information about certain species, there have been pulses of data over time as research focus changed. Overall, the general lack of, or gaps in, data would make threat assessments, environmental assessments and population monitoring very difficult, if not impossible, in some cases. He also emphasized the importance of monitoring by citizens though programs such as FrogWatch.

The Decline of Tall Grass Prairies in Manitoba

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Darcy C. Henderson
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Abstract – Tall grass prairies are critically endangered in North America. Our objectives were to evaluate potential roles of prairie patch structure in explaining changes in number, size, and quality of northern tall grass prairies over time. In 2006, we evaluated changes in remnant tall grass prairies at the most northern extent of the tall grass prairie range by resurveying plant communities in 65 remnant patches in Manitoba, Canada, that were previously surveyed in 1987 or 1988. In 2007 and 2008 we conducted more detailed surveys of vegetation structure and composition at 580 quadrats distributed within 24 remnant patches of northern tall grass prairie. Our findings suggest remnant northern tall grass prairies continue to suffer from serious threats: 37% of the patches surveyed in 1987 or 1988 had changed to other habitat types by 2006, and most patches, particularly smaller ones, declined in quality. Both native and alien species responded more strongly to distance-to-edge than to patch size or matrix type. Richness of native plants was negatively correlated with cover of alien species, suggesting that alien species may displace native species. Few existing northern tall grass prairies are likely to be self-sustaining, and immediate active management is required to prevent further loss of remnant northern tall grass prairies.

Note – This is a summary of the following publication: Koper, N., K.E. Mozel and D.C. Henderson. 2010. Recent declines in northern tall-grass prairies and effects of patch structure on community persistence. *Biological Conservation* 143: 220-229. The authors recommend readers cite this longer paper for most purposes, as it is more comprehensive than this summary.

Introduction

Prairies are among the most endangered ecosystems in the world, as they have experienced the most conversion, yet are the least protected of any biome worldwide (Hoekstra et al. 2005). Northern tall grass prairies have lost more than 97.5% of their historical extent, and as such are the most threatened of the North American prairies (Samson et al. 2004). Manitoba contains almost all of Canada's tall grass prairies, yet has lost a greater percentage of its tall grass prairies than any other state or province (Samson and Knopf 1994). Over 99% of the historical range of tall grass prairies in Manitoba has been converted to other cover types, usually agricultural (Samson and Knopf 1994). The status of remnant tall grass prairie patches in Manitoba is, therefore, of extremely serious conservation concern.

Revisitation studies are critical for evaluating long-term and ongoing changes in plant communities, as there may be particularly long time lags between land-use change and local population extinctions of plant species (Honnay et al. 2005). To evaluate recent changes in northern tall grass prairies, in 2006 we returned to remnant prairies that had been surveyed for an inventory and status assessment of Manitoba tall grass prairies in 1987 and 1988 (M. Latta, unpubl. data, 1993). We evaluated changes in remnant patch number, size, and quality since the original assessment. Although resurveys allowed us to describe changes over time in prairie patch number, size and a qualitative measure of patch quality, addressing the reasons for these changes required more detailed and quantitative sampling. We therefore augmented the 2006 revisitation study with compositional sampling of 24 prairie remnants in 2007 and 2008.

Quality of northern tall grass prairies may be affected by characteristics of patch structure, defined in our study by the size of the prairie patch, edge effects, and composition of the surroundings of the prairie patch. One measure of patch quality is the proportion of the prairie composed of native species (Cully et al. 2003). Small patches may be particularly vulnerable to invasion by alien species (Levine and D'Antonio 1999), but this pattern is likely to vary with the type of matrix in which the patch is embedded (Williams et al. 2005). Edge effects may also explain the effects of patch size and habitat fragmentation on species (Fahrig 2003, Honnay et al. 2005).

The objectives of the current study were to: (1) determine how the quality and extent of tall grass prairies in

Manitoba has changed between 1987/1988 and 2006; and (2) evaluate effects of patch size, distance from the patch edge, and surrounding matrix type on northern tall grass prairie plant community composition and structure.

Methods[1]

We define a prairie patch as an uncultivated tall grass prairie plant community surrounded on all sides by other cover types or land uses. A remnant prairie is a prairie that was once part of the original tall grass prairie that dominated the region. Distance to patch edge is the distance between a quadrat within the patch and the nearest patch edge. We defined alien species as species that were not present in North America prior to European colonization (Scoggan 1957).

In 2006, we surveyed 65 remnant prairie patches that had been surveyed in 1987 or 1988 (M. Latta, unpubl. data, 1993). An ordinal rank letter grade was assigned for each patch based on the grading guidelines described by the Manitoba Conservation Data Centre (Mansell 1995, Koper et al. 2010). To determine the quality rank of each patch, the surveyor recorded all plant species observed, land use (grazed, hayed), proportion of alien species, surrounding habitat types, and any evidence of anthropogenic disturbances. The same methods were used to evaluate prairie quality in the original 1987-88 surveys.

Additional compositional analyses were conducted on 24 prairie patches in 2007 and 2008. Six of the patches surveyed in both 1987-88 and in 2006 were used. An additional 18 remnant prairie patches provided a wider range of patch sizes, and therefore distances to edge, than were available from the patches originally identified by 1988.

Eleven patches were sampled only in 2008, 6 patches were sampled only in 2007, and 7 patches were sampled both years (different quadrats each year). Vegetation was sampled within clusters of 10 quadrats (each 0.2 x 0.5 m) nested in 20 x 50 m modified Whittaker plots (see Fig. 3 in Stohlgren et al. 1998), and between one to four modified Whittaker plots were in each patch. Percent foliar cover for every plant species was estimated visually, using a set of cover classes adapted from Daubenmire (1959).

To calculate the area of prairie remnants, in 2006-08, the surveyor walked around the perimeter of each prairie with a GPS unit. Waypoints were uploaded into ArcMap version 9.2 (ESRI 2007) and digitized into polygons that represented prairie boundaries. A Visual Basic for Applications script (VBA 2003) downloaded from the ESRI Support Centre (ESRI 2008) was used to calculate the area of the prairies. In 1987 and 1988, area was calculated from aerial photographs (J. Morgan, pers. commun., 2009).

Manitoba Forest Resource Inventory (FRI) land classification data (Forest Resources Management 2000) were used to determine surrounding matrix habitat types. In ArcMap, 500 m buffers were used to capture matrix habitat types adjacent to each remnant patch. The area of each matrix habitat type within the buffers was calculated using the VBA "calculate areas" script. Within each patch, minimum distance from each quadrat to the edge of the patch was estimated using another VBA script.

Statistics

We used logistic regression to determine effects of patch size (logarithm transformed) and quality on the likelihood of being degraded or actively converted. The letter grade for patch quality was converted to an ordinal scale to facilitate analyses, where A = 0, A- = 1, B+ = 2, etc., to D = 9. We used paired *t*-tests to determine whether patch quality and log(patch size) of each prairie changed between 1988 and 2006.

We used linear regression to determine whether change in patch quality was correlated with log(patch size), and to determine whether change in patch size was correlated with 1988 or 2006 patch sizes. We used a generalized additive model to model the nonlinear relationship between current patch quality and current patch size. We used ANOVA combined with Fisher's Least Significant Difference test to determine effects of land ownership on changes in prairie size and quality.

We used generalized linear mixed-effects (GLME) models to determine effects of patch size in 2006 (logarithm transformed), matrix type (proportion of forest, agriculture and grassland), and distance between each quadrat and patch edge, on community composition (proportions of native and alien cover, native and alien species richness (number of species), and total species richness), and on cover of individual species. Proportional response variables were arc-sin transformed. We used 24 remnant prairie patches and 580 quadrats for richness analyses. We used 22 patches and 560 quadrats for species analyses, as data were not available for two of the patches analyzed for the community measures.

We determined whether native species richness was correlated with richness and abundance of alien species at 2 spatial scales: the scale of the patch, and the scale of the quadrat (0.1 m^2). We used linear regression to determine whether native species richness at the patch scale

[1] For more detail see Koper et al. 2010.

was correlated with richness and cover of alien species. Because data were compiled across quadrats within patches (rather than using each quadrat as a sample unit, as in the GLME), we randomly selected a subsample of 20 quadrats per site, and discarded patches with fewer than 20 quadrats per site, to ensure relationships were not driven by number of quadrats per site (n = 19 prairies).

Results

Fifteen of the 65 prairies surveyed (23%) had been converted to another non-prairie cover type, while an additional 9 (13.8%) were severely degraded by invasion of alien species. Only patches less than 11 ha were converted to other habitat types.

There was a correlation between change in patch size and patch size in 2006, where patches smaller than 21.16 ha (CI = 8.37 - 33.35) tended to have decreased in size, while larger patches tended to have increased in size (β = 0.455, SE = 0.074, $p < 0.001$, R^2 = 0.442, n = 50). This resulted in a net increase of 67.8 ha (5.6%) in the total area of prairie among the remnant patches.

In 1987-88, remnant prairie patches ranged in quality from A to C-. In 2006, the same patches ranged in quality from B+ to D. Patch quality declined significantly between 1987-88 and 2006 (difference = 1.173, CI = 0.441 - 1.906, p = 0.002, n = 50). Smaller patches were more likely to decline in quality than larger ones. This pattern was more obvious when patch quality was compared with patch size in 2006 (β = 0.375, SE = 0.059, $p < 0.0001$, R^2 = 0.479, n = 50) than when compared with its size in 1987-88 (β = 0.333, SE = 0.110, $p < 0.033$, R^2 = 0.093, n = 50).

Change in prairie quality varied by landowner (p = 0.002). Only prairies owned by railways invariably declined in quality, significantly more than prairies owned by all other landowners ($p < 0.05$). However, this result may have been driven by prairie size, which also varied with landowner ($p < 0.001$; mean_{NGO} = 56.69 ha, mean_{gov} = 25.26, $\text{mean}_{private}$ = 21.92, mean_{rail} = 3.72).

Smaller remnant prairie patches were lower quality than larger patches (F_{npar} = 13.973, $p < 0.001$). The generalized additive model suggested that quality increased as patch size increased to approximately 50 ha, but there was no correlation between patch size and habitat quality above 50 ha (Fig. 1).

At both the patch and quadrat scale, richness of native species was negatively correlated with alien cover ($p <$ 0.031, Fig. 2).

More native species responded to distance to edge than to prairie patch size or matrix type (Table 1). Occurrence of alien species was equally likely to be influenced by remnant prairie patch size and distance to edge, compared with native species (Table 2). Alien species generally had a higher probability of occurrence per quadrat closer to edges.

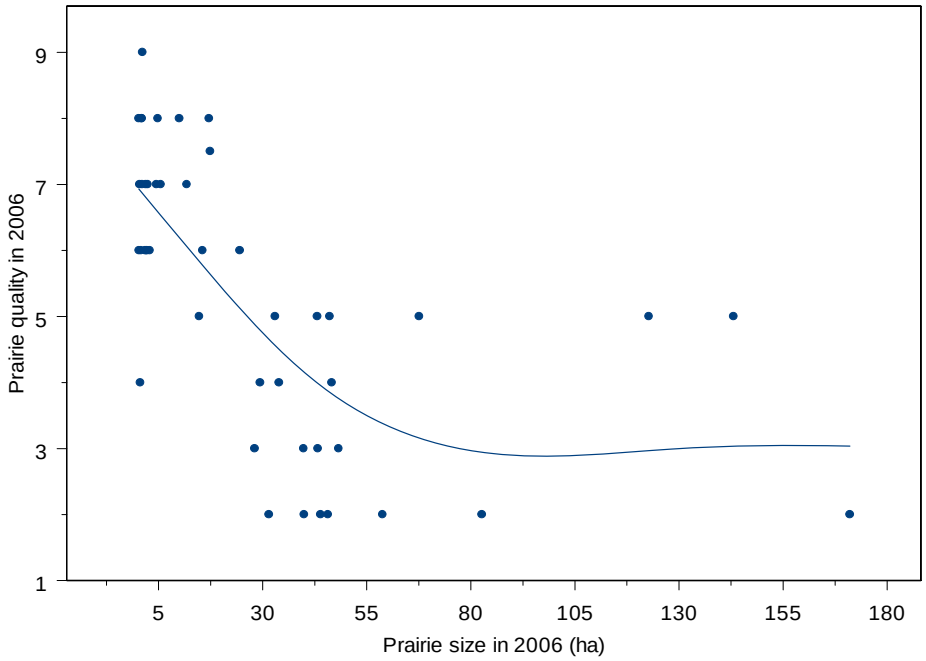

Figure 1. Generalized additive model of relationship between quality and size of tall grass prairie patches in Manitoba, Canada, in 2006. Lower numbers on the Y axis reflect higher quality, where 0 = A, 1 = A-, to 9 = D.

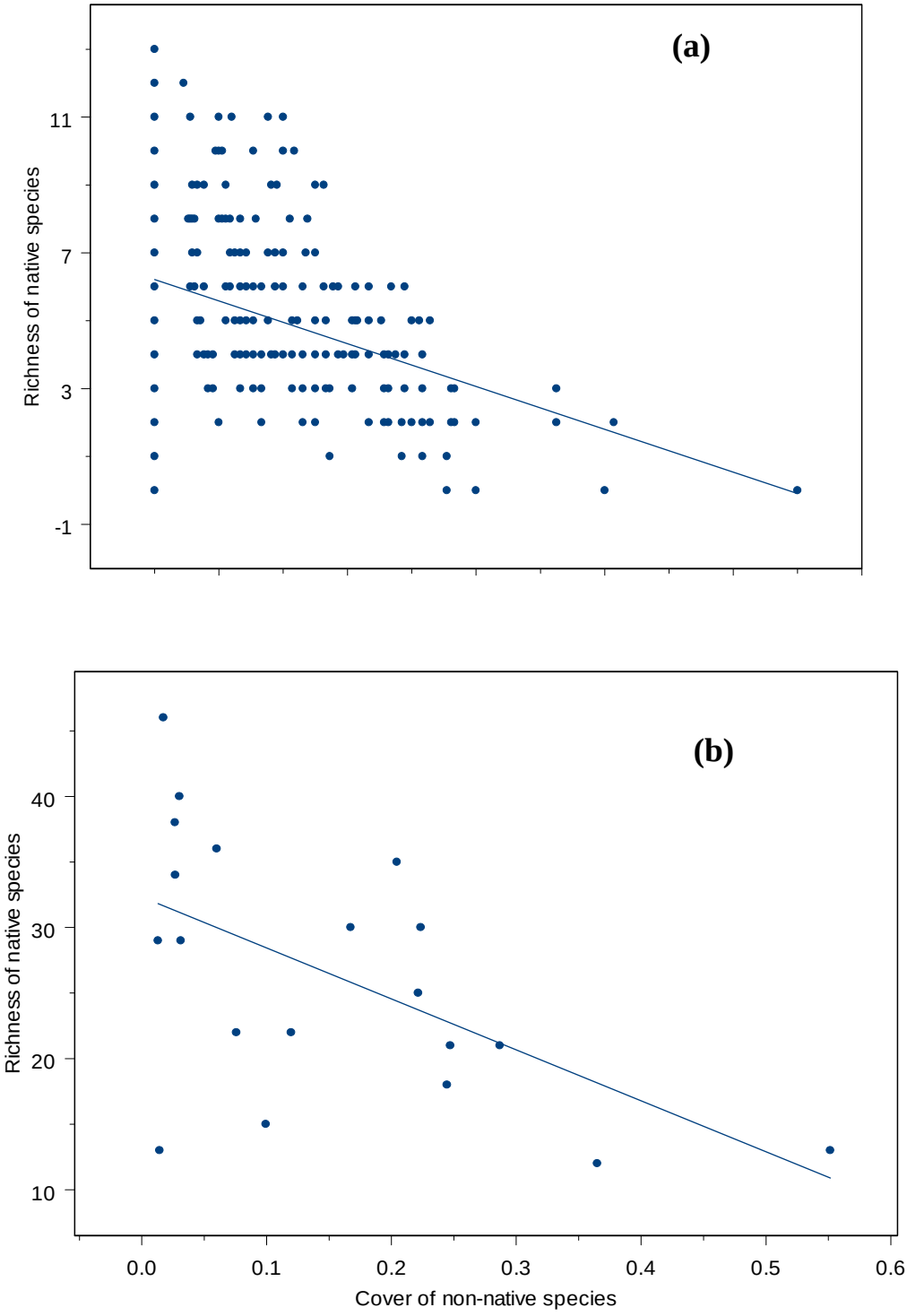

Figure 2. Effects of cover of non-native species on richness of native tall grass prairie species in Manitoba, Canada, in 2007 and 2008, at the a) quadrat, and b) prairie patch scales.

Table 1. Effects of prairie size, matrix type, and distance to edge on occurrence of native tall grass prairie plants in Manitoba, Canada, 2007-2008. Only significant results are shown. * indicates $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Year was included in the model as a nuisance variable, and was often significant. The model for Meadow Blazingstar did not converge.

Common name	Scientific name	Area (log ha)	Proportion agriculture	Proportion forest	Proportion grassland	Distance to edge (m)
Yarrow	*Achillea millefolium*					
Northern Wheatgrass	*Agropyron dasystachyum*	184.38**				1.006***
Common Ragweed	*Ambrosia artemisiifolia*					0.985***
Big Bluestem	*Andropogon gerardi*	0.170*				0.997*
Silverweed	*Argentina anserina*					0.995**
Reed Grass	*Calamagrostis inexpansa*		466.997*		514.541*	0.998*
Spike Rush	*Eleocharis sp.*		20658112.763**	183544407.844**	23819107407.890***	
Virginia Strawberry	*Fragaria virginiana ssp. glauca*		0.007*			
Northern Bedstraw	*Galium boreale*	3.940*				
Three-flowered Avens	*Geum triflorum*					0.986***
Beautiful Sunflower	*Helianthus laetiflorus*	0.098**				1.005**
Narrow-leaved Sunflower	*Helianthus maximiliani*			0.002*		
Baltic Rush	*Juncus balticus*	11.555***	82228929.696**	205773606.302**	212951947.752***	0.997**
Soft-leaf Muhly	*Muhlenbergia richardsonis*				1188.672*	
Canada Goldenrod	*Solidago canadensis*				0.028*	
Showy Goldenrod	*Solidago nemoralis*					0.993***
Stiff Goldenrod	*Solidago rigida*					1.003*
Cordgrass	*Spartina pectinata*					0.996**
Snowberry	*Symphoricarpos occidentalis*				0.003*	1.005***
Many-flowered Aster	*Symphyotrichum ericoides*					1.002*
Smooth Blue Aster	*Symphyotrichum laeve*					
Willow Aster	*Symphyotrichum simplex*					
Heart-leaved Alexander	*Zizia aptera*			0.0002**		1.004**
	Number that responded	5	4	4	6	14
	Proportion that responded	0.22	0.17	0.17	0.26	0.61

Table 2. Effects of prairie size, matrix type, and distance to edge on occurrence of alien plants in tall grass prairies in Manitoba, Canada, 2007-2008. Only significant results are shown. * indicates $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Year was included in the model as a nuisance variable, and was often significant.

Common name	Scientific name	Area (log ha)	Proportion agriculture	Proportion forest	Proportion grassland	Distance to edge (m)
Redtop	*Agrostis stolonifera*					0.997**
Smooth Brome	*Bromus inermis*					
Canada Thistle	*Cirsium arvense*					0.991**
Sheep Fescue	*Festuca ovina*					
Black Medick	*Medicago lupulina*	224.752**				0.997**
Perennial Sowthistle	*Sonchus arvensis*					
Common Dandelion	*Taraxacum officinale*	11.953**	0.005*		0.004*	1.003**
Red Clover	*Trifolium pratense*					0.968**
	Number that responded	2	1	0	1	5
	Proportion that responded	0.25	0.13	0.00	0.13	0.63

Discussion

Tall grass prairies represent an extraordinarily threatened ecosystem, and their threats continue today. We documented substantial recent declines in the number and quality of northern tall grass prairie remnants over less than two decades, and found that smaller prairies were particularly vulnerable to extinctions and declines in quality. Conversely, larger patches (>21 ha) tended to increase in size. Correlations between prairie size and quality may occur partly as a result of edge effects, but perhaps also because larger patches are more likely to have been subject to restorative treatments.

Because the cumulative area of northern tall grass prairies increased slightly over the last two decades, this provides some hope for conservation, as amount of habitat may have a greater effect on species conservation than habitat configuration (Fahrig 2003). However, it remains of great concern that most remnant tall grass prairies in Manitoba remain at risk. Small remnant patches may play an important role in species conservation by increasing stability of metapopulations (Foppen et al. 2000), decreasing isolation (Steffan-Dewenter and Tscharntke 1999), and functioning as stepping stones (Urban and Keitt 2001). If these mechanisms are important, loss of small prairies over future decades may compromise the survival of the remaining northern tall grass prairies.

Alien species were more likely to occur closer to the edge of patches, while the responses of native species to edges were positive, negative or neutral. Some reductions in native species near edges may be due to competitive exclusion by alien species (Henderson and Naeth 2005), while the patterns of both positive and negative responses of natives could be due to a variety of abiotic and biotic changes in the edge environment (e.g., Artz and Waddington 2006). Patch size and matrix composition affected a few individual native species, but we found no trend that suggested that agricultural fields functioned as a source, and forests as a barrier, to alien species invasions. Alien species may displace native species in northern tall grass and other prairie ecosystems.

Alien species seem to establish themselves at the edges of prairies, then spread inward from the patch edges. Edges may provide the foothold required to allow a population of an alien species to establish and thrive (Parker et al. 1993), which may result in declines in prairie quality over time. Managers of remnant prairies should not be complacent about the higher quality of large patches, as this may represent an extinction debt (Tilman et al. 1994), while the dominant edge effect of alien invasions continues to insidiously reduce cover and richness of native species. Given the evidence of both recent changes over time, and observed effects of patch structure on native and alien species, it seems probable that most remaining northern tall grass prairies are not self-sustaining or likely to persist over time. Overall, active management is clearly needed to conserve remnant patches of a once larger and contiguous North American ecoregion.

Acknowledgements

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Prairie Canaries: Are the Warning Songs of Grassland Birds Falling on Deaf Ears?

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Canadian Wildlife Service

Abstract – Read any article on grassland birds published in the past 10 to 15 years and you will encounter a sentence stating something to the effect, "Grassland birds show the most consistent, widespread, and steepest decline of any group of birds in North America". Although this statement has become somewhat of a cliché, like most clichés, it succinctly and accurately summarizes the situation. From 1966 to 1979, 13 of the 21 species adequately monitored by the North American Breeding Bird Survey in Canada experienced population declines. Unfortunately the situation has not improved since the first Prairie Conservation and Endangered Species Conference. From 1980 to 2007, all 21 species have been in decline and 6 are currently listed by COSEWIC; the status of several others are under review. Most alarming is the fact that the current conservation crisis facing grassland birds has largely gone unnoticed in Canada. The Canadian public is likely more aware of the loss of biodiversity in the Amazon than that on the Canadian prairies. I examine factors influencing grassland bird populations, identify current threats, and discuss opportunities and challenges for grassland bird and prairie conservation across prairie Canada.

The Future of Threatened Butterflies and Orchids in Manitoba's Tall Grass Prairie

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Abstract – Critical habitat for unique prairie plants and animals continues to shrink in North America due to conversion of natural prairie ecosystems to agricultural crop and range land. Tall grass prairie is considered the most biologically diverse and productive type of prairie grassland. Within Manitoba, tall grass prairie once covered over 6,000 km^2 in the south-central portion of the province prior to western European settlement, but now, remaining tall grass prairie remnants are confined to approximately 2000 ha. These few isolated remnants require some level of management to maintain healthy populations of native plant and animal species, and to prevent overgrowth by trees and shrubs and invasion of exotic plant species. While it is not always possible to closely mimic natural disturbance regimes, management techniques include controlled burning, use of domestic grazers, and mowing and haying. Given the small size of remaining tall grass prairie habitats, these activities can negatively impact populations of certain prairie plants and animals. This study examines the effects of management techniques on survival of three endangered/threatened species (two butterflies and an orchid): the Dakota Skipper (*Hesperia dacotae*), the Poweshiek Skipperling (*Oarisma poweshiek*) and the Western Prairie Fringed-orchid (*Platanthera praeclara*). Each species reacts differently to management techniques, and activities that positively affect one species often negatively influence the population stability of the other species.

Amphibian and Reptile Conservation in Prairie Canada: Knowledge and Engagement

Andrew Didiuk
Canadian Wildlife Service

Abstract – Knowledge of amphibian and reptile ecology and their conservation needs in prairie Canada was fairly limited until the 1980s compared to knowledge of other taxa. Since then, there has been increasing activity in research programs, albeit with a recent focus on species considered to be at risk. There has been a concurrent increase in reporting of this knowledge, supplemented by status review reports, recovery strategies and action plans in recent years. Regulatory considerations were quite general until the advent of species at risk legislation, when additional protection for some species has been applied, including the federal *Species at Risk Act*. Engagement in conservation through stewardship programs, with a focus, or at least a partial focus, on amphibians and reptiles has been very limited with some recent exceptions. Most conservation actions have been indirect, through more general wetland and upland habitat conservation programs. Outreach programs have occasionally been a component of stewardship programs, and increasingly amphibians and reptiles have been included in conservation media products. A variety of monitoring programs have been initiated, with varying success. The trend of conservation status of amphibians and reptiles is presented, with linkages to past, present and possible future efforts in obtaining knowledge and engaging in stewardship.

WORKSHOP 2 – CHANGES IN THE PHYSICAL ENVIRONMENT

Moderators: Tracy Maconachie, *Ducks Unlimited Canada*
Carol Scott, *Manitoba Conservation (retired)*

Workshop Summary

Settlement history on the Canadian prairies may be short (about 200 years) yet the magnitude of change in the natural landscape as a result of settlement is vast. This workshop described past and projected future changes in the physical landscape, particularly wetlands, and identified policy issues to address negative impacts.

Droughts occur on the Canadian prairies every year, but not necessarily everywhere as the pre-historical record reveals. Dave Sauchyn (page 55) stressed the importance of knowing the extent of natural variation before trying to identify man-made changes. Knowing that the salinity of lakes changes with lake levels and that diatoms vary depending on salinity, he analyzed lake sediments as a proxy to identify past moisture regimes at a gross level. Tree-ring analyses refined those estimates, providing an absolute annual chronology. Research focused on the eastern Rocky Mountain area, which supplies 80% of prairie water. He reported an approximate 65-year wet/dry cycle for severe droughts, but noted that three severe droughts had once occurred within a single 100-year period. He asked: what might be the economic and policy implications of these findings?

Gordon Goldsborough (page 62) addressed the historical (settlement) period with a focus on Manitoba. He noted that Manitoba has abundant wetlands in the north, but settlement has been primarily in the south. Wetlands comprised 11% of the southern landscape in the 1870s, but are now reduced to less than 0.01% after continued drainage to increase agricultural lands, with the concomitant loss of ecological goods and services. Concentrating on the drainage history of Big Grass, Oak Hammock (St. Andrew's Bog) and Netley-Libau Marshes, he noted that public opinion is shifting to value wetlands. He cited the provincial government's 2008 Throne Speech, which announced a new Wetlands Protection and Restoration Initiative, as a basis for hope.

A critical and provocative analysis of "best management practices" in agriculture was the subject of Don Flaten's presentation (page 62). Addressing the issue of phosphorus in run-off, he observed that on the prairies, most run-off results from snow melt, not precipitation-triggered erosion. Many practices recommended for the Canadian prairies are tested elsewhere, and are unsuccessful in reducing phosphorus in run-off, and in some cases, may actually increase it. He stressed that environmental health should be treated in the same manner as human health issues – on a case-by-case basis. To ensure success, best management practices need to be validated for local conditions, and evaluations must include a full suite of environmental benefits and liabilities, rather than focusing on a single environmental criterion or on economics alone.

Hank Venema (page 63) examined climate variability, attempting to assess possible sources of landowner and community adaptability and resilience. Building on the findings of the previous three speakers, he was critical of extensive drainage on the prairies that accompanied agricultural development, without regard for, or perhaps knowledge of, the ecological goods and services provided by wetlands. The Prairie Farm Rehabilitation Act (PFRA) was a positive response to intense drought. He noted that some adaptive approaches, such as minimum and zero tillage, are becoming more widely accepted but that a huge extension effort was required. With the likelihood of increased drought arising from climate change, extension efforts by a variety of institutions must be increased, not be cut back. He stressed that we must rethink water drainage and storage to cope with an increasingly irregular water supply across a longer growing season. A wetland policy change is needed as insurance against increasing drought, and agricultural policy in Canada must reflect urgent adaptation priorities.

All four speakers agreed that significant drainage had been a product of settlement on the prairies, with detrimental results for the environment accompanying increased agricultural production. Drought is more frequent than once thought on the prairies and projected to increase with climate change. Fundamental changes in attitudes to drainage and water storage will be needed to prevent large-scale disruption and economic loss.

Patterns of Past Climate on the Prairies

Dave Sauchyn and Suzan Lapp
Prairie Adaptation Research Collaborative, University of Regina

Abstract – Because some climate cycles are as long as or longer than weather station records, proxy data are required to capture multi-decadal cycles and the full range of climate extremes. Paleoclimate data for past millennium reveal the internal climatic variability that will underlie the trends imposed by global warming. A climate signal is preserved in biological and geological archives where the distribution of terrestrial and aquatic ecosystems and rates of biophysical processes are sensitive to changes in climate. The postglacial climate history of Canada has been reconstructed largely from the plant and animal remains preserved in lake sediments and from the source and age of surficial deposits such as sand dunes. The only proxies with annual resolution are varved lake sediments and tree rings, both of which are lacking from the Prairies Ecozone. At the PARC (Prarire Adaptation Research Collaborative) Tree-Ring Lab at the University of Regina, we have collected tree rings from more than 100 sites that surround the Prairies Ecozone. At these dry sites, annual tree growth is moisture limited and therefore a signal of water availability. The tree-ring chronologies provide a history of prairie hydroclimate, including quasi-periodic wet and dry cycles that vary in intensity and duration. The most prolonged and severe droughts occurred during the several centuries preceding the settlement of the prairies.

Introduction

Because the duration of some climate cycles exceeds the length of most weather station records, longer time series of proxy climate data are required to capture these multi-decadal cycles and the full range of long-term conditions (St. George and Sauchyn 2006). Climate signals are preserved in biological and geological archives where the distribution of terrestrial and aquatic ecosystems (Hogg 1994) and rates of biophysical processes (Vance and Wolfe 1996) are sensitive to changes in climate. This paper provides an overview of past changes in the climate of the Canadian prairies region with a focus on recent studies of the past millennium. We also present reconstructions of climate moisture from a network of moisture-sensitive tree-ring chronologies to map the pattern of hydroclimatic variability since 1500.

The Prairie Climate of Past Millennia

In the prairies, changes in climate are recorded in the shifting of vegetation, fluctuations in the level and salinity of lakes, patterns in tree rings, and the age and history of sand dunes (Lemmen and Vance 1999, Vance and Wolfe 1996). In this dry environment, where vegetation and surface processes are linked to the surface and soil water balance, most proxies are records of hydroclimate.

Most of the paleoclimatic records from the prairies region are derived from lake sediments. Recently, the continuous sampling and precise dating of lake sediments at fine intervals has yielded time series of higher resolution for the past several millennia. Diatom assemblages from prairie lakes show multi-centennial shifts in moisture regime (Michels et al. 2007, Laird et al. 2003). A marked shift from dry to moister conditions occurred near the end of the Medieval Climate Anomaly and the onset of the Little Ice Age; i.e., about 800 years ago at Chauvin Lake and about 670 years ago at Humboldt Lake (both lakes in central Saskatchewan). Using paleo-environmental information from the Peace-Athabasca Delta, Wolfe et al. (2008) determined that the levels of Lake Athabasca have fluctuated systematically over the past millennium. The lowest levels were during the 11th century, while highest lake levels coincided with maximum glacier extent during the Little Ice Age.

The frequency and duration of dry periods has been inferred from the age and history of sand dune deposits (Wolfe 1997). The regional reactivation of a dune field requires a dry period lasting several years to decades (Vance and Wolfe 1996). The lake and sand dune records indicate that early in the postglacial period the climate was generally warmer and drier than today, culminating in the mid-Holocene warm dry 'climatic optimum', when dune activity was so extensive that evidence was not preserved (Wolfe et al. 2002). From the precise optical dating of quartz grains, Wolfe et al. (2001) identified a widespread reactivation of sand dunes about 200 years ago and correlated this geomorphic activity with tree-ring records of prolonged drought during the mid- to late-18th century. There was a lag between peak dryness around 1800 and the onset of dune activity at about 1810. Dune stabilization has occurred since 1890. The droughts of the 1930s and 1980s were insufficient to renew dune activity.

Tree rings are the source of both climate information and an absolute annual chronology. At dry sites, tree growth is limited by available soil moisture, enabling the reconstruction of hydroclimatic variables: precipitation (Watson and Luckman 2004, 2005a), streamflow (Axelson et al. 2009, Case and MacDonald 2003, Watson and Luckman 2005b), forest fire frequency and area burned (Giardin and Sauchyn 2008) and drought (Giardin et al. 2006, Sauchyn and Skinner 2001, Sauchyn et al. 2003, St. George et al. 2009). A common conclusion of the paleoclimate research on the prairies is that the climate of the instrumental period is representative of the longer-term frequency of one- to two-year droughts but does not capture the full range of intensity and duration. The dry periods of greatest severity and duration occurred before the prairies were settled. These include the intense drought years of the 1790s (and the sand dune activity described above) and the sustained drought of the 1850-60s. The severity and timing of these droughts is corroborated by historical observations. In May 1794, low water levels in the North Saskatchewan River prevented the shipment of furs from Fort Edmonton, and in 1859, John Palliser described the Canadian plains as "forever comparatively useless" (Sauchyn et al. 2003). Thus tree rings and other climate proxies suggest that the climate of the 20th century was relatively favourable for the settlement of the prairies, as it lacked the sustained droughts of preceding centuries, especially since the 1930s. Tree-ring and archival records from Manitoba (Ferguson and St. George 2003, Blair and Rannie 1994, Rannie 2006, St. George and Nielsen 2002, 2003) have highlighted the recurrence of wet years and flooding, and point to a contrast in climate between the western and eastern prairies.

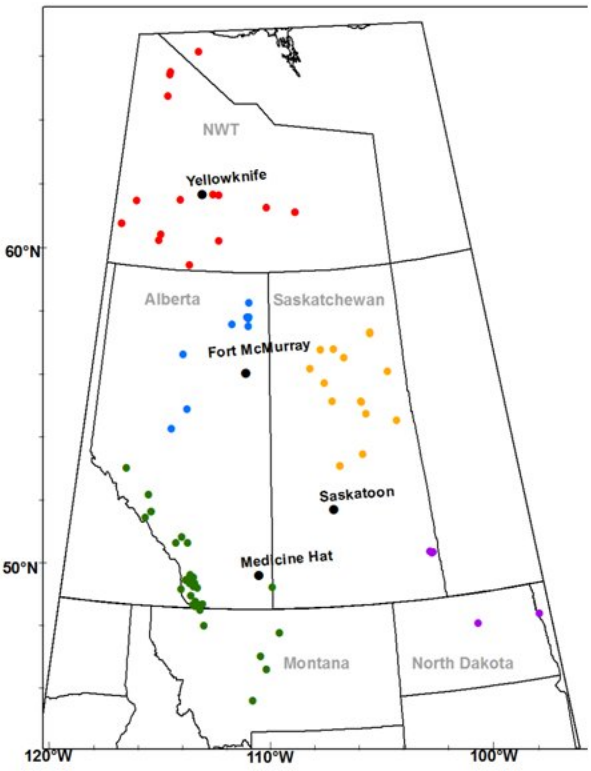


Figure 1. The network of tree-ring chronologies spanning the boreal, montane and island forests of Alberta, Saskatchewan, Northwest Territories, eastern Montana and western North Dakota. Sites are colour-coded by regions and similar forest.

The Pattern of Prairie Hydroclimate since 1500

A major limitation of paleoclimate research is the uneven geographic distribution of the records dictated by the locations of suitable natural archives. The major advantages of tree rings as a climate proxy are the absolute annual resolution and widespread distribution of trees. Researchers from the PARC (Prairie Adaptation Research Collaborative) Tree-Ring Lab at the University of Regina have collected tree rings from more than 100 sites across the boreal forest of Saskatchewan, Alberta and the Northwest Territories, the montane forest of the Rocky Mountains and island forests of the northern Great Plains (Fig. 1). This network of tree-ring sites enables the reconstruction of past annual climate over a large area that encompasses the Prairies Ecozone. Because the western interior has a dry climate and the tree rings are from dry sites (south- and west-facing slopes, sandy soils, ridge crests), there is a strong correlation between the moisture-sensitive tree-ring chronologies and a climate moisture index (CMI) of precipitation minus potential evapotranspiration (P-PET). We calibrated standardized tree-ring data using a gridded historical (1901 to 2000) climate model and reconstructed the CMI for each grid cell from the nearest tree-ring records as described below.

Climate Data

We used the climate moisture index (CMI) as a measure of effective precipitation (P) in excess of water loss by evapotranspiration (PET). The CMI can be evaluated over large regions where historical climate data are limited to temperature and precipitation. CMI values are meaningful biogeographically; for data from 1951-80, a zero CMI (P=PET) defines the southern boundary of the boreal forest, and the boundary between aspen parkland and grassland corresponds to a CMI of negative 15 (Hogg 1994). Hogg (1997) simplified the Penman-Monteith method of estimating PET so that the only input required is the altitude of the station and the mean maximum and minimum temperature for each month. Monthly precipitation and temperature data were obtained from the baseline observed historical gridded (0.5°) climate data generated by the Canadian Forest Service (McKenney et al. 2006). Elevation data, from the North American HYDRO1k digital elevation model

of the U.S. Geological Survey at a resolution of 1000 m, were re-gridded to coincide with the 0.5° historical gridded climate data. The monthly PET index is calculated as:

For Tmean > 10°: PET = 93 D exp(A/9300)

For 10° > Tmean > - 5°: PET = (6.2 T + 31) D exp(A/9300)

For Tmean < - 5°: PET= 0

where PET is in mm month^{-1}, Tmean is the mean monthly temperature (°C), D is vapour pressure deficit (kPa) [D = O.5(e_{Tmax} + e_{Tmin}) − e_{Tdew}], A is station altitude (m), and e_{Tdew} is equivalent to the saturation vapour pressure at 2.5°C below mean minimum temperature.

Tree-ring Reconstructions of CMI

Late spring / early summer precipitation and the May-June-July (MJJ) CMI correlated best with standardized ring-width data. The index chronologies from 93 sites were constructed by first detrending the time series in the program Arstan using a 100-year cubic spline with a 50% frequency cutoff (i.e., half of the signal at a wavelength of 100 years is lost; all of the signal at frequencies of ~32 years and shorter would be expected; and essentially none of the variability at frequencies longer than ~315 years). Expressed Population Signal (EPS; Wigley et al. 1984) was computed as a function of mean inter-tree correlation and sample size, and an EPS equal to or greater than 0.85 was the threshold for truncating chronologies past a sample depth providing a reliable chronology (Cook and Kairiukstis 1990).

Forward selection step-wise regression models were derived for each grid cell using a maximum of five chronologies and a minimum of three. Restricting the predictor chronologies to the vicinity of the grid cell prevented over-fitting by the model and biasing the explained variance (Rencher and Pun 1980). The predictors were chosen based on values of F (fit of the least squares regression), R^2a (explained variance adjusted for the number of predictors), and RMSEv (root-mean squared error of validation). We took a "leave-1-out" approach to the cross-validation of the reconstruction models and adopted the reduction of error (RE) statistic as measure of validation; positive values are indicative of transfer model with predictive skill. The reconstructions were extended to AD 1650 following the nested method of Cook et al. (2007), where all chronologies were used for the initial reconstruction back to about 1914 (the shortest chronology), and chronologies were then discarded if shorter than 1900, 1850, 1800 and so forth, at 50-year intervals to extend the reconstruction from 2000 back to 1650. The reconstructions were then 'spliced' together to create one homogeneous record by adjusting each series to account for its different level of regression R^2. Each nested reconstruction was rescaled to have the same variance over the calibration period as the instrumental CMI data.

Results and Discussion

Calibration and validation statistics were computed for each grid cell and year in the CMI reconstructions. In Figure 2, the spatial distribution of the reduction of error (RE) and explained variance (R^2) is mapped for one year (1800). It shows that the regression models have lowest RE and R^2 in the boreal forest of northern Alberta, where the tree-ring chronologies are relatively few and have lesser moisture sensitivity than in the drier montane and island forests to the south, and boreal shield to the northeast.

All further results are maps and plots of CMI data classified according to the legend in Figure 3, which has predominantly negative values at 5 mm intervals, reflecting the dry climate of the western interior, where PET exceeds P over much of the region.

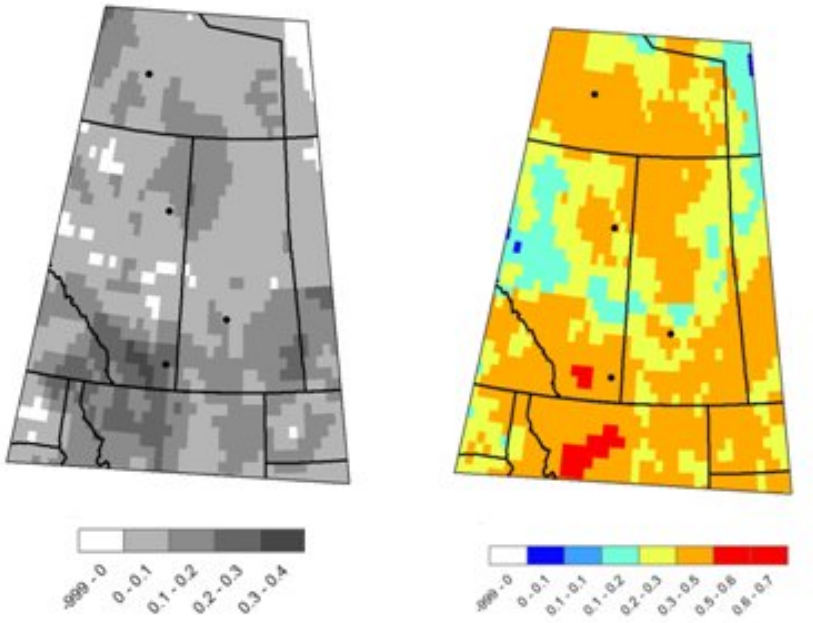


Figure 2. Maps of the reduction of error (RE) and explained variance (R^2) for the reconstructions of 1800.

The maps in Figure 4 of (a) instrumental and (b) reconstructed CMI for the period 1961-90 show the general correspondence of the pattern of CMI derived from climate data and inferred from the tree-ring chronologies. Both maps illustrate how the Prairies Ecozone is defined by a moisture deficit of at least 15 mm. Time series for the grid cells at Medicine Hat, Alberta (Fig. 5a) and Saskatoon, Saskatchewan (Fig. 5b) also show the correlation between instrumental and inferred CMI. These plots span the calibration period (20th century) and extend to 1500 to show the pre-settlement hydroclimatic variability including some prolonged droughts (e.g., 1850-60s).

The full set of reconstructions illustrates the inter-annual variability in the magnitude and geographic pattern of the CMI. Of particular interest to most users and managers of land and water are extreme negative values over a large area; i.e., extensive and severe drought. The CMI maps in Figure 6 show the severity and extent of drought (low CMI) in 1988 as compared to reconstructions for 1759, 1793 and 1815. Inter-annual to multi-decadal variation in the hydroclimate of western North America has been linked to sea-surface temperature oscillations, specifically the Pacific Decadal Oscillation, the El-Niño Southern Oscillation and the Atlantic Multidecadal Oscillation (Bonsal et al. 1993, Shabbar et al. 1997, Shabbar and Skinner 2004). Paleohydroclimate records reveal many more cycles of the low frequency modes of variation and how the strength of these climate oscillations can vary over time.

Conclusion

Reconstructions of past climate provide historical analogues for recent observed climate changes and extreme events, such as drought. They reveal the long-term range of climatic variability and provide a context for the changes projected from global climate models. Long time series of past climate can be used to assess the capacity of climate models to simulate past climate variability and trends and thereby project future climate. Paleoclimate data reveal the internal climatic variability that will underlie the trends imposed by global warming.

The rate of current global warming is concerning only because we know that it is unusual in the context of past climate. In western Canada, temperatures inferred from boreholes (Majorowicz et al. 2002) and from tree rings at high elevations in the Rocky Mountains (Luckman and Wilson 2005) indicate that the warmest climate of past two millennia was during the late 20th century. Global warming is projected to result in increased climate variability and a larger range of extreme events (Kharin and Zwiers 2000). The greatest challenge presented by a warmer climate in western Canada is an amplified variability in available water resources, and especially the potential for more frequent severe and prolonged drought. The paleoclimate record indicates that drought is characteristic of the regional climate and has been more severe and prolonged in the past. Thus it is a baseline for the evaluation of changes in drought frequency, magnitude and duration under global warming.

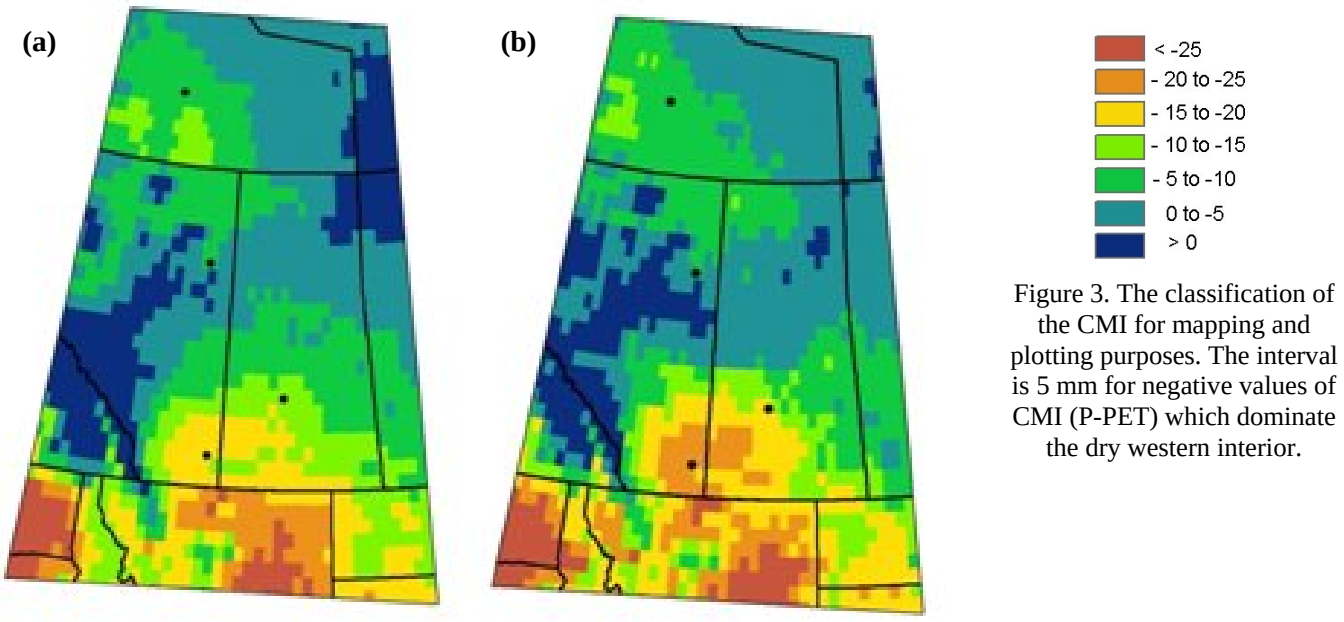
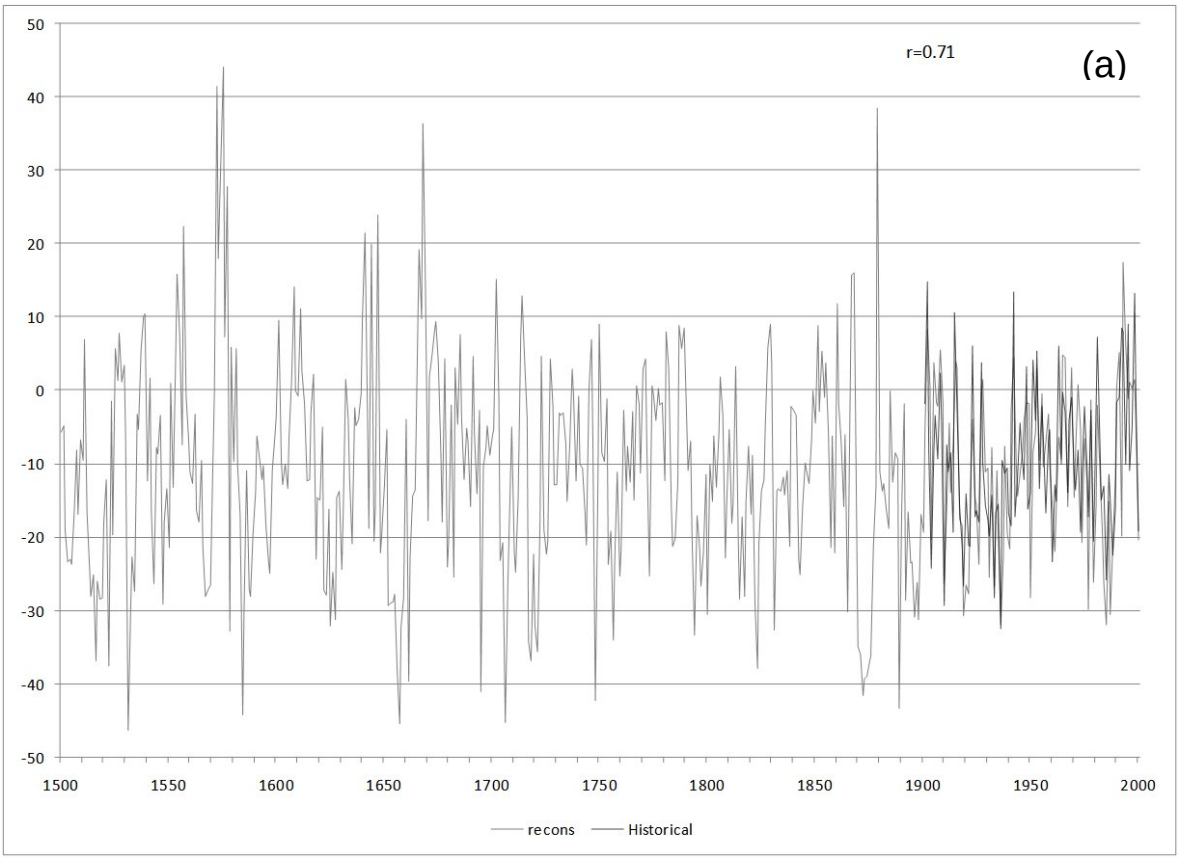


Figure 3. The classification of the CMI for mapping and plotting purposes. The interval is 5 mm for negative values of CMI (P-PET) which dominate the dry western interior.

Figure 4. Maps of (a) instrumental and (b) reconstructed CMI for the period 1961-90 showing the general correspondence of the pattern of CMI derived from climate data and inferred from the tree-ring chronologies. Both maps illustrate how the Prairies Ecozone is defined by a CMI of less than -15 mm.



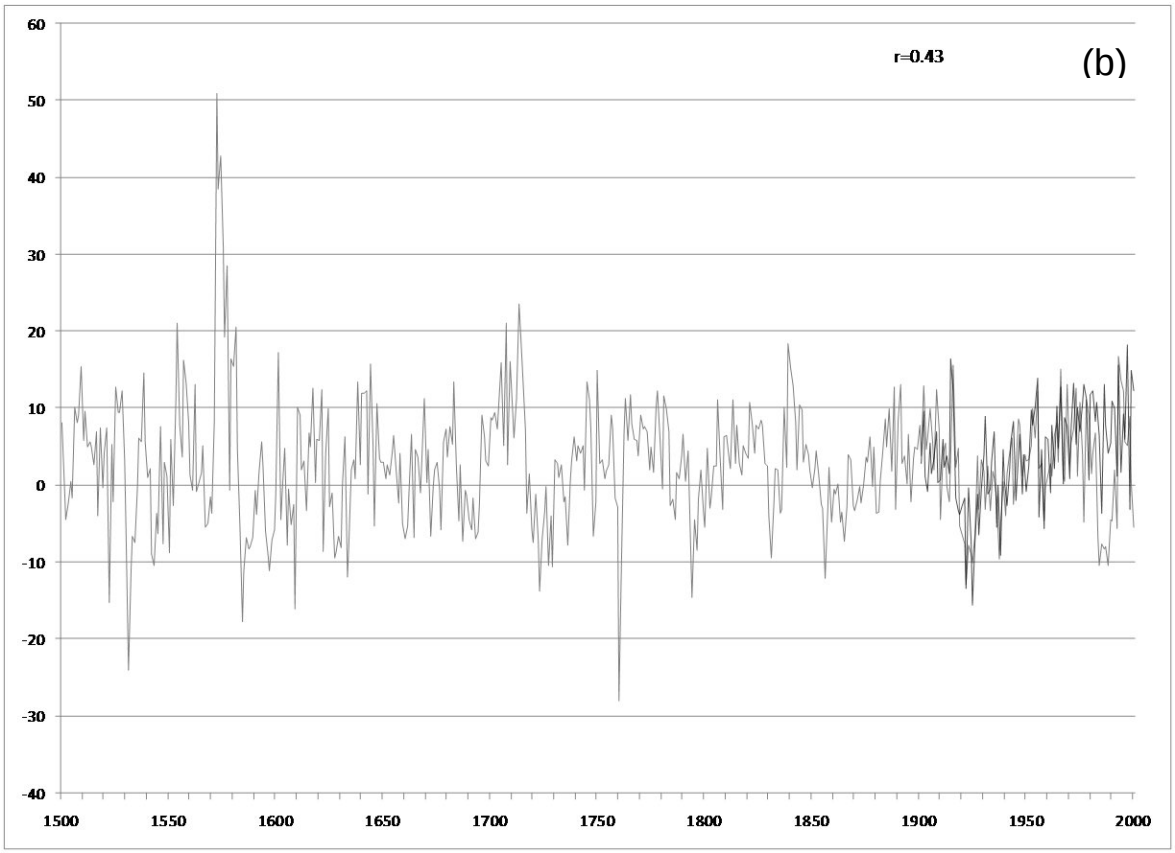


Figure 5. Plots of instrumental versus reconstructed CMI for the grid cells coinciding with (a) Medicine Hat, Alberta, and (b) Saskatoon, Saskatchewan. The plots span the calibration period (20th century) and extend to 1500 to show the pre-settlement hydroclimatic variability.

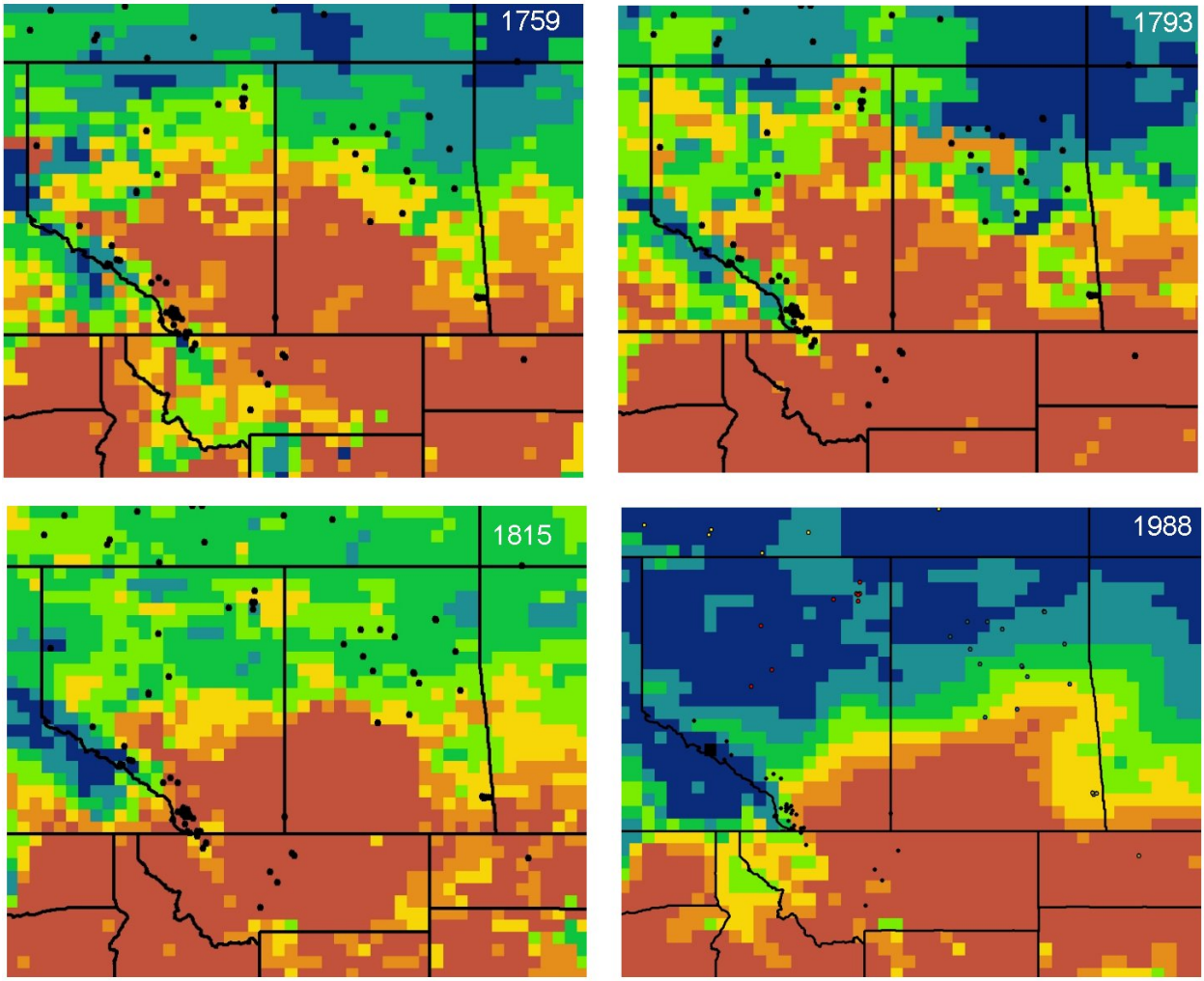


Figure 6. CMI reconstruction maps for the pre-settlement drought years of 1759, 1793 and 1815 and the baseline drought of 1988.

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Legacy of the Stinking River: Wetland Loss and Restoration on Manitoba's Southern Prairies

Gordon Goldsborough
Department of Biological Sciences, University of Manitoba

Abstract – The earliest European settlers to the prairies of southern Manitoba experienced a profoundly different landscape than the one we see today. Vast areas of wetlands covered much of what is now productive farmland. The Land Drainage Act of 1895, enacted with the express purpose of increasing agricultural productivity, first in the Red River Valley, and later on the west side of Lake Manitoba, fostered active land drainage through much of the 20th century. In the Red River Valley, wetlands comprised some 11% of the land area in the 1870s compared to less than 0.1% today. Growing awareness of the ecological goods and services provided by intact wetlands is underpinning new initiatives by the Manitoba government and non-governmental agencies to promote wetland restoration. I provide information on the spatial extent of wetlands that once existed on Manitoba's southern prairies, discuss anthropogenic threats to the ecological function of those that remain, and describe efforts to restore wetlands in Manitoba, using the Big Grass Marsh, Delta Marsh, Netley-Libau Marsh, and Oak Hammock Marsh as examples.

Environmental Benefits, Costs and Risks Associated with Agricultural Best Management Practices

Don Flaten
Department of Soil Science, University of Manitoba

Abstract – A variety of agricultural beneficial management practices (BMPs) have been developed by scientists, encouraged by public and private agencies, then adopted by farmers to protect and improve the environmental health of prairie ecosystems. However, we rarely evaluate the full environmental and economic benefits and costs of those practices within this region. Instead, many of our BMPs are promoted on the basis of research done elsewhere and/or they have been evaluated for only a relatively narrow range of criteria. In reality, BMPs not only have economic costs, they often have environmental costs or side-effects as well. For example, recent research in southern Manitoba shows that even though conservation tillage reduces losses of sediment and nitrogen losses to surface water, this "BMP" increases losses of phosphorus. Therefore, we need to start evaluating agricultural BMPs for environmental health in a manner that is similar to evaluating remedies for human health issues; i.e., on more of a case-by-case basis, with more knowledge and disclosure of the most important environmental risk for that area, and all the benefits and costs of the practices that could be used to address that risk.

Adaptation as Resilience Building: A Policy Study of Climate Change Vulnerability and Adaptation on the Canadian Prairies

Henry (Hank) Venema
International Institute for Sustainable Development

Abstract – The Canadian prairies are frequently affected by climate-related stresses such as climate variability and particularly drought, which are projected to worsen with climate change. This project documents a seminal attempt to identify sources of farm- and community-level resilience to climate stress across the three Canadian Prairie Provinces (Manitoba, Saskatchewan and Alberta) with the explicit objective of aligning Canadian agricultural policy with urgent adaptation priorities. Methodologically, we serially link vulnerability and resilience concepts, developing first a vulnerability space map to select comparative case studies using indicators of adaptive capacity, and historic exposure to climate stress. We then use the resilience lens to investigate socio-ecological response dynamics to historic climate stress and shock, using participatory rural appraisal techniques.

Key findings include the ubiquity of mal-adaptive drainage practices that have continued essentially unabated since initial European settlement – particularly natural wetland drainage, which reduces landscape heterogeneity and hydrologic buffering capacity, and is driven by production-oriented incentives. In contrast, conservation, minimum and zero tillage practices are adaptation successes that have required decades of extension support from a wide array of formal and informal institutions. The implications of this research – increased ecological goods and service programming, and agro-ecological extension for building climate resilience – are essentially rediscoveries of traditional knowledge, but nonetheless major research inputs into the ongoing evolution of Canada's next generation Agricultural Policy Framework.

WORKSHOP 3 – CHANGING SOCIO-ECONOMIC PRESSURES

Moderators: Allen Tyrchniewicz, *Tyrchniewicz Consulting*
Lauren Stone, *Manitoba Cattle Producers Association*

Workshop Summary

The Canadian prairies face several socio-economic pressures that influence land management and indirectly influence prairie conservation and endangered species. The purpose of this workshop was to highlight some of these socio-economic pressures. The workshop was divided into two parts, with the first examining how on-farm decision-making can impact land transition, and the second examining external forces that influence on-farm decision-making, and the subsequent impacts on prairie conservation and endangered species.

Jim Unterschultz (page 65) described the various types of farm income and how it varies with farm size, production type, family income, productivity and provincial boundaries. He pointed out that it was difficult to design farm programs due to these dramatic differences and the impacts they would have on farm income. He concluded that smaller farms did not necessarily have the resources required to implement Ecological Goods and Services programs, and that most of these programs decreased farm productivity, with a resulting net cost to the farm.

Ray Armbruster (page 66) discussed the absence of natural processes on the prairie landscape due to a disconnected policy model. He highlighted how grain production for biofuels has impacted the landscape by removing seven million acres of range and grassland for crop production. The natural landscape provides a number of Ecological Goods and Services. Each time a 'drainage-exhaustive cultivation-restoration' transition cycle occurs on the landscape, a portion of the total long-term ecological benefits of wetlands and perennial green cover is lost in the process. He indicated that once highly ecologically valuable rangelands are put under the plough and natural cycles are disrupted, the landscape can never be completely returned to its original state. He concluded his presentation by stating that we need Ecological Goods and Services programs in order to encourage society to use landscapes in a way that achieves both economic production and environmental benefits.

Wanda McFadyen (page 69) described the process by which Manitoba farmers develop Environmental Farm Plans (EFP). She highlighted that while the program was voluntary, over 5,600 farmers developed plans for their farms and 8.9 million acres were impacted as a result of the program. She also mentioned that 80% of producers implemented improvements without any financial assistance as a result of involvement in the EFP program.

Cynthia Edwards (page 71) outlined water policy impacts on habitat in the Canadian prairies with a particular focus on wetlands. She indicated how water and wetland policies have evolved from large wetland drought-proofing projects to being a key policy focus for conserving wildlife habitat. She highlighted the Prairie Habitat Joint Venture (PHJV) and how their Policy Committee is working towards a reduction of wetland loss and degradation as well as a movement to a position of no-net-loss of wetlands. She also mentioned that the PHJV is trying to have each province integrate wetland policy into their water strategies. She concluded that for policies to be effective, the true value of wetlands as a complex ecosystem must be recognized by the public as well as included in policy development.

Matt McCandless (page 73) discussed the demand for biofuels and the impact on the landscape. He took participants through the different types of biofuels and pointed out the impacts of first-generation biofuels on the landscape and the subsidies associated with ethanol and biodiesel. He also pointed out that biofuels are an inefficient way to reduce greenhouse-gas emissions as they cost between $200 to 430 per tonne of CO_2 equivalent. He mentioned that agriculture and forestry are inexpensive ways to mitigate climate change. At a carbon price of $100 per tonne, agriculture and forestry could account for 45% of carbon mitigation. He concluded by suggesting an Ecological Goods and Services system that produces biofuels in an efficient manner across the prairies, using feedstock that does not compete with food products and landscapes that are not capable of producing food crops.

Prairie Farm Incomes, Productivity and the Impact of Farm Environment Policy

Jim Unterschultz
Department of Rural Economy, University of Alberta

Abstract – A brief overview highlights aggregate farm income and sources of income in the three Prairie Provinces. For example, farm income in Manitoba, Saskatchewan and Alberta showed an increase in 2008. However, long-term growth in agricultural productivity, a key source for increasing overall farm income, has been declining in the past decade. In particular, this productivity decline has been most pronounced in the crop and oilseed sector. Recent farm policy is likely reducing productivity growth in the livestock sector. Environmental policy initiatives to maintain or increase Ecological Goods and Services (e.g., maintain and improve wetlands, riparian areas or other wildlife habitat) will likely have two direct impacts on farm income. As conventionally measured, these policies will slow productivity growth and hence overall farm income. Second, implementing many environmental initiatives will be a net farm cost and this will also reduce overall farm income on the prairies. Farm examples related to the costs of retaining wetlands in cropland, maintaining riparian zones and land clearing is presented.

Absence of Natural Processes on the Prairie Landscape

Ray Armbruster
Manitoba Cattle Producers Association

Abstract – As frontline conservationists for generations, cattle producers in Canada have had an appreciation for the many ecological benefits that arise from responsible stewardship of the land. As one of the largest groups of landholders in Manitoba, cattle producers have historically ensured that vast tracts of the Canadian landscape remain under perennial cover and that this landscape continues to provide so many of the ecological benefits we depend on as a society. Producers are under pressure to transition their land away from ecologically valuable perennial cover. The process of land-use transition causes soil erosion and degradation, increases nitrous oxide emissions, reduces nutrient filtration and cycling, and reduces biodiversity through an increase in monocultures. Each time the transition from 'drainage-exhaustive cultivation-restoration' occurs, a portion of the ecological benefits of wetlands and perennial cover is lost (i.e., decreasing greenhouse gas emissions released to the atmosphere). I discuss how on-farm decision-making can impact land transition, and how these decisions will affect the environment and the species within it.

Introduction

As a society, we have the ability to consider the various impacts being made on our prairie landscape, and this is something that I have a strong interest in as a producer and representative of Manitoba's cattle industry. My presentation will discuss how the economics of land-use decisions can lead to the absence of natural processes on the landscape, but when properly managed sustainable farm practices are used, production activity can actually encourage rather than discourage biodiversity, the protection of species at risk and the natural habitat of the prairie landscape.

Land-use Decisions: Economic Production vs. Environmental Preservation

As front-line conservationists for generations, cattle producers in Canada have had an appreciation for the many ecological benefits that arise from responsible stewardship of the land. As one of the largest groups of landholders across the prairies, cattle producers have historically ensured that vast tracts of Canadian landscape remain under perennial cover, and that this landscape continues to provide so many of the ecological benefits we depend on as a society. For much of the last century, agricultural policy in Canada has tended to view farm operations narrowly through the lens of mass food production. Thus, situations often arise where farmers and producers re-evaluate their commitment to habitat on their land. Economics truly drives decisions on the landscape. There is often a conflict between making land-use decisions that benefit the environment and making decisions that will increase total economic production.

Biofuels have been added to the policy mix in recent decades, and government policy in general has not fully incorporated the concept of the farm operation as a positive contributor to the environment. In general, the opposite has occurred; i.e., government environmental policy has tended to see farm operations as homogenous entities that stall environmental goals requiring extensive regulation. In addition, government programs, such as those that encourage ethanol production, are in fact promoting this disconnected policy model of environment versus economy. Current federal ethanol policy is in the midst of a major shift from the direct subsidization of ethanol to the promotion of ethanol through mandated fuel content. In 2008, the government replaced the federal ethanol tax exemption with an incentive program for domestic ethanol producers. The mandated content requiring 5% renewable fuel is intended to drive up the demand for ethanol in order to allow manufacturers guaranteed markets and to turn a profit.

The ethanol mandate is a good example of this disconnected policy model in the cattle industry. An escalation in ethanol production increases the demand and price for feedstock until such a time that supply can meet or outstrip the demand. However, it is next to impossible to forecast the exact numerical value of the increase in price of feedstock resulting from the mandated fuel content. Instead, we see a negative effect on the cattle landscape – the extensive impact of ethanol through intensive crop production. Tearing up ecologically valuable perennial cover to plant wheat in western Canada and corn in eastern Canada, not for food production but

specifically for ethanol, results in the loss of natural capital on the prairie landscape.

The amount of forage land that has been torn up for crop production has had a drastic effect on the beef herd in the past number of years. There has been a drop of 500,000 to one million beef cow herds across Canada in seven years, and a loss of seven million acres of forage and grazing land needed to support those herds. Table 1 shows the decrease in cattle herds as of January 1, 2010.

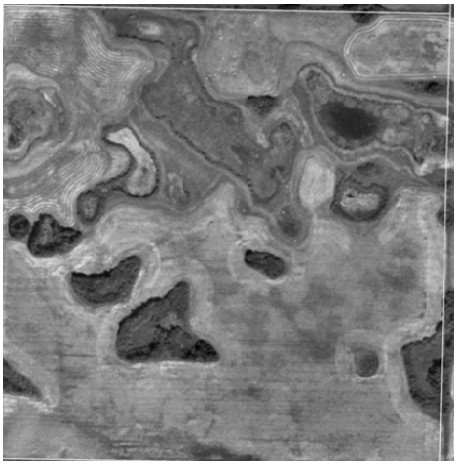
Table 1. Cattle Inventories as of January 1, 2010 (from Statistics Canada, 2010-02-16).

	thousands of head			% change
	2008	2009	2010	2009 to 2010
Canada	**13,895.0**	**13,180.0**	**13,015.0**	**-1.3**
Atlantic	271.5	270.4	257.1	-4.9
Quebec	1,345.0	1,340.0	1,310.0	-2.2
Ontario	1,883.5	1,704.6	1,742.9	2.2
Manitoba	1,355.0	1,280.0	1,230.0	-3.9
Saskatchewan	2,870.0	2,650.0	2,800.0	5.7
Alberta	5,560.0	5,380.0	5,150.0	-4.3
British Columbia	610.0	555.0	525.0	-5.4

Impacts of Land Transition on the Prairie Landscape

While much land on the Canadian prairies has often cycled between annual and perennial use during the 20th century, it is becoming more evident that each time a 'drainage-exhaustive cultivation-restoration' cycle occurs on the landscape, a portion of the total long-term ecological benefit of wetlands and perennial green cover is lost, particularly with respect to genetic diversity and species at risk. The landscape can never be completely returned to its original state. This process poses immense ecological risks, including an increase in nitrous oxide emissions, reduced nutrient filtration and cycling, reduced biodiversity from an increase in monocultures, and soil erosion and degradation.

Worse still, this current trend of land transition poses a serious climate change threat. Wetlands are vital carbon sinks and contain greenhouse gases. When drained as part of land transition, the greenhouse gases are released into the atmosphere. As shown by various research projects conducted across the province, there has been a long-term reduction in wetlands and perennial cover. The images below illustrate an aerial view of drainage over ten years of a single quarter section in Manitoba.



Source: Delta Waterfowl

The Potential to Increase Environmental Benefits through Economic Production

Speaking from our perspective as cattle producers, it is our farm operations and our land-use decisions that are maintaining today what is left of the valuable natural capital needed to supply the public with natural water filtration, nutrient cycling, and soil conservation. Grasslands used for grazing hold vast potential to fight climate change. Agriculture and land use have the potential to help minimize greenhouse gas emissions through well-managed and sustainable grazing practices. These practices on arable land do not entail a significant loss in the quantity of the Ecological Goods and Services produced from perennial natural capital, and can increase the productivity and resilience of agriculture. *No use is not best use.* Active hoof-action on the prairie landscape is essential to the continued delivery of these services. For example, 31% of native and tame forage land is in use by agriculture. Increasing the amount of carbon-sequestering grasslands improves the water retention capacity of the soil, therefore increasing its ability to withstand drought. Grazing lands are estimated to store 30% of the world's soil carbon. Thus, an increase in forage increases the amount of carbon sequestered in soils.

The cattle industry encourages rather than discourages biodiversity. Cattle producers support landscapes in a different way than most agricultural production. We have the ability to not only enhance the environment but also improve it. So how do we shift the current philosophy of agricultural policy to encourage producers, farmers and society to use landscapes in a different way – a way that accomplishes both economic production and environmental preservation?

Programs have been initiated to solve this discrepancy. The Food and Agriculture Organization (FAO) released a report indicating that measures promoting improved grasslands management should include payment for environmental services. We need to continue promoting an agri-environmental policy that focuses on incentives and rewards for the positive contributions that producers make as stewards of Manitoba's water quality and land. Because repeated short- and long-term transition cycles depreciate the stock of natural capital, policy instruments such as these payments are highly desirable for their ability to provide counter-signals to agricultural producers that will help stabilize transitions in agricultural land use. An Ecological Goods and Services Program is the best solution to these discrepancies.

The Manitoba Cattle Producers Association, building on previous research in the field of Ecological Goods and Services, has devised a formal policy proposal that seeks to change the way government and society handles the connection between food production and environmental preservation. The proposal seeks to operationalize a large-scale, province-wide Ecological Goods and Services Program in Manitoba that would use public-private incentives to encourage the preservation of Manitoba's dwindling base of natural capital in settled areas. Given the speed and force with which current price signals are promoting land-use transition among Manitoba cattle producers, there is a real urgency to take policy action in the direction of encouraging well-managed grazing land without giving up economic production.

Conclusion

The cattle industry is an economic activity where production actually encourages rather than discourages biodiversity, the protection of species at risk, and greenhouse gas mitigation on the landscape. The longer that financial counter-signals to land-use transition are absent in Manitoba, the faster wetlands and perennial cover are going to disappear, with the consequential loss of natural capital and the ecological benefits produced from that natural capital. Cattle grazing has proven to be sustainable over time. The immediate challenge is to begin implementing these programs now in order to protect our healthy and diverse natural prairie landscapes.

Impacts of Environmental Farm Planning

Wanda McFadyen

Abstract – In 2002, the federal Minister of Agriculture announced a new farm program called the Agricultural Policy Framework. This program, which became known as the APF, was comprised of five primary pillars, one of which related to the environment. One of the items under this pillar was the goal to have an Environmental Farm Plan (EFP) program voluntarily available to each and every farmer across Canada. This presentation focuses on the development and delivery of the EFP program in Manitoba under the APF, along with its impacts and success rate.

An Environmental Farm Plan (EFP) is a *voluntary, confidential, self-assessment* of a farmer's own farm or ranch. The plan assists the farmer in identifying their environmental assets and risks, and aids in the development of an appropriate action plan to address the risks.

EFPs were developed in Manitoba as a result of the main objective under the Agricultural Policy Framework (APF) of Agriculture and Agri-Food Canada. A main objective of the APF was to advance Canada's role as a world leader in environmentally responsible agricultural production. In order to realize this goal, a national initiative for agri-environmental planning was undertaken in Canada in 2002.

When the APF was first announced in 2002, there was no agency involved in the delivery of the EFP process in Manitoba. Other provinces such as Ontario had plans in place. Under the guidance of the Manitoba Rural Adaptation Council, the process of developing an EFP program for Manitoba was undertaken. This resulted in the formation of the Farm Stewardship Association of Manitoba (FSAM).

FSAM represented the interests of farmers in Manitoba in providing perspective to the public agricultural sector partners in the EFP program. FSAM, in cooperation with public agricultural sector partners and other stakeholder agencies, delivered EFPs to Manitoba farmers who wished to voluntarily participate in the process. FSAM was also responsible for conducting the one-on-one confidential review process of EFPs with farmers.

The agreement to start the delivery of EFPs in Manitoba was signed in June 2005. From June 2005 to the end of the program in March 2009, a total of 440 initial workshops (see below) were delivered with 6,940 farmers participating. During this same time frame, 433 follow-up workshops (see below) were held with 6,530 participants, representing a return rate of 94%. Of the 6,530 who completed both workshops, 5,614 went on to have their plans reviewed and received a Statement of Completion. Eighty-six percent of participants attended both workshops and went on to review. The farmers who had plans reviewed managed just over 8.9 million acres.

The EFP delivery process consisted of six primary steps:

Step 1: The farmer voluntarily registered for an initial workshop and submitted legal land descriptions of land that they managed.

Step 2: They attended the initial workshop and started their farm plan.

Step 3: They worked on the plan at home.

Step 4: They attended a follow-up workshop where questions and concerns were addressed and plans completed.

Step 5: Upon completion of the EFP, the farmer could ask for a confidential one-on-one review with FSAM to receive their Statement of Completion certificate.

Step 6: They then applied to the cost-shared Canada-Manitoba Farm Stewardship Program (see below).

The workbook that was used throughout the program was comprised of three primary sections: Section A – Natural Risks, Section B – Management of Assets and Risks, and Section C – My Environmental Farm Plan.

Section A allowed the farmer to analyze the natural risks of the land under their management using a variety of tools. It included analyzing both farmyards and field groups. Baseline information was used as well as ortho photos, soil maps, etc.

Section B of the workbook was divided into 19 subsections which dealt with farmyard and field situations and addressed a variety of concerns and management options from an environmental perspective. The farmer completed only the subsection or questions that pertained to their operation.

In **Section C** the farmer would develop appropriate action plans to deal with items of higher environmental risk as identified in Section B of their workbook.

When all sections were complete, the farmer could seek a voluntary, confidential, one-on-one review in order to receive their Statement of Completion.

This then allowed them to access the cost-shared Canada-Manitoba Farm Stewardship Program (CMFSP). The primary objective of this program, which was delivered in Manitoba by AAFC-PFRA, was to accelerate the adoption of beneficial management practices (BMPs) through cost-shared incentives for the implementation of these BMPs to address on-farm environmental risks. There was a list of thirty BMPs, with a variety of practices that farmers could apply for. If the benefit of the practice was deemed to be of more value to the general public, it was cost-shared at 50 percent; if it was deemed to have more benefit to the farmer, it was cost shared at 30 percent. The significant effort of farmers through the CMFSP in making improvements in areas of point-source concern and overall environmental improvement was certainly a success for this program.

When overall program successes are reflected upon, the participation, stewardship ethic, enthusiasm, desire and positive outlook of farmers regarding the EFP process, along with the implementation of a wide variety of BMPs, cannot be overlooked.

In a 2007 random exit survey conducted by FSAM with farmers who had either partially or fully participated in the program, 92 percent of respondents said they would recommend the EFP program to others. Eighty percent indicated they had implemented on-farm environmental improvements without any outside financial assistance. The economic spin-off in rural Manitoba was certainly an additional benefit.

In conclusion, the Environmental Farm Plan program under the Agricultural Policy Framework was one of the most successful agri-environmental programs delivered across Canada in recent memory. The participation of farmers across Canada was unprecedented.

Water Policy: The Impact on Wildlife Habitat

Cynthia Kallio Edwards
Ducks Unlimited Canada

Abstract – The strategies used to conserve wildlife habitat have evolved over the last several decades to include more emphasis on how policy can be utilized to achieve habitat objectives. Because wildlife habitat also provides multiple benefits to society such as flood and erosion control, carbon sequestration, and air and water purification, society has a vested interest in conserving these areas. One of the goals of non-government organizations is to increase the awareness of these benefits in order to build the public will that is needed to change policy.

Water policy in prairie Canada is primarily implemented at a provincial level, so changes to those policies are driven by different circumstances across the three provinces. This presentation provides an overview of the status of water policy in each of the three Prairie Provinces, in addition to discussing the implications these policies have for wildlife habitat. Because a lack of effective water policy, particularly as it relates to wetland habitat, has facilitated the ongoing loss of these areas, this presentation focuses on the impacts of wetland habitat loss on waterfowl. Results from recent research on the implications of wetland loss on other goods and services, such as water quality and carbon sequestration, are also highlighted.

Wetland and water policy is vital to meet the needs of wildlife across prairie Canada, and increasing societal pressure is imperative to changing government policy. This presentation makes some suggestions for improvements to water policy that can effectively conserve natural areas, not only for wildlife habitat but also for the other societal benefits they provide. It also illustrates how effective water policy can help government meet its other obligations such as biodiversity conservation and the North American Waterfowl Management Plan.

Wildlife habitat provides multiple benefits to society such as flood and erosion control, carbon sequestration, and air and water purification. As these benefits have been quantified through research, non-government organizations have been able to draw attention to wildlife habitat issues and involve a broader segment of society in conserving these areas. As a result, the strategies used to conserve wildlife habitat have evolved over the last several decades to include more emphasis on how policy can be utilized to achieve habitat objectives. For example, within Ducks Unlimited Canada, our focus has shifted from the large drought-proofing projects of the 1970s and 1980s to focus on the role of public policy in conserving waterfowl habitat. Influencing public policy requires the support of the public. One of the roles of non-government organizations is to increase the awareness of the benefits of wildlife habitat in order to build the public will that is needed to change policy.

Water policy in prairie Canada is primarily implemented at a provincial level, so changes to those policies are driven by different circumstances across the three provinces. A lack of effective water policy, particularly as it relates to wetland habitat, has facilitated the on-going loss of these areas. This ongoing loss has had a detrimental impact on waterfowl as indicated in the recent Prairie Habitat Joint Venture (PHJV) Implementation Plans, which emphasize the need to maintain the existing wetland base as well as to restore wetlands in order to achieve waterfowl population targets.

The emphasis on policy within the Prairie Habitat Joint Venture has increased over the past decade and is managed primarily through the PHJV Policy Committee. This Committee has three main objectives pertaining to wetland and water policy:

1. to reduce wetland loss and degradation and encourage a policy of no-net-loss of wetlands in each province;
2. to work with federal and provincial governments to develop effective sustainable water and land-use policies;
3. to work with provincial governments to adopt integrated wetland policy and provincial water strategies covering both private and public lands.

There are numerous challenges to achieving effective wetland and water policies. The value of the services provided by wetlands, and the costs of losing them, are not well understood. Research on these services is expanding, with recent emphasis on the role of wetlands in water-quality improvements and carbon sequestration. This information needs to be effectively conveyed to the public in order to begin influencing government (Yang et al. 2010). Historically, wetlands have been viewed as waste/nuisance lands, and non-government organizations have a role to play in changing this attitude through good information and messaging. Another substantial challenge is technical advancements in drainage methods/machinery and the desire to farm corner-to-corner. Private landowners need to generate income from their lands, and they often view retaining wetlands as a barrier to economic gain.

The status of wetland and water policy varies throughout the Prairie Provinces. In Manitoba, existing protection for water resources fall under the *Water Protection Act* and the *Water Rights Act*. The Manitoba Water Council recently met with a Provincial Stakeholder Group (including farm organizations and conservation groups) to provide input into supporting material for the pending public consultation process. This consultation will be an excellent opportunity for the public to provide input regarding the importance of wetlands and ideally will lead to the development of a provincial wetland policy.

In Saskatchewan, the existing policy is dated (1995), and currently, levels of compliance and enforcement are low. However, the Ministry of Environment has recently renewed its emphasis on a wetland policy, and discussions to renew the policy are underway.

Progress has also been made on wetland policy in Alberta, beginning with the *Water for Life* Strategy in 2003 and subsequent work on a wetland policy as an outcome from that strategy. The Alberta Water Council began work on a wetland policy for that province in 2005, with a draft wetland policy being submitted to Cabinet in the fall of 2008. This draft was developed by a group of stakeholders and included broad public consultations. The release of the new policy is expected in spring 2010 and efforts will then be directed to finalizing an implementation plan for the policy.

Wildlife habitat is not the key driver for the advancement of wetland and water policy in prairie Canada. Therefore, those of us interested in wildlife habitat also need to be highlighting the benefits of wetlands in other areas of environmental concern, such as climate change, water quality, flood control and drought. Public support is needed to change policy, and the public needs to be concerned about ongoing loss of wetlands and the associated loss of goods and services they provide. In order to increase conservation efforts through government policies and programs, wetland loss must become an issue of concern to those outside the wildlife community.

The conservation community can help drive water and wetland policy by effectively communicating the broader values of wildlife habitat such as wetlands to the general public and policy makers. Scientific and economic information is required to drive the message. The members of the conservation community must also collaborate with each other and with other partners on points of mutual interest. The Joint Ventures under the North American Waterfowl Management Plan are one avenue to do this, as are conferences and stakeholder meetings.

Wetland and water policy is vital to meet the needs of wildlife across prairie Canada. Current policies are not adequate to meet these needs. Increasing societal pressure is imperative to changing government policy, and increasing societal pressure requires good information in order to influence public opinion. There is a role for the conservation community to play in raising the profile of the importance of water and wetland policy in prairie Canada.

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The Demand for Biofuels and Landscape Impacts

Matthew McCandless
International Institute for Sustainable Development

Abstract – Demand for biofuels is rapidly changing the profile of agriculture on the Canadian prairies and throughout the world. Presently, biofuel production is supported in large part by government subsidies, but the industry's emergence signals a growing recognition of agriculture's multifunctionality. Increasingly, farmland is seen as a provider of multiple ecosystem goods and services. Prairie landowners have the opportunity to sell carbon credits, and programs exist to compensate landowners for improvements in water quality and wildlife habitat. Policies and markets are continually evolving to allow farmers to be compensated for some of the positive environmental externalities of their activities in an effort to enhance agriculture's public benefit. The development of a biofuel industry can be a complement or a detriment to these efforts, depending on how policies are formulated.

The International Institute for Sustainable Development (IISD) is embarking on a multi-year project to examine how to develop and implement sustainable biofuel policy for the Canadian prairies. This presentation explores some recent IISD research on biofuel subsidies in Canada and internationally, and the effect that these policies have had. This serves as a basis for a discussion of the work currently underway on the development of a sustainable policy for biofuels that carefully balances ecosystem goods and services in an effort to maximize the public and private benefits from healthy agricultural landscapes.

Balancing the Increasing Energy Demand with Wildlife Habitat

Peggy Strankman
Canadian Cattlemen's Association

Abstract – Canadians are proud of our landscapes, our natural environment, our wildlife and our heritage. We are also very comfortable with our enviable standard of living.

The need for reliable and affordable energy has supported the Canadian lifestyle. The need for food has helped support that lifestyle and directed the development of the prairies. Food and energy security are important to Canadians now, and will be more so in the future. However, these needs are delivered on the same lands that are important to Canadians for wildlife, its habitat and other ecological services.

Most, and perhaps all, of the current environmental issues are wicked problems. They defy solution. The silver-bullet solution evades us, much to our dismay. Even trying to define these issues presents insurmountable challenges. This presentation uses examples and case studies to illustrate the challenges.

WORKSHOP 4 – CHANGES IN PRAIRIE HEALTH

Moderators: Melanie Dubois, *Agriculture and Agri-Food Canada*
Kevin Teneycke, *Nature Conservancy of Canada – Manitoba Region*

Workshop Summary

The intent of this workshop was to build on the status and trends reported in Workshop 1 Ecological Changes, and discuss how that information is used as a tool to address the impacts on prairie health, and subsequently species at risk. The speakers explored how that information is pulled together to direct policy and program responses, as well as identify gaps in the current tools and approaches. The session demonstrated why focus must shift from individual species components toward an ecosystem or multi-species approach, and the projects that are underway to accomplish this. The workshop also addressed the challenges of studying cumulative impacts, and the different approaches that have been attempted.

Main topics for discussion included:

- Ecosystems Status and Trends Report: A Tool for Change – filling the gap on ecosystem-scale information and providing ecosystem-based information as a foundation for education, extension and prioritization.
- The Wildlife Habitat Availability on Farmland Indicator – This provides a multi-species assessment of broad-scale trends in the capacity of the Canadian agricultural landscape to provide suitable habitat for populations of terrestrial vertebrates.
- Multi-species at risk planning initiatives in Alberta – Developing applied habitat management techniques and working cooperatively on private land.
- Cumulative impacts on grassland birds – the challenges of measuring those impacts.
- Aquatic species at risk – assessing the cumulative impacts, the education and extension tools, as well as the regulations targeted at mitigating those impacts.
- Assessing the health of the prairies – looking at the multiple challenges concerning assessments, including consistency in methodology, application of results, and making the link to management actions to improve or maintain a healthy ecosystem.

Ecosystem Status and Trend Reports

Melanie Dubois
Agriculture and Agri-Food Canada

Trish Hayes
Environment Canada

Abstract – The Ecosystem Status and Trends Report for Canada (ESTR) is a joint federal-provincial-territorial initiative of the Canadian Councils of Resource Ministers (CCRM) to assess the health of Canada's ecosystems from a biodiversity perspective. The focus is on trends in ecosystem condition, drivers and stressors. A deliverable under the CCRM's 2006 Biodiversity Outcomes Framework, the purpose of ESTR is to inform the national biodiversity agenda, complement the historic focus on species, and help Canada's resource ministers set priorities. ESTR also delivers on part of Canada's international obligations under the UN Convention on Biological Diversity – to assess progress toward the 2010 biodiversity target.

Technical reports are being prepared for terrestrial and marine ecozones, as well as national thematic reports on drivers, ecosystem processes, and trends in selected species groups. The peer-reviewed ecozone technical reports distill and synthesize relevant knowledge on ecological status and trends, highlighting those trends of most significance to biodiversity. They are intended to be working documents, forming the scientific basis of other ESTR products and providing information for planning further integrated ecological research monitoring and assessment. This initiative provides an opportunity to bring results from ecological research and monitoring to the attention of Canadians, to highlight results in a policy context to decision-makers, and to highlight strengths and gaps in knowledge and monitoring of Canada's ecosystems. All ESTR reports will be completed in 2010 and made available primarily as web-based products.

This presentation covers the purpose, process and use of ESTR, and presents preliminary key findings for the Prairies Ecozone.

Balancing the Needs of Multiple Species at Risk and Sustainable Rangelands in a Working Prairie Landscape

François Blouin
Alberta Sustainable Resource Development

Abstract – Alberta's Grassland Natural Region encompasses 14.4% of the province, but only 34% of it remains in a relatively natural state. Yet it is home to about 75% of the species ranked "At Risk" or "May be at Risk" under the General Status of Alberta Wild Species, and 71% of the 28 endangered and threatened species currently legislated under the provincial *Wildlife Act*. Recovery planning and actions have traditionally been developed and implemented using a species-specific approach. However, with an increasing number of threatened and endangered species at the two levels of government, the number of recovery actions to be implemented with limited resources on the landscape is becoming overwhelming. In addition, recovery actions for different species sometimes conflict with one another or may negatively impact ranching operations. Landowners or lease holders become confused, frustrated and disillusioned, and are often left bearing the costs of recovery. Alberta Sustainable Resource Development and the Alberta Conservation Association have jointly developed the MULTISAR project to address these issues.

The MULTISAR process involves working collaboratively with landowners or leaseholders in the development of Habitat Conservation Strategies (HCS) for multiple species at risk in priority areas. Each HCS looks at the current land uses and the grazing history of the ranch and completes wildlife, plant community, range and riparian health assessments and a survey of key habitats. It is developed through a team of biologists, agrologists, land management specialists, and the landholder(s) who interpret survey results and provide balanced grazing management and habitat enhancement recommendations for priority species or guilds, as well as recommendations to minimize the impact of industrial development. MULTISAR continues its technical and financial assistance and its personal relationship with the landholder(s) in the implementation of the HCS, while the response of habitats and species at risk are monitored periodically to ensure that the strategy reaches its objectives.

The Grassland Natural Region is the area of southern Alberta where the level to rolling native prairies and cultivated croplands progress into the grassy foothills to the west. The total area is 95,565 km^2 and makes up about 14.4% of the province (Natural Regions Committee 2006). Only about 34% of the area remains in a "relatively" natural state (quarter-sections classified as including 76-100% of native prairie vegetation; derived from the Native Prairie Vegetation Inventory, Resource Data Branch 1995; Fig. 1). What remains is largely privately managed under Crown (56%) or private (44%) ownership (Saunders et al. 2006) and used for cattle production.

However, important and increasing pressures prevail on Alberta's native grassland ecosystems from complex land uses driven by population growth and an economy based on natural resource extraction. They include: habitat loss due to conversion of natural prairies to agricultural land, urban and acreage development, and energy and other industrial development; habitat fragmentation caused by access and other linear development; and habitat degradation due to alien species invasion as a side effect of uninformed land uses. These act either singularly or cumulatively, and contribute to the decrease in plant and wildlife populations and to species becoming at risk.

The Grassland Natural Region is where the largest proportion and densities of species at risk occur in Alberta. Over 676 species are considered species at risk in the province ("At Risk", "May be at Risk", or "Sensitive" under the General Status of Alberta Wild Species 2005; derived from Alberta Sustainable Resource Development 2010). Of those, more than 75% occur in the Grassland Natural Region and share their habitat with the human population. The region also presents the greatest densities of species at risk (distinct species count) per township recorded in the Alberta Fish and Wildlife Management Information System (FWMIS; Fig. 2). Highest density townships correspond to areas where large patches of natural grassland remain. Two "high value" landscapes (6-12 species at risk per township) have been identified in the province. The first occurs largely on federal land in and adjacent to Suffield, the Canadian military base and its associated National Wildlife Area, and the second occurs in the Milk River Basin in southeastern Alberta.

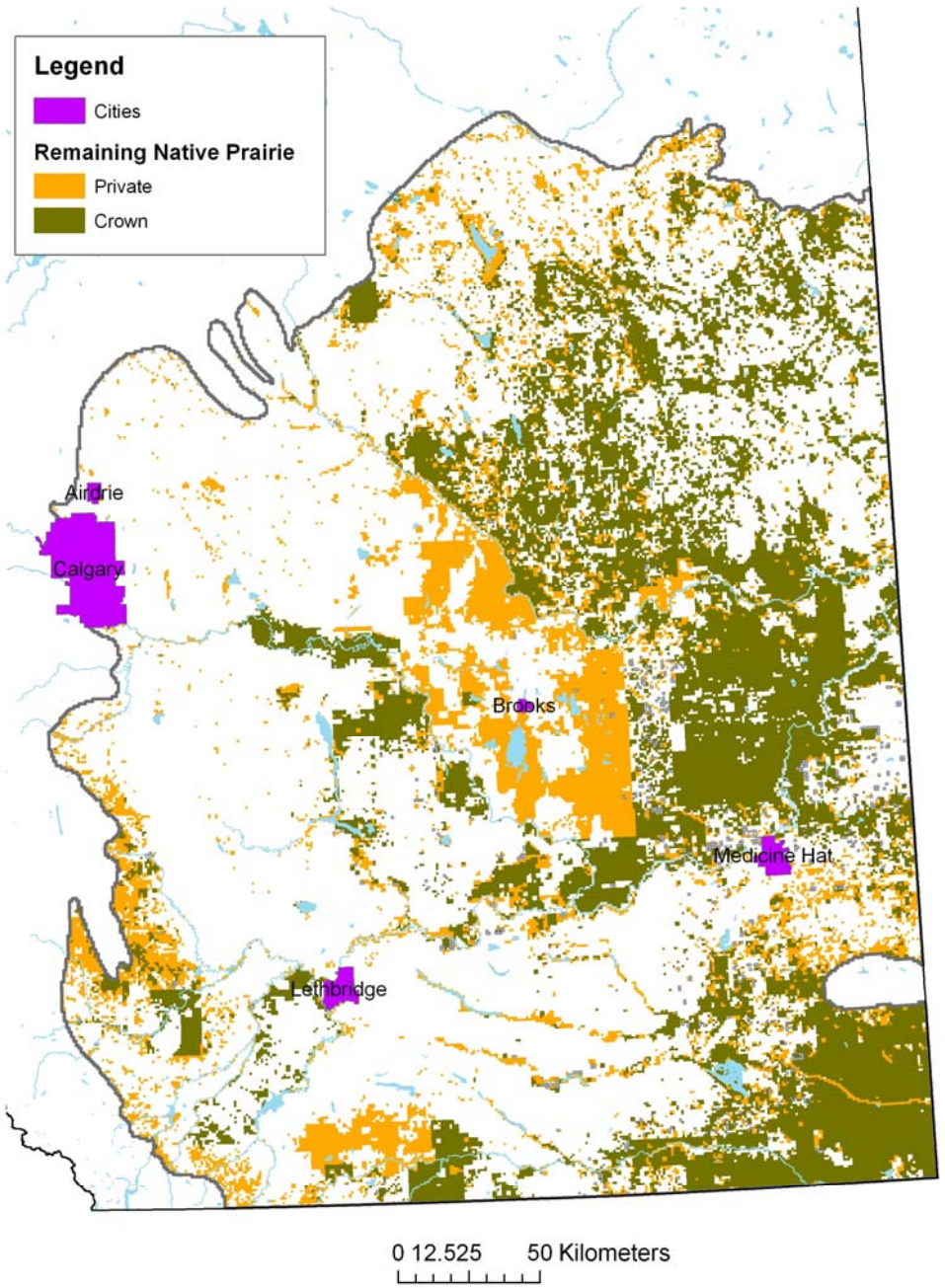

Figure 1. Remaining native prairie vegetation (76% or more per quarter section) on private and Crown lands in the Grassland Natural Region of Alberta.

While some level of habitat protection is provided by a few existing provincially and federally protected areas (Fig. 3), the majority of the provincial land in the two high-value landscapes is unprotected in a "working landscape". These areas are primarily owned by the Crown and managed for cattle production by private leaseholders (Fig. 3). Therefore, private leaseholders have a critical role to play in the maintenance and stewardship of native grasslands and in the protection and recovery of species at risk.

Landowners and leaseholders are also primarily impacted by legislation and policies targeted at the protection and recovery of species at risk. Two levels of responsibility for species at risk exist in Alberta. The provincial government takes first responsibility for the management and recovery of endangered and threatened species on private and public lands in the province (Alberta Fish and Wildlife Division 2008). On federal land (such as national parks, military reserves, national wildlife areas, First Nations Reserves, etc.), this responsibility falls under the federal government. Recovery plans or strategies are required for legislated endangered and threatened species under either Alberta's *Wildlife Act* or the federal *Species At Risk Act*, with some coordination between the two levels of government. These plans provide the rationale and recovery objectives, as well as the

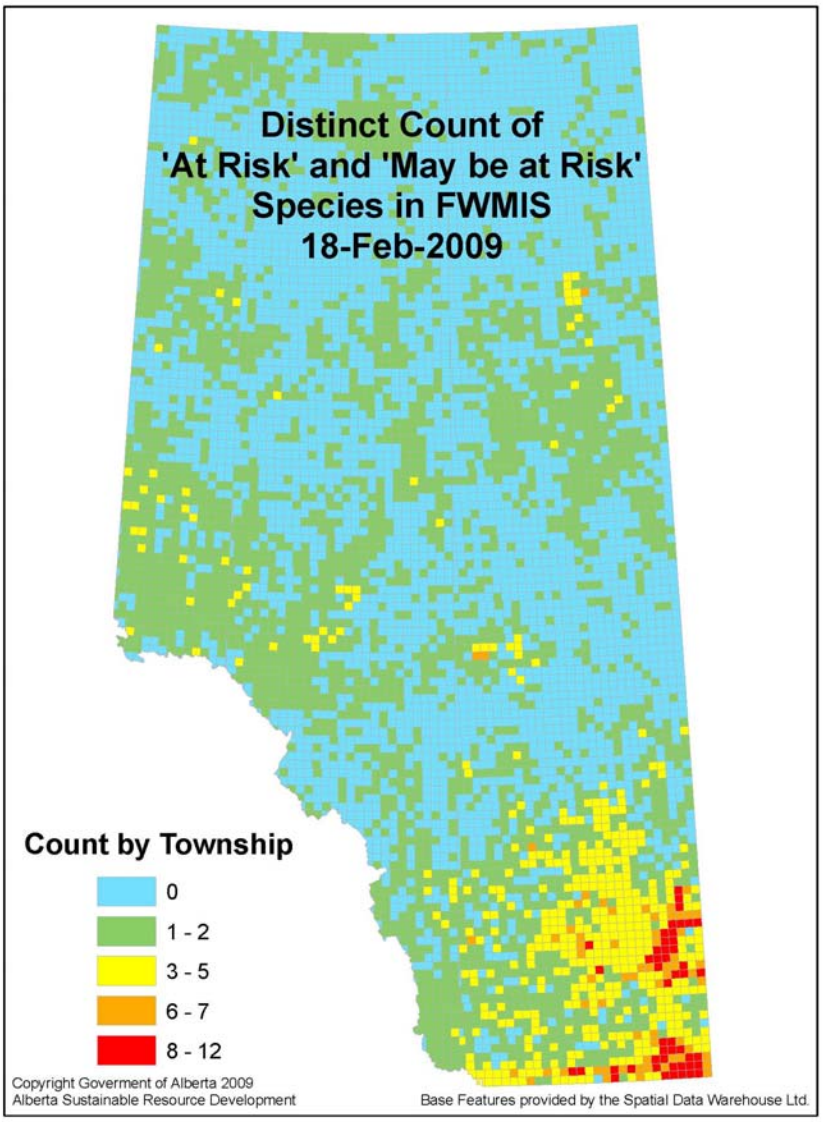

Figure 2. Density of species "At Risk" and "May be at Risk" per township recorded in the provincial Fish and Wildlife Management Information System as of February 18, 2009.

actions needed to achieve those objectives. However, traditionally species at risk conservation has been approached through species-specific research, recovery and stewardship actions. These may be promoted by several individuals representing several organizations or institutions. In a landscape such as the Grassland Natural Region, where multiple species at risk may occur on the same management unit, there are potentially a large number of individuals knocking at the same landowner's door, each with their own version of how the land should be managed to improve the habitat for their target species. This leads to a large number of so-called beneficial management activities potentially occurring on the same management unit and sometimes conflicting with one another. The landowner, left with sorting out and implementing these actions while trying to make a living, becomes confused, frustrated and alienated by this business of species at risk recovery, and many doors get shut. MULTISAR strives to balance the needs of multiple species of wildlife along with the needs and the capacity of land managers in the provision of stewardship recommendations for the conservation and recovery of species at risk.

MULTISAR is a *voluntary* grassroots conservation and habitat stewardship program that aims at influencing land management decisions and creating habitat improvements to assist in the conservation and recovery of species at risk at the landscape level *in a manner that also benefits ranchers* in southern Alberta. MULTISAR stands for MULTIple Species At Risk, which defines its approach toward species conservation and recovery. It also represents the multi-disciplinary and multi-partner structure of the program. Partners in the MULTISAR program include the Alberta Conservation

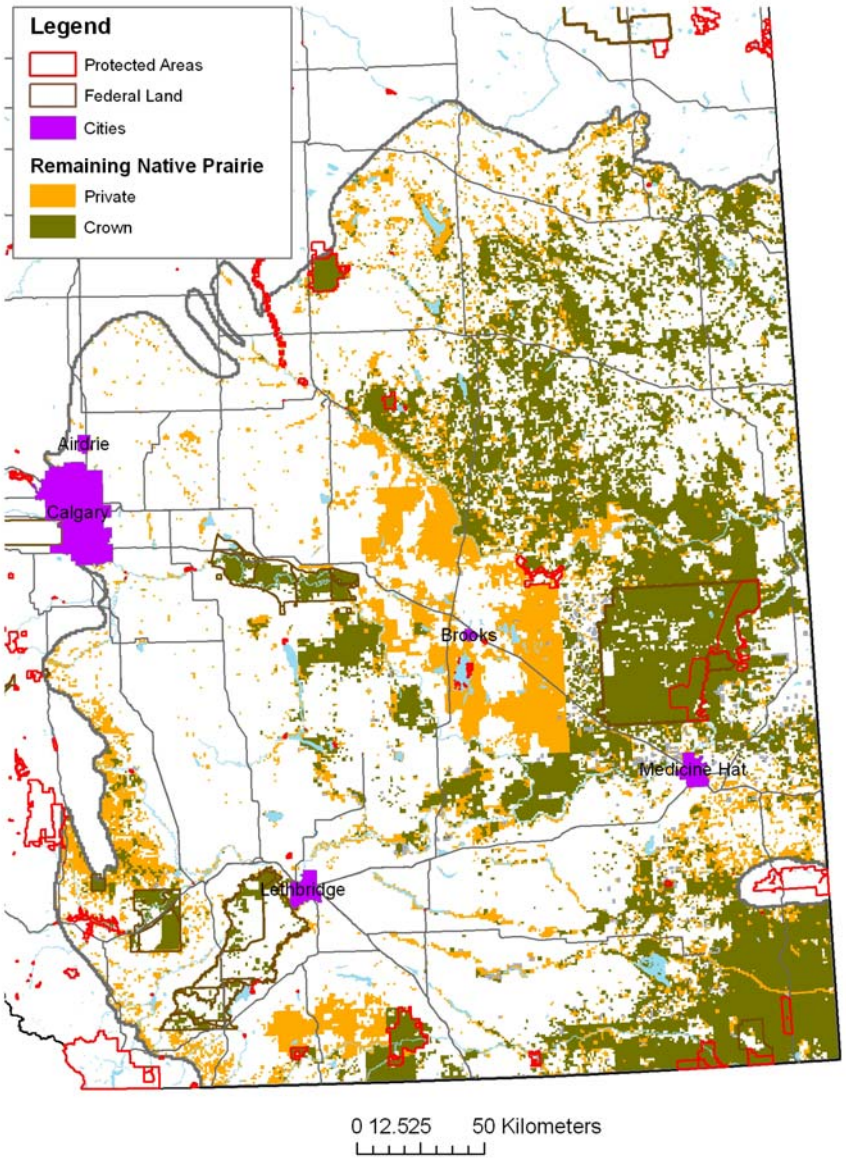

Figure 3. Provincially or federally protected areas in the Grassland Natural Region of Alberta.

Association, Alberta Sustainable Resource Development and the Prairie Conservation Forum. These partners, along with the landowner(s) or leaseholder(s) at the centre and potentially other groups that may have a stake on the land, compose the MULTISAR Team responsible for the development and implementation of individual Habitat Conservation Strategies (HCS) in the high priority area of the Milk River, Pakowki Lake and St. Mary's River Basins.

HCSs are detailed plans for the maintenance and improvement of wildlife habitat and for the sustainability of rangeland. HCSs are developed from the results of plant and vertebrate animal surveys, and from assessment of rangeland and riparian health. They integrate the land manager's knowledge of past and current range management practices and stocking rates, location of water sources, salt, mineral sites, cattle oilers, industrial activities, access, fences, etc. Land management objectives, recovery actions identified in species at risk recovery plans, beneficial management practices for species at risk, as well as land-use guidelines for industrial development are also considered when developing the strategies.

The development and implementation of a habitat conservation strategy is a ten-step process (Fig. 4). The first step in the HCS process is engaging landowners or leaseholders in priority species at risk areas. This is achieved through field days or information sessions organized by MULTISAR or other groups, through participation in grazing schools, and/or through one-on-one visits to landholders at their ranch. These one-on-one meetings are critical because not only do they allow MULTISAR staff to present the objectives and the process of a HCS, they also mark the start of a relationship that is expected to endure into the future.

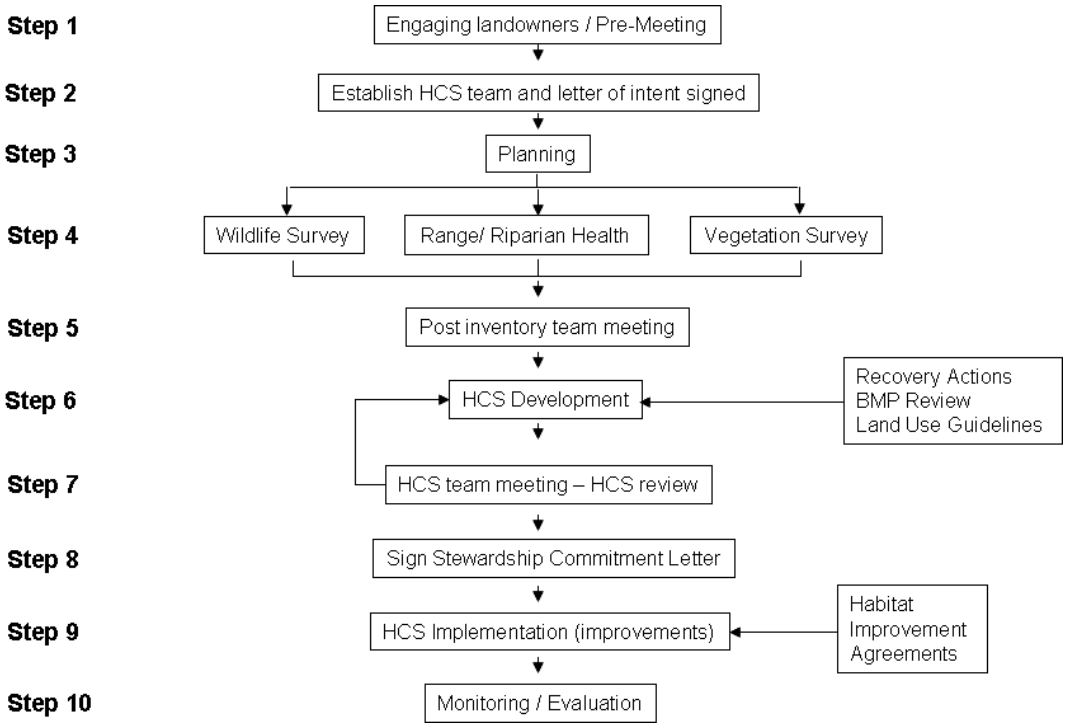

Figure 4. MULTISAR Habitat Conservation Strategy (HCS) process.

The second step of a habitat conservation strategy is the assembling of the HCS Team. The HCS team includes the landowner(s) or leaseholder(s) and/or the land manager, a range agrologist and a wildlife biologist from either one of the partnering organizations. On provincial Crown land, the district agrologist and a land-use specialist also join the team. Where other organizations have a legal stake on the land (e.g., a conservation easement), a representative from that organization may complete the team. The first task of the team is to gather the background information about the property. This includes grazing history, current management practices, known or potential occurrences of wildlife, existing spatial databases and base features (access, hydrology, Grassland Vegetation Inventory, orthophotography, etc.). A survey plan (step 3) is then developed from that information prior to conducting the actual field surveys.

The fourth step involves conducting the field work to establish the state of the rangeland ecosystem. It includes wildlife and vegetation surveys as well as range and riparian health assessments. All are conducted at the *ecological range site* level based on the Alberta Grassland Vegetation Inventory (SRD GVI Committee and LandWise Inc. 2009). Wildlife surveys utilize two approaches: 1) a multiple species point-count approach using a modified distance sampling technique (Rosenstock et al. 2002, Rotella et al. 1999, Landry-DeBoers and Downey 2010) with three distance zones at 50 m, 100 m, to a maximum of 200 m for a coverage of about 50%; and 2) a species or habitat specific approach using sampling equipment such as trail cameras, bat detectors, wildlife callers with call play-backs, dip nets, minnow traps, or other techniques to survey key habitats (e.g., wildlife corridors, riparian areas, badlands, etc.), depending on the known or potential habitats or species on the ranch.

Vegetation surveys involve the use of 50 m transects at representative locations of the range site polygons. Species composition, foliar cover, % lichens and % bare ground are recorded and the plant community is determined or attempted. Weeds and rare plants are noted separately from each transect or recorded as encountered incidentally. In addition, a visual obstruction reading (Robel et al. 1970) is taken at each transect. A range health assessment is also conducted within each ecological range site and follows Adams et al. (2009), while the riparian health assessment follows Fitch et al. (2001) in selected riparian polygons. The data are compiled at the management unit level (pasture) and analyzed prior to the post-inventory team meeting.

Step 5 of the HCS process is the first post-inventory team meeting. By then, the survey results are complete and provide a picture of the wildlife, plants, plant communities and habitats present on the ranch, along with the health of the various pastures and the riparian areas. The results also identify where range and habitat issues and opportunities may be occurring. This meeting allows an open discussion with the landholder(s) about the results and the potential range management or land-use changes that may be suggested to address the

issues, or possible wildlife habitat improvements that would be appropriate for species at risk. This exchange allows the team to sketch a preliminary outline of the HCS that will direct its development.

Step 6 is the actual HCS development. Relevant recovery actions for species at risk listed in either the national or provincial recovery plans, as well as beneficial management practices for MULTISAR's target species or groups of species (Rangeland Conservation Services 2004), are reviewed and integrated with the results of the field work and discussions from the post-inventory team meeting. Recommended provincial land-use guidelines for the protection of selected wildlife species (Alberta Fish and Wildlife Division 2001) are also included where relevant. The draft HCS provides pasture-specific recommendations for rangeland sustainability and improvement of wildlife habitats. This is where the trade-off begins between the needs of healthy rangelands, the needs of priority species, and the needs of cattle and the producer. Management at heavily impacted areas (e.g., corrals or around dugouts) may not need to be changed if they are found to provide habitat for some of MULTISAR's priority species (e.g., Burrowing Owl or Ferruginous Hawk, which need open and sparsely vegetated habitats). On the other hand, other riparian or upland areas ranked as "unhealthy" to "high healthy with problems" may benefit from a change in grazing management. Suggested habitat improvement projects are not limited to but may include:

- fencing of nesting, or potential nesting, trees or shrubs to prevent cattle from rubbing on them and maintain habitat for raptors and the Loggerhead Shrike;
- fencing of riparian corridors to better manage grazing in that sensitive area;
- restoring cropland to a locally occurring natural plant community;
- installing a remote watering system or drilling a well at strategic locations to improve water quality for cattle, fish, and amphibians, and to control grazing in riparian areas or to provide better cattle distribution throughout the ranch;
- using a smooth bottom wire raised at 45 cm (18") on fences in Pronghorn habitat.

These will form the draft HCS that will be presented to the team.

At step 7, the HCS team is convened again to review the draft HCS. All team members get a chance to react to it, endorse it, or propose changes. If significant changes are required, a feedback loop sends the team back to the drafting table at step 6 until all members are satisfied with the strategy.

Step 8 is the signing of the "Stewardship Commitment Letter". The letter is functionally a handshake agreement. It recognizes the collaborative process in the development of the plan and the living nature of the HCS document, which is subject to changes as directed by an adaptive management approach and continued monitoring and consultation with the HCS team. The letter is also a statement of commitment to work together to implement the plan over the next five years and to review, revise and renew the plan for another five years thereafter. The letter is signed by the landowner, the leaseholder (if applicable) and by representatives from each agency and organization involved in the HCS Team.

Step 9 is the implementation phase of the HCS. The landholder begins implementing the recommendations at their own pace and as operationally suitable. MULTISAR will usually help with the development of habitat improvement projects as funding allows, to minimize the fiscal burden on the landholder and to ensure prompt environmental changes and benefits to species at risk and cattle. Larger projects where equipment is purchased (e.g., a remote watering system) require a legal improvement agreement that details the conditions of use and ownership.

The final step is monitoring the implementation of the strategy. Monitoring is ongoing and involves regular visits to habitat improvement project sites to see if equipment is still in good working condition and/or the projects are achieving their objectives, or are in need of adjustments (e.g., weed control, re-seeding, etc.) or changes. Every five years after signing of the HCS commitment letter, a sub-sample of the ecological range sites are re-assessed for plant species composition, range and riparian health assessments, and wildlife diversity and abundance to see how management changes have impacted the rangeland ecosystem.

In summary, MULTISAR is a non-threatening grassroots voluntary stewardship program sensitive to the landholder's needs, interests and capacity. It is aimed at influencing land use and land management in a way that benefits range sustainability, multiple species at risk, and the cattle operation. The MULTISAR Habitat Conservation Strategy is a ten-step approach that integrates land management, land use and fish and wildlife management principles and provides recommendations for the sustainable use of rangeland, the conservation of wildlife species, and the recovery of species at risk in the landscapes of the Milk River, Pakowki Lake and St. Mary's River Basins.

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Aquatic Species at Risk: Responding to a Changing Environment

Sherry Nugent
Fisheries and Oceans Canada

Abstract – When we think of the prairie environment, we often overlook the aquatic component. Fisheries and Oceans Canada is responsible for the protection of aquatic species at risk. As more aquatic species become listed in the Prairie Provinces, we need to find new ways to protect them. The prairie landscape has changed dramatically due in part to industrial development. We discuss present and future strategies for aquatic protection with regard to implementation initiatives, plans to fill in knowledge gaps, the importance of partnerships in the recovery of aquatic species, and highlight proactive measures to prevent currently secure species from becoming at risk in the future.

Preliminary Assessment of Cumulative Impacts for Birds in Prairie Canada

Brenda Dale
Canadian Wildlife Service

Abstract – Grassland birds are declining more severely than any other habitat group in North America, and they occupy a disproportionately high number of places in priority rankings and on COSEWIC listings. Many factors have been identified as precipitating this decline, but we have almost no information on the magnitude of their specific contributions. While it is important that we collect and utilize the specifics to develop accurate cumulative impact estimates as well as detailed recovery strategies, we cannot wait for complete information before vigorously pursuing conservation initiatives that will preserve remaining prairie and safeguard it from further degradation.

A Geomatics Approach to Assessing Riparian Health on a Landscape Scale

Grant Wiseman
Agriculture and Agri-Food Canada

Abstract – This riparian health assessment pilot will provide science-based information on the feasibility of classifying riparian areas using air photos and linking the attributes identified through Object Image Analysis (OBIA) to riparian health indicators. The outcome would be a significant improvement in our ability to develop management plans for riparian areas on a watershed scale.

The three main objectives are to determine:

- Can the use of high resolution imagery and OBIA software be used to classify riparian zones by vegetative class?
- Can the health of riparian zones be determined using spectral, spatial and relational attributes of riparian vegetative classes?
- How can we use this information in watershed management plans?

The project will serve multiple purposes including:

- Providing a cost-effective riparian area health assessment protocol that is systematic, replicable and available for use in watershed management planning.
- Filling a gap in information regarding the status of riparian area health in Manitoba. A comprehensive assessment of riparian areas would help to target programs as well as help to detect change.
- Classify riparian areas using spectral, spatial and relational characteristics derived from high resolution imagery by using OBIA.

Preliminary analysis has shown that high-resolution imagery and object-oriented software can be used to classify riparian zones by vegetative class. The 2009 field season data is used to correlate the on-ground health assessments to the vegetation classification. Work is being done to link the assessments to management recommendations for individual landowners.

WORKSHOP 5 – CHANGES IN PRAIRIE AND SPECIES CONSERVATION

Moderators: Diana Bizecki Robson, *The Manitoba Museum*
Jason Greenall, *Manitoba Conservation*

Workshop Summary

Rare species are particularly vulnerable to extinction because their small population sizes and reduced ranges make them more susceptible to genetic, demographic and environmental uncertainties. For these reasons, initial conservation efforts on the prairies focused on rare species. These early conservation efforts revealed that rare species cannot be saved without also saving the ecosystems in which they live, and allowing or facilitating processes such as fire and grazing. The speakers noted that management activities that help to maintain habitat for some rare species may, unfortunately, be detrimental to others – plants and reptiles in dune ecosystems and grassland birds were cited as examples. The conservation of rare species at the periphery of their ranges was also felt to be important in the face of climate uncertainties and the need for species adaptation. The broad conclusion was that multi-species conservation planning of entire landscapes is needed to ensure that a mixture of micro-habitats is retained, and that all species in an ecosystem are conserved.

There have been rapid advances in our understanding of genetics, and with them has come new information that is changing our understanding of species and of the problems that rare species may face. Our present and future conservation activities are changing as a result. The speakers outlined three cases where their research, recovery action and stewardship are revealing, or are being guided by, a change in understanding of the genetics of rare species: first, a case where research is challenging our thinking about the importance of hybridization as a threat to a rare prairie plant; second, a case where recovery action was guided in part by the genetics of a very small surviving population of animals; and finally, a case where our improved understanding of species' biology, ecology and genetics gives reason to question traditional lines of thinking.

Gaps and Overlaps: Northern Great Plains Ecosystems, Processes and Threats to Species at Risk

Darcy C. Henderson
Canadian Wildlife Service

Abstract – Patterns of change in ecosystems and species are all around us, but the challenge is to recognize those patterns and learn something from them. Some of the perceptual filters that prevent us from recognizing patterns include biases from our education and experience as biologists or land managers. In the interest of bridging those gaps, I highlight where we may or must overlap our efforts with common understanding. First, I discuss the scales at which ecosystem processes such as drought, fire, and grazing may have operated on the northern Great Plains in the past. Second, I briefly describe how settlement, landscape fragmentation, and habitat loss has forever changed those original patterns. Finally, I discuss why these changes in patterns may account for the way in which we perceive threats and appropriate recovery actions for species at risk. Some recommendations may challenge long-held beliefs in rangeland or wildlife management, and others challenge whether some species at risk can or should be protected. Throughout, I use prairie sand dune ecosystems and selected plant species at risk from Alberta, Saskatchewan and Manitoba as model settings and responses.

Introduction

Now that 24 years have past since the first Prairie Conservation and Endangered Species Conference, where the subject of ecosystem approaches was also discussed and advocated (Trottier 1987), it may be a surprise that we still struggle with the concept. Ecosystem management is not just a concept, but a daily reality practiced all around us in the form of National and Provincial Park Management Plans, Military Base Range Sustainability Plans, Nature Conservancy Conservation Area and Site Plans, etc. Some of these plans and actions may make reference to species at risk, but not all, and rarely are species at risk the primary focus (Efroymson et al. 2009).

Most species at risk in the Prairie Provinces share common threats, the greatest of which are habitat loss and degradation. This suggests an ecosystem approach may make the most sense for recovery planning (Kerr and Cihlar 2004, Venter et al. 2006). Implementing such an approach is easier said than done because it requires consideration of complex issues, conflicting values and uncertain knowledge. Many jurisdictions will have to be involved (private, municipal, provincial, federal), and our efforts to be compliant with the *Species at Risk Act* (SARA) should not create liabilities under other legislation affecting land use. Actions recommended to protect or recover species at risk may be in conflict with those recommended for other species at risk, or with current economic utilization of the land, or with beliefs about what is good for the land (Barla et al. 2000). Added to these concerns is the uncertainty about the future of agricultural markets, as well as new threats to species at risk and the functioning of prairie ecosystems.

I will use sand dune ecosystems in the Prairie Provinces as a case study for illustrating the challenges of implementing an ecosystem approach.

Prairie Sand Dune Ecosystems

Sandy soils of the Prairie Ecozone are most often associated with glacial meltwater channels, outwash plains and glacial lake deltas, and wind has reshaped some areas into dune fields of various forms (Wolfe et al. 2002). Vegetation on these sandy soils is very similar to surrounding vegetation typical of the aspen parkland and mixed grass prairie ecoregions, but there is also a suite of psammophilic (sand-loving) species more common in sandy soils than surrounding landscapes. Notable amongst those species are some grasses (*Calamovilfa longifolia*, *Oryzopsis hymenoides*, *Sporobolus cryptandrus*, and *Elymus lanceolatus* spp. *psammophila*) and forbs (*Psoralea lanceolata* and *Rumex venosus*) capable of colonizing and stabilizing actively eroding sand dunes. Shrubs such as Chokecherry (*Prunus virginiana*) and Creeping Juniper (*Juniperus horizontalis*) are also very common in sandy soils.

Regional differences in species composition or abundance reflect on the surrounding ecoregions. In the mixed grass prairie of southeastern Alberta and southwestern Saskatchewan, stands of Silver Sagebrush (*Artemisia cana*) and Hybrid Cottonwood (*Populus X jackii*) are often the first indication on the horizon when you are approaching a sand dune ecosystem (Epp and Townley-Smith 1980). In the western aspen parkland of central Alberta and Saskatchewan, Trembling Aspen (*Populus*

tremuloides) has formed dense thickets that cover nearly everything except for south-facing slopes, while sagebrush and cottonwoods are absent. In both the western aspen parkland and mixed grass prairie, cacti (*Opuntia polyacantha, Opuntia fragilis*) are very common on the driest hill crests (Hulett et al. 1966). Further east, near the Manitoba-Saskatchewan border, aspen forests become mixed with Bur Oak (*Quercus macrocarpa*), and with White Spruce (*Picea glauca*) in the Carberry sandhills. These eastern sand dunes are nearly devoid of cacti, and the herbaceous vegetation contains many tall grass species (*Andropogon gerardii, Schizachyrium scoparium* and *Sporobolus heterolepis*) that are absent or uncommon elsewhere in sandy soils further west (Bird 1927).

Over time, cycles of seasonal change or multi-year droughts shaped when and where fires and herds of migrating bison occurred on the northern Great Plains (Fuhlendorf and Engle 2001). The location of water and forest cover further altered those patterns, and sand dune ecosystems were often associated with tree cover and proximity to water on the otherwise treeless and dry plains.

Seasonally, fires could occur in any month of the year when the land was not covered with snow in winter or soaked by rain in summer. As a result, most fires occurred in spring and fall, and most were ignited by people (Romo 2005). Most locations in the Prairies Ecozone burned every 10 to 25 years on average, mostly as a result of a few large fires, not a large number of small fires. Some isolated riverbed islands, badland mesas, or swales between sand dunes may have rarely burned due to the natural fire guards of water, barren clay or sand. Ironically, the feedback of burning sand dune vegetation should ultimately cause less frequent fire than in surrounding areas, because patches of open sand function as natural fuel and fire breaks.

Seasonally, bison herds appear to have occupied the treeless mixed grass prairie more in spring and summer, and aspen parkland more in fall and winter (Epp 1988). Locally, burned-over grasslands would have attracted grazing animals for several years because the blackened ground would warm up and green-up earlier in the season, and the absence of dead grass litter made the forage more palatable. The corollary was that unburned grasslands were likely to go ungrazed, and the accumulated dead litter would increase the probability of a fire (Potvin and Harrison 1984, Pfieffer and Steuter 1994, Leonard et al. 2010). Because of their woody cover, sand dune ecosystems may have functioned like islands of aspen parkland and supported over-wintering herds of ungulates in higher densities than the surrounding treeless plains. Trampling alone could increase the area of bare sand and initiate sand dune activity (Blanco et al. 2008).

First Nations very likely used and manipulated these patterns to their advantage. Archaeological, paleo-ecological and historical evidence suggest First Nations preferred many prairie sand dune ecosystems as a source of fuelwood and posts for buffalo pounds, and as winter hunting grounds. The result may have been localized, highly frequent, and purposeful use of fires in pockets of sand dunes surrounding traditional campsites or buffalo pounds (Wolfe et al. 2007). Could this explain the spotty distribution of isolated active sand dunes in otherwise stabilized dune fields? Was disturbance more important than climate in dictating the area of bare sand and dune activity in some locations? (see Forey et al. 2008). These are some of the most interesting questions regarding the ecology of our prairies, and some of what we have learned can be applied to the conservation problems we now face.

Threats to Prairie Sand Dune Ecosystems

A number of major landscape transformations followed European colonization of North America with significant consequences for sand dune ecosystems (Table 1). First, displacement of First Nations removed the ignition source for 95% of prairie fires and with it, the selective or regulating force that the peoples' burning and hunting practices had on all ecosystems across the prairies. Second, settlement, cultivation and permanent gridding of the region with roads caused direct loss of habitat and created permanent barriers to the spread of fire. At

Table 1. Historical transformations and the consequences of these transformations as continuing threats to prairie sand dune ecosystems.

Historical Transformation	Continuing Threats and Consequences
Displacement of First Nations Cultivation, roads and fragmentation Active fire suppression Removal of native ungulates Fencing of native grasslands European livestock introductions Alien plant introductions	Lack of fire disturbance (loss or degradation of habitat) Incompatible grazing seasons and rotations (direct herbivory, loss of habitat) Alien species invasions (loss or degradation of habitat)

the same time legislation for fire prevention and suppression was introduced. The combined result of these actions was a drastic decline in the possible extent and frequency of fires (Romo 2005).

Third, this same settlement process replaced large-scale migratory grazing by native species with small-scale sedentary grazing by livestock, along with many accidental introductions of alien invasive species like Kentucky Bluegrass (*Poa pratensis*), Russian Thistle (*Salsola kali*) and Leafy Spurge (*Euphorbia esula*). These invaders do well under sedentary grazing, and the resulting vegetation structure is less conducive to the spread of fires. Fourth, agricultural improvements lead to the introduction of Crested Wheatgrass (*Agropyron cristatum*) to stabilize drifting sandy soils after the 1930s, the subsidization of irrigation to cultivate drought-prone sandy soils after the 1950s, and changes in public/Crown land regulations that gradually reduced stocking rates and promoted stabilization of sand dunes.

Today the Prairies Ecozone is drastically altered, and former ecological connections that maintained relatively less woody cover and more open sand on landscapes (that were also free of alien invasive species) are now lost. At the same time, we have created new and more rapid connections (roads and edges) that have facilitated fire suppression, forest encroachment and alien species invasion. The cumulative effect of these landscape transformations has been widespread, and there have been well-documented declines in sand dune activity and the area of bare sand in the Great Plains (Wolfe 1997, Wolfe et al. 2000, 2002). These changes have not only threatened some previously rare psammophilic species (Lesica and Cooper 1999, Ballinger and Watts 1995, Stubendieck et al. 1989), but the increase in woody and invasive alien species in particular has also threatened livestock forage supplies.

Implementation of an Ecosystem Approach

Management actions that can halt threats or restore some aspect of ecosystem structure and dynamics become the focus of ecosystem approaches. At most, species at risk become a vital indicator of continuing threats or the success of ecosystem management. At worst, a species at risk could become a rigid constraint that may prevent implementation of management actions for multiple benefits (ecological, economic, social, political, and even those required by other legislation). Perhaps this is why ecosystem approaches to species at risk recovery so far have been rare in the prairies.

SARA legally requires the status assessment of species but not ecosystems. SARA legally prohibits destruction of individuals, residences or critical habitat of species, but not ecosystems. Of the 142 Sections in SARA, only two places regarding recovery planning (Section 41(3) and Section 67) state that a multi-species or ecosystem approach may be adopted if appropriate. Nowhere in the act is ecosystem defined. Despite this, a few groups have forged ahead with multi-species approaches (e.g., MULTISAR in southern Alberta, and a "South of Divide" project in southern Saskatchewan). We have much to learn from the experiences of the people involved in these projects, and we can apply those lessons to prairie sand dune ecosystems.

Critical habitat identification and protection may be the closest to an ecosystem approach advocated for most species under SARA. However, the description of critical habitat is legally required to be biased from the perspective of the single species. The spatial boundaries and the features within that boundary must only define what is critical to the survival of that species to be legally defensible. This is a niche or component approach, not a synthetic approach to protecting the whole ecosystem (Hodges and Elder 2008, Hoekstra et al. 2002). Other concerns are frequently brought to the table by owners and managers of land regarding three legal liabilities in relation to critical habitat:

1. Examples of activities likely to result in destruction of critical habitat in a recovery strategy or action plan (Sections 41 & 49);
2. Activities that are permitted by a recovery strategy, an action plan or a management plan (Section 83);
3. Creating regulations requiring the "doing of things" that protect critical habitat or prohibit activities that may adversely affect the critical habitat (Section 59).

Why these seemingly good aspects of SARA are a problem has to do with three very real concerns. First, where critical habitats for multiple species overlap may also be where contradictory examples of destruction, permissible activities or recommendations for the "doing of things" occur. Carrying out a recovery action for one species may potentially threaten another. For example, mechanical disturbance to purposely reactivate a sand dune for one species can risk introducing competitive alien invasive species on equipment.

Second, species may occupy multiple types of ecosystems, and what may be destructive, permissible, or a good thing to do in one ecosystem or scale may not be good in another. This complexity requires considerable detail that is not always possible in the format constraints of a recovery strategy, and thus dooms recovery strategies to *not* identify critical habitat because destruction cannot be briefly and simply defined. For example, Western

Spiderwort (*Tradescantia occidentalis*) occurs in all three prairie sand dune regions, but one kind of disturbance may improve habitat at one location, while the same disturbance destroys habitat at another location through differing feedbacks unique to each ecosystem.

Third, assumptions should not be made that all species specialists are also ecosystem managers who understand causal linkages that create or maintain the features of habitat critical to survival of a species. The risk is that recommendations for permissible activities or the "doing of things" could unintentionally become destructive to the critical habitat features, or require actions outside the boundaries of critical habitat where there is no legal requirement to comply with recommendations. For example, sand dunes and bare soil are not static features of critical habitat, and were historically maintained by the interaction of drought, fire and grazing operating at scales independent of the biology of any single species (Lesica and Cooper 1999). Investing energy in a short-term or small-scale restoration project may only have fleeting results due to system feedbacks, and practical lasting solutions will require broader land management approaches.

How Do We Move Forward?

Communication

Ecosystem approaches are only possible with more communication, such as in-person group meetings with maps and diagrams, and debates regarding cause-effect relationships and practical applications. People with different values, opinions and ideas need to be at the table, which is not as comforting as surrounding oneself with like-minded specialists. This particular kind of communication (a.k.a. cooperation and consultation) requires parking egos at the door and spending more time listening. It will also stray from an in-depth discussion of the biology of a species toward the practical nature of how to manage a piece of property and invest resources in actions.

Capacity-Building

Wildlife species specialists are rarely part of the same organization as those who manage land (i.e., ranchers, forage and livestock agrologists, rangeland ecologists, oil and gas reclamation specialists, etc.). Now that some wildlife agencies have responsibility for critical habitat identification and policy, additional capacity in land management (both money and people) is needed rather than training or engaging more species specialists.

Policy Development

Critical habitat identification and protection will ultimately require an ecosystem approach that integrates and allows for multiple species and values. It goes beyond a single-species recovery strategy, and thus cannot be part of a recovery strategy. It uses boundaries that follow natural breaks in ecosystems (e.g., soil polygons) or management units (e.g., fencelines). Features within must be broadly defined with allowance for variance in order to account for our certainty that ecosystems are dynamic and our uncertainty about almost everything else. Action plans should be exclusively for ecosystems, and should integrate the needs of multiple species along with the values and needs of those who actually own and manage the critical habitat (rarely is that Environment Canada). Action plans for prairie species at risk can be range management plans, for example, and can be lead by those who actually own and manage property. Many of these already exist, and simply beg for small revisions in order to be SARA-compliant. This is a piecemeal approach, and it is not clear where to start, or how long it will take, but it may be the only way that leads to action on the ground in light of our limited capacity and time.

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Are Landscapes Changing Faster than Species Can Adapt?

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Abstract – Most prairie species have had over 10,000 years to adapt to a landscape shaped by glaciers. In comparison, perhaps less dramatic yet still substantial landscape changes have happened in the last 100 years. In this analysis, I examine trends in landscape change and compare these with requirements, as I have come to understand them from long-term studies of Ferruginous (*Buteo regalis*) and Swainson's Hawks (*B. swainsoni*) and Burrowing Owls (*Athene cunicularia*). These raptors may serve as an example of how species are able or unable to respond to change.

In one area near Hanna, Alberta (about 140 km northeast of Calgary) that has been monitored since the mid-1970s, populations of Ferruginous and Swainson's Hawks have exhibited four distinct patterns of abundance: from moderate to high, back to moderate, and then low population densities. While patterns exhibited by Ferruginous and Swainson's Hawks were nearly identical, the less common Red-tailed Hawk has shown a small but steady increase over the same period. Burrowing Owls have declined and have shown no sign of recovery locally. It appears from the data that one factor may facilitate one species while indirectly being to the detriment of another species. For Red-tailed Hawks, breeding at the edge of their range, tree expansion provided new nesting sites. Burrowing Owls suffered from incidental predation as parkland habitat invaded prairie, a change that favoured the local predator community.

Broad, overlapping categories of ecological change on this northern Great Plains study area include: 1) altered temperature regimes influencing ecosystem productivity, 2) greater human traffic, and 3) altered timing and potential for miscues relative to migration, hibernation, or other coping strategies.

Data sources are from long-term studies of the raptors, complemented with the literature. Trends over the years, from the 1970s to today, lend themselves for analysis, as do comparisons among individual birds or pairs in the same year in different agricultural/industrial landscapes within the study areas.

Insofar as the emerging conclusions reflect trends amenable to management, strategies for conservation can be evaluated. Strategies range from the targeted and intensive management of individuals or small populations to an extensive concern for the ecological integrity of a region. While strategies that protect all the parts of a biological puzzle are ideal, the question may be asked: is the protection of all parts possible and/or efficient in a rapidly changing world?

Introduction

Most prairie species have had over 10,000 years to adapt to a landscape shaped by glaciers. In comparison, perhaps less dramatic yet still substantial landscape changes have happened in the short 100 years up to today.

In this analysis, I present observations based on a study of prairie raptors and their ecosystem near Hanna, Alberta (about 140 km northeast of Calgary). The study extended over 25 years beginning in 1975, and yielded insight on long-term population and habitat trends. These are considered in light of:

1. a gradual habitat change possibly resulting from altered temperature regimes or other factors (e.g., grazing),
2. greater human traffic, and
3. altered timing and potential for miscues relative to migration, hibernation, or other coping strategies.

Changes in habitat, both natural and human-induced, and changes in the seasonal timing of ecological events are of interest for conservation and sustainability. For example, the timing of events in the annual cycle of an animal represents an adaptation that is the product of evolutionary history and is deeply rooted in the genetic and behavioural make-up of an organism. Changes in timing, especially if these happen too fast for an evolutionary response, or if they simply preclude a behavioural response, may have detrimental impacts on species (Thomas et al. 2001). Similarly, Peñuelas et al. (2009) found that changes in regional climate affected leaf emergence, and this in turn affected local climate.

Study area

The Hanna study area is sparsely treed, which enabled the finding of all occupied hawk nests, and even most started nests, with great confidence. Native drought-adapted grasses growing in the gently rolling landscape include Western Porcupine Grass (*Stipa curtiseta*), Needle-and-thread (*S. comata*), Green Needle Grass (*S. viridula*), Northern Wheat Grass (*Agropyron dasystachium*) and Western Wheat Grass (*A. smithii*). On average, summer (May through August) temperature was 16.2°C (range 8.7-23.6°C) and average summer rainfall was 15.6 cm (range 8.8-23.3°C = 25th and 75th percentiles; Strong and Leggat 1992).

Ecological and population trends

Trees and Nesting Sites

The study area extended 40 km from north to south. Within this short distance a gradual southward expansion of parkland habitat was noticeable. In the 1970s, aspen clumps and semi-permanent ponds bordered by willows were common in the north and rare in the south of the study area. (This expansion was evident in photos shown at the conference.) Photos also showed aspen trees that began to grow since 1975. The most common type of expansion by trees was the characteristic suckering by aspen. However, several aspen clusters were at least one km from the nearest aspen grove, indicating that spreading by seed is also occurring. Aspen had been absent from these sites for at least 20 years and are therefore unlikely to have grown from previous rootstock. The outcome was that, in recent years, hawks were nesting in trees that were not present in the 1970s. The added availability of nest sites for these tree-nesting hawks compensated for the ageing and gradual loss of trees that had been planted as shelterbelts decades ago (e.g., Gorman 1988).

A comparison of hawk densities between an area where artificial nest sites were erected and an adjacent control area showed that hawk numbers were limited by availability of nest sites in the southern part of the study area in earlier years. The recent increase in trees has not only provided more nesting opportunities for Ferruginous and Swainson's Hawks, but was likely also instrumental in the expansion of nesting by Red-tailed Hawks from the north (Fig. 1; see also Houston and Bechard 1983).

Raptor Population Trends

Long-term studies typically display complexities and insights not evident in the short term. Ferruginous and Swainson's Hawks showed fluctuations and significant declines in nesting pairs in recent years (Fig. 1). This decline was apparently related, at least in part, to a coincident decline in ground squirrels from the high densities of the 1970s (Schmutz et al. 1979) and 1980s (Schmutz and Hungle 1989) to 2000. The decline was apparently not due to changes in the hawks' annual survival (Schmutz et al. 2006, 2008). The data indicate that a reduction in the hawks' main prey, the Richardson's Ground Squirrel *(Spermophilus richardsonii)*, led to

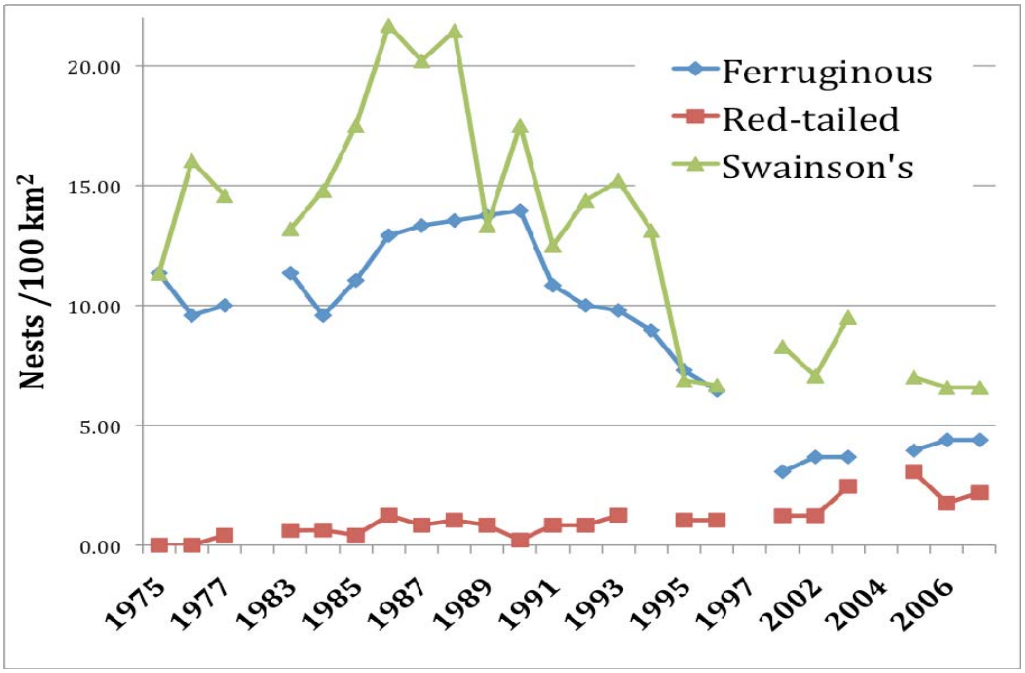

Figure 1. Nesting densities for a 326 km^2 central portion of the Hanna, Alberta study area, where a complete search for all nests was done from 1975 to 2007.

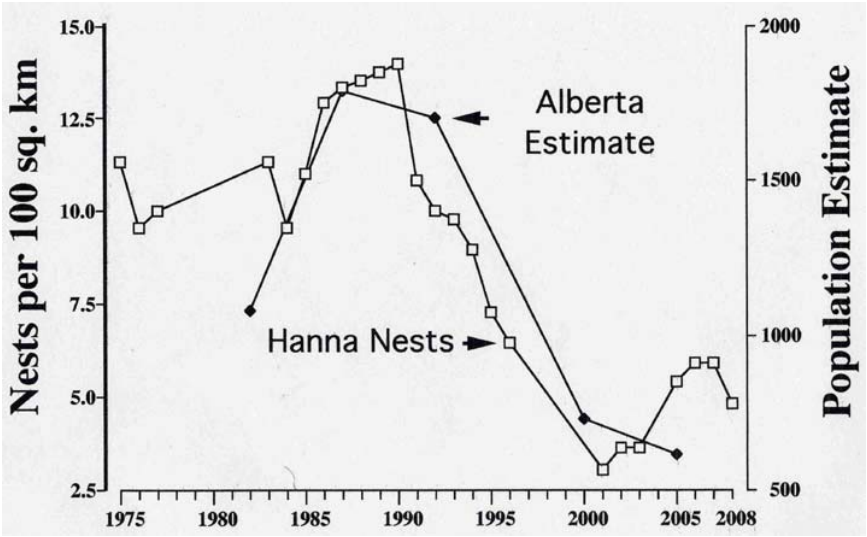

Figure 2. Trend in the numbers of nesting pairs of Ferruginous Hawks in relation to an overall southeastern Alberta population estimate based on randomly selected sampling plots (Schmutz 1984, Downey 2005).

reduced production of young which, when persistent over many years, lead to a lack of recruitment into the breeding population even in years when ground squirrel numbers temporarily recovered.

The decline in densities of Ferruginous Hawks observed on the Hanna study area was also reflected in a series of Alberta-wide population estimates (Fig. 2). This suggests that the Ferruginous Hawk decline was a regional, not local, phenomenon, one that was even mirrored in Saskatchewan (Schmutz et al. 2008).

Raptor Interrelations

The expansion of trees from parkland into former mixed grass ecoregions and the concomitant increase in hawks has had a detrimental impact on Burrowing Owls *(Athene cunicularia)*. A study of radio-marked owls by Clayton and Schmutz (1999) documented high mortality (0.45% among adults and 0.55% among juveniles) during the five summer months prior to migration. This high mortality occurred among juveniles when they were still under partial care of adults and had not yet begun the challenging migration to the southern U.S. and back. This high mortality is a plausible contributing factor in the decline of Burrowing Owls in Canada in recent decades.

On the Hanna study area, raptors were the main source of mortality for adult owls, and both raptors and predatory mammals for juveniles (Clayton and Schmutz 1999). This study also included owls monitored on the Regina Plains. Here, raptors were sparse, and 90% of the land was used for crop production (compared to 20% at Hanna); overall mortality was also high, but mostly resulting from starvation and vehicle collisions.

The incidental predation on owls by hawks is accentuated by the habitat change that is occurring. It appears that the expansive and treeless grassland once maintained by bison and fire (e.g., Romo 2003) is being lost, possibly irrevocably so. This poses particular conservation challenges for maintaining the historic raptor diversity and distribution.

In addition to incidental predation on owls by Swainson's Hawks, expansion of trees has also provided new nest sites and brought the hawks into competitive conflict among themselves. Aggression and some reproductive failures could be shown resulting from competition for nest sites (Schmutz et al. 1980). Thus, competition between hawks may be a contributing factor in the decline of Ferruginous Hawks at Hanna, and possibly province-wide. This is also suggested by the otherwise anomalous observation that Ferruginous Hawks declined substantially on the Hanna area per se, but not in the treeless landscape immediately to the south.

In the fall of 1987, 15 artificial nest platforms were attached to the steel towers of a high-voltage transmission line in collaboration with Transalta Utilities Corporation. Of these, 13 have been monitored during most years since then. The artificial nests extend 25 km south of the Hanna study area, 2-4 km apart. The area containing this power line and the nests consists of virtually pure grassland without human habitation except for a feedlot near the end of the artificial nest segment. Given the layout of roads, human disturbance from oil and gas service personnel is likely low. Similarly, few to no other species of hawks are seen there in the absence of trees. From 1988 to 2009, from 6 to 11 nests were occupied by Ferruginous Hawks. The trend was remarkably stable and did not show the declines evident on the treed study area immediately to the north (Fig. 1).

Seasonal Changes

Climate change is the most likely factor influencing changes in seasonal events on the study area. Over the study period, ground squirrels have emerged earlier in spring (J.K. Schmutz, unpubl.), as plant flowering times have moved forward (Beaubien and Freeland 2000). Similarly, Ferruginous Hawks have advanced their breeding cycle, continuing to closely coincide their nesting period with ground squirrel emergence, but Swainson's Hawks could not. Swainson's Hawks spend the austral summer in South America (Schmutz et al. 1996), where they depend on local seasonal cues to initiate migration. After a long, and therefore energetically costly, migration, the seasonal availability of food on the Great Plains may be asynchronous and thus impacts the hawks on their arrival.

The prolonged and significant decline in ground squirrels on the study area (Schmutz et al. 2008) may also be in part attributable to a changing climate. Local knowledge of area residents suggests that snowfall was higher during the winters of decades ago. A blanket of snow of varying depths that lasts for varying amounts of time would influence soil temperatures and thus the energy-hibernation dynamics of ground squirrels (e.g., Inouye et al. 2000). Similarly, differences in range management practices, in so far as they influence the amount of vegetative carryover and provide an insulating layer in the winter, could also influence hibernation dynamics via soil temperatures.

Ecosystem Change: A Synthesis

Ecosystem change can represent both a challenge and an opportunity. At the same time, change is also unsettling and a response may be to try to counteract it. Many of the changes alluded to above are broad and pervasive, and arise from within the ecosystem from an interaction of co-dependent factors. The hawks were apparently able to respond positively to some changes in nest sites, up to a point. While nests sites helped the hawks increase in density and expand their distribution, this impacted Burrowing Owls, and possibly led to greater competition among hawks.

The changes described are not easily amenable to manipulation and may require a recalibration of conservation approaches. Much of the effort at addressing a biodiversity crisis in prairie Canada and elsewhere has been to manage specific species and presumed limiting factors to try to restore former conditions; i.e., a species-centric focus on restoration (e.g., Rowe 1979, Fuhlendorf et al. 2008). Rowe (1979) and Fuhlendorf et al. (2008) recommend instead that functional ecosystem processes should be maintained, which in turn has the anticipated benefit of maintaining functional integrity and biodiversity in ecosystems.

In prairie Canada, settlement has lead to species loss and redistribution (e.g., Potyondi 1995). Worse, a misunderstanding of the vulnerability of the arid prairies to European-style agriculture led to the greatest disaster in Canadian history (Jones 2002). Some of the damage done to the system has been restored (e.g. Gorman 1988), but much more needs to be done to sustain both grassland bird diversity (e.g. Herriot 2009) and the very sustainability of the prairie ecosystem itself.

In searching for such a vision, Herriot (2009) asked, "What can I do as a caring individual?" The pressures of our ecological crisis have increased in recent decades. However, we have never had the communication potential, the ability to make connections with similar interests, as we have now.

As a brief synopsis, the avenues for possible conservation action include several levels, among them:

- Many different professionals work and interact on the prairies: park naturalists, ranchers and farmers, industry engineers and administrators. Each one can exercise his or her role in the best prairie-friendly manner possible.
- At a higher level, professionals of all stripes can influence their respective community, including professional associations, NGOs and the like, and encourage growth in prairie-friendly interests.
- Expanding the sphere, there are various markets that impinge on prairie sustainability, and quality information can enable action via markets; for example, in the form of certification. Niche marketing of prairie-ecosystem-friendly food products and coupling these with farm/ranch tours could have considerable impact and has the potential to grow. (It is more difficult to envision such positive action playing a role in affecting the energy footprint on the prairies.)
- Professionals and consumers can work together to dismantle institutional barriers that impede prairie-friendly marketing. Often there are perverse rewards that are unintended but have a negative impact.
- Finally, every resident of the prairies, and many not residing here, affect the future direction of the prairie ecosystems by the personal choices they make in their daily lives.

The continued existence of this series of conferences under the banner "Prairie Conservation and Endangered Species" is a promising sign. This forum had its humble beginning in 1987 (Dyson 1996) and could continue to remain influential in bringing a new conservation vision to the prairies.

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Hybridization in Prairie Orchids: Conservation Threat or Life as Usual?

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Abstract – Extinction through hybridization can threaten endangered species when hybrids are vigorous and fertile. However, hybridization may also allow the transfer of adaptive traits between species or contribute to the evolution of new species. We are studying hybridization between the endangered Small White Lady's-slipper (*Cypripedium candidum*) and the common Yellow Lady's-slipper (*C. parviflorum*) in Canada. Our overall goals are to understand the causes of hybridization in these orchids and to assess the threat that hybridization poses to *C. candidum*.

To date, DNA fingerprinting in 182 individuals from four Manitoban populations has confirmed the presence of first and later generation hybrids. However, most individuals that appear 'pure' have genetic profiles that are consistent with their appearance. Thus, genetic assimilation of the endangered *C. candidum* by the more common *C. parviflorum* does not seem imminent, perhaps due to the high local abundance of *C. candidum*. Ongoing studies will determine if this pattern is consistent over a broader geographic area, and whether or not gene flow is from the common to the rare species.

In addition to describing patterns of gene flow, we are investigating how hybridization among *Cypripedium* species is influenced by the reproductive biology of the orchids and the diversity of the surrounding floral community. *Cypripedium* species produce flowers with no nectar reward, and therefore rely on co-flowering rewarding species to sustain pollinators. Pilot data on pollinator visitation, pollen viability and fruit set in Manitoban populations indicate that *C. candidum* may have lower fertility than either hybrids or *C. parviflorum*. The implications of this trend for the long-term persistence of *C. candidum* populations are discussed.

Introduction

Hybridization is a process with a wide variety of potential consequences. These include formation of stable hybrid zones where species ranges overlap, transfer of adaptations from one species to another, formation of novel phenotypes and ultimately new species, as well as extinction of one species through genetic assimilation or 'swamping.' When hybridization involves an endangered species, concerns about the latter outcome are inevitable. However, the consequences of hybridization depend on the direction and rate of gene flow as well as the relative fitness of the parental species and their hybrids. Thus, assessing the threat posed by hybridization requires careful genetic and ecological studies (Allendorf et al. 2001). Ideally, such studies should include multiple populations because hybridization rates may vary geographically (Campbell and Aldridge 2006).

We are studying hybridization between the globally endangered Small White Lady's-slipper orchid (*Cypripedium candidum*) and the common Yellow Lady's-slipper (*C. parviflorum*). *Cypripedium candidum* is native to tall grass prairies and is endangered throughout its range, whereas *C. parviflorum* occurs in a variety of open and woodland habitats and is widespread across North America. Putative hybrids occur wherever the two species overlap, including all Canadian populations, and hybridization is recognized as a potential conservation risk (Environment Canada 2006).

The unique reproductive biology of *Cypripedium* orchids is likely to have an important influence on reproductive fitness and hybridization dynamics. Most flowering plants provide rewards to pollinators, but *Cypripedium* species produce no reward and achieve pollination through deceit. These species are classified as 'generalized food mimics', i.e., they appear attractive and have scents produced by rewarding species. The nectarless labellum (slipper) of *Cypripedium* flowers temporarily traps visiting insects. The exit routes are at the back of the labellum on either side of a structure called the column. The sex organs are located on the column, and insects are forced to make contact with both the stigma and anther when they squeeze past to escape the flower (Stoutamire 1967).

Several aspects of food mimicry may alter pollinator specificity and reproductive isolation compared to rewarding flowers. First, food mimics may depend on sympatric rewarding species to retain pollinators in the population. Second, pollinator visitation rates and pollinator fidelity are low when flowers are unrewarding. As a result, food mimics receive more heterospecific pollen

than do rewarding species, and rare phenotypes may receive a disproportionate number of visits. This situation may promote hybridization (Cozzolino and Widmer 2005, Cozzolino et al. 2006, Tremblay et al. 2005).

Below, we provide a preliminary summary of research conducted between 2007 and 2009. This work involves analyses of morphological and genetic variation to assess the current status of *C. candidum* in Canada, and comparisons of reproductive fitness among parental species and their hybrids to determine whether extinction through genetic assimilation seems likely.

Morphological and Genetic Variation within Populations

Overall Patterns in Canada

Between 2007 and 2009, we surveyed a total of 13 populations containing *C. candidum* from all regions where this species has been recorded in Canada. All of these populations contained putative hybrids and 12 also contained *C. parviflorum*. We analyzed 12 morphological traits (floral and vegetative dimensions) on almost 700 individuals, and collected tissue samples from most individuals for genetic analysis.

The data collected in 2007 was from four populations in the Interlake region of Manitoba (north of Winnipeg), and analyses of the 182 individuals are complete (Worley et al. 2009). Individuals identified in the field as *C. candidum* were morphologically and genetically distinct from those identified as *C. parviflorum*. These results suggest that genetic assimilation of the endangered *C. candidum* by the more common *C. parviflorum* may not be imminent. However, DNA fingerprinting confirmed the presence of first and later generation hybrids. Introgressed individuals were usually intermediate in appearance but some plants had a morphology similar to one of the parents. The genetic profiles of putative hybrids also overlapped with both parental taxa, indicating that the species are exchanging genes (Worley et al. 2009).

Preliminary analyses of morphological data from populations in Ontario and other areas of Manitoba (south of Winnipeg, and near Brandon) confirm the patterns observed in Manitoba's Interlake region. Individuals identified as either parental species were morphologically distinct, and hybrids were intermediate. Analyses of genetic fingerprints are ongoing.

Pollinator Entry and Exit Routes in Manitoba

For hybridization to occur, insect pollinators must fit through one of two exit routes created by the close proximity of the column and the labellum. The degree of overlap in the size of these exit routes in the two parental species may influence the opportunity for hybridization (Li et al. 2006, 2008). In 2009, we measured pollinator exit routes in 80 individuals each of *C. candidum* and *C. parviflorum*, and 42 putative hybrids from three different populations in Manitoba. Exit routes in *C. candidum* were consistent across the sites, with a mean diagonal dimension of approximately 4 mm. Exit routes in *C. parviflorum* were approximately 5.5 mm for the two sites with a high frequency of hybrids, and 7.5 mm for the site with only three putative hybrids. Overlap between the two species was also much greater in the sites with a high frequency of hybrids. These results are consistent with the expectation that hybridization rates may be influenced by the dimensions of pollination routes. Exit routes in hybrids were intermediate and overlapped with both parental taxa. Thus, the presence of hybrids may facilitate backcrossing with either parent and increase rates of gene flow between the taxa.

Reproductive Success

Hybridization is most likely to lead to genetic assimilation of an endangered species when either hybrids or the more common species have greater fitness than the endangered parental species. We are currently comparing reproductive success in *C. candidum*, *C. parviflorum* and their hybrids by assessing pollinator visitation rates, pollen viability and fruit set.

Pollinator Visits

Rates of pollinator visitation are usually low in rewardless orchids and difficult to quantify by direct observation. However, non-orchid pollen left in the exit routes of orchids provides a proxy for pollinator visitation. In 2009, we recorded deposition of non-orchid pollen in exit routes across three sites in Manitoba. In total, non-orchid pollen occurred in 27/70 (34%) genets of *C. parviflorum*, 26/122 (21%) hybrid genets, and 6/160 (4%) genets of *C. candidum*. Thus, *C. candidum* appears to receive fewer visits from effective pollinators than either *C. parviflorum* or putative hybrids.

Pollen Viability

We used a histochemical stain to quantify the proportion of viable pollen grains. We estimated pollen viability in 96 individuals from Ontario (2008), and 267 individuals from Manitoba (2009). Estimated viability was lower in 2008 because pollen samples were older at the time of processing. However, differences between taxa were consistent across years and locations. In 2009, most individuals of *C. parviflorum* produced 75-100% viable pollen grains whereas most *C. candidum* individuals produced 50%-90% viable pollen. Hybrids were

intermediate, but more similar to *C. parviflorum*. These data suggest that even when pollen is transferred between plants, *C. candidum* individuals may have lower fitness through male function.

Fruit Set

In 2009, we recorded fruit set in the same Manitoban populations for which pollinator visits and pollen viability were assessed. Our data showed a similar trend to that found in our pollen viability study with fruit production in genets over the three sites being 128/135 (95%) for *C. parviflorum*, 38/80 (48%) for hybrids, and 31/191 (16%) for *C. candidum*. The substantially lower female fitness found in *C. candidum* likely reflects the combined effects of lower rates of pollinator visitation and lower pollen viability.

Conclusions and Future Directions

Our data indicated that *C. candidum* and *C. parviflorum* remain morphologically and genetically distinct in Canadian populations. However, differences in reproductive fitness suggest that *C. candidum* may be more vulnerable to extirpation than either *C. parviflorum* or hybrids between the two species. Ultimately, data on reproductive fitness must be combined with information on recruitment and survival of genets in order to gain a better understanding of the long-term viability of *C. candidum* populations.

Our ongoing and future research has two main components. First, we will be completing the genetic analysis of Canadian and ultimately North American populations. This will involve additional genetic fingerprints and analysis of maternally inherited genes to assess the direction of hybridization. Second, we will be investigating the reproductive biology of these species in more detail. These studies will include identifying pollinators, assessing the role of co-flowering species in sustaining pollinators, and verifying whether the differences in pollinator visitation and fruit set are consistent across sites and years.

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